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The Aviation Consumer

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WHERE ARE THE NEW ADS-B WEATHER PRODUCTS?

You've probably heard that the FAA, through its datalink weather service and support contractor Harris Corporation, is adding new weather products to the subscription-free FIS-B ADS-B data that's broadcast to UAT/978 MHz ADS-B receivers. Since the rollout was scheduled for June 2018, like others I cranked up my portable ADS-B receiver and tablet app, but didn't see the new lightning, turbulence, icing, cloud tops, G-AIRMETs and center weather advisories that are part of the new ADS-B In data. Without sampling the new weather products yet—including the planned new radar data that will replace the current Nexrad—it's not fair to say the second-gen FIS-B stream will be a SiriusXM subscription killer, but based on the lineup of expected data it's quite possible. Turns out implementing the new weather products isn't as easy as I thought it might be, but it will likely be worth the wait.

And wait is what some users will have to do because according to Eldridge Frazier, the lead engineer for the FAA's Weather Technology in the Cockpit Program, not only has the FAA's weather provider slipped on the deployment, it will take time for app and ADS-B hardware manufacturers to modify software, hardware and in some cases, the TSO of certified equipment, which requires a new MOPS (minimum operation performance standard). The MOPS will be submitted to the RTCA committee and ultimately published in 2019 as DO-358A for flight information systems. According to Frazier, the actual data stream could be available later this summer. Garmin said it's planning compatibility with its Pilot app for iOS users around the AirVenture 2018 time frame, which is when you'll be reading this, and later in the fall of 2018 for the aera 660 portable navigator, the G3X Touch and Garmin Pilot for Android. For certified displays like the GTN navigators and G500/600 TXi displays, the products should play in the first half of 2019. Seattle Avionics said it's working on implementing the data in its FlyQ app. ForeFlight will likely announce a plan by AirVenture this summer.

Frazier called the new suite of products the "bread and butter to the typical GA pilot," reiterating the benefits of the data's rapid refresh rate. The lightning product shows strike count and polarity information and is refreshed and uplinked every five minutes. That's obviously not real-time data you'd get from an onboard lightning detector like a Stormscope, but it should be fresh enough to make on-the-fly tactical avoidance decisions. Lightning strike data is overlaid on a map and is intended to show the most severe areas of convective activity. The turbulence forecast product is updated every 15 minutes and includes clear air and mountain wave turbulence from 2000 to 24,000 feet and is reported in 2000-foot increments. It's displayed on a map and color-coded based on the Eddy Dissipation Rate (EDR). The cloud top data is uplinked every 15 minutes in 1500-foot increments between 1500 and 15,000 feet and in 3000-foot increments from 15,000 to 24,000 feet. There's also CWA (center weather advisories) for essentially real-time short-term forecasts for wind shear, freezing and heavy precipitation, turbulence and forecasts for low IFR conditions.

Frazier also boasted that the new MRMS (for multi-radar multi-sensor) that's expected to replace the current Nexrad radar technology and deployed later this year will have a five-minute update rate. It integrates data from multiple radars/networks, surface observations and numerical weather prediction models. If you want to learn more, NOAA's National Severe Storms laboratory published an informational document on the new technology at www.nssl.noaa.gov.

In other ADS-B news is the current functioning ADS-B Out equipage numbers, which according to the FAA is 50,763 aircraft as of June 1, 2018. It's increasing, but lagging. It's said that the force-fed ADS-B mandate is stick and carrot, and if you've invested in a full ADS-B Out and In interface, I think a better suite of subscription-free weather products takes some of the sting off. —*Larry Anglisano*

BAD ELF COMPATIBILITY

In the June 2018 *Aviation Consumer* article on the Bad Elf Wombat data transfer hub, you stated that "the Wombat accommodates all storage formats, including the SD cards used in Garmin's G1000/3000 flight decks and in the Garmin GTN-series retrofit navigators."

In addition to the information on the Bad Elf website, this was the only reason I bought the unit, but I couldn't update my Garmin GTN650 and G3X datacards with it, which use data loaded from the flyGarmin website. I feel like I've been duped.

Jeremiah D. Jackson
Del Mar, California

We asked Bad Elf for comment and it sorted out the situation that all potential Wombat users need to understand.

It responded: "As the article stated, in order to use Wombat, you need to have the Jeppesen Distribution Manager (JDM) as your data provider. Bad Elf teamed with Jeppesen, which has launched a mobile version of the JDM that for years ran primarily on desktop and laptop computers. We do support your avionics, but the flyGarmin service is proprietary and does not support wireless data updates via the Wombat."

Bad Elf also suggested that flyGarmin customers who want to use the Wombat wait until the subscription has expired and then switch to the Jeppesen JDM because the cost is nearly the same and it will allow them to use the Wombat for remote avionics data updates. Worth mentioning is that Garmin's Flight Stream 510 wireless card that performs a similar function (plus a variety of other ones, including flight plan transfer and data overlay) is in the $1500 price range, compared to the $250 Wombat piston model.

HOME FLIGHT SIM FEEDBACK

My foray into home flight simulators began long before you ran your article on simulators in the June 2018 issue of *Aviation Consumer*. I agree with your assessment. I was put on to X-Plane 11 by the Sim Essentials tutorial by Pilot Workshops (www.pilotworkshops.com).

Also, I am very pleased with the Volair flight simulator chassis.

Donald Hardman
via email

Thank you for the thorough article on home flight simulators in your June 2018 issue. This is a timely and helpful buyer's guide for me. Do you plan to follow up with an article on professional simulator training? I'm stepping up to a Cessna Conquest from my Cirrus and my insurance company requires that I get initial and recurrent training. I would like your thoughts on the quality/value of sim-based transition training.

Stan Altmann
via email

We'll add step-up sim training programs to our editorial list.

WHICH BACKUP EFIS?

In my Twin Comanche I have been using the Aspen Evolution PFD1000 for several years now without problems and am considering replacing the backup vacuum-driven mechanical attitude gyro and finally removing the vacuum system for good. For a backup attitude indicator I'm torn between the RC Allen RCA2610-3 digital AI and the Garmin G5 EFIS. I back up the Aspen, Avidyne IFD540 and Garmin GNS430 with an iPad.

The Garmin G5 beats the RC Allen instrument on price at $2149 which includes a battery, versus the RCA2610-3 for $2650, plus $725 for a standby battery.

Am I wasting $1000 by going with the lesser-featured RC Allen instrument or is there value in its battery and unit construction? I'm tired of changing vacuum pumps.

Charles Allen
Puryear, Tennessee

While we have no problem with the RC Allen's construction or performance (based on the one we flew with and looked at on the bench), the PFD functionality in the Garmin G5, along with price, is convincing enough to pick it, in our view. But it will likely require additional approval for use as a backup since it's STC'd for primary use.

The RCA2610-3 shown above has optional pitch synchronization, but there's no inclinometer. That's an additional $147, which is a mechanical add-on for the instrument's bezel. We hoped the company would add flight instruments to the unit by now.

ANTENNA UPKEEP

Larry Anglisano's article on antenna upkeep in the July 2018 issue was right on the money—literally.

Our P-model Baron just came out of the avionics shop after major panel rework, and antenna upgrades were a whopping $6000 after engineering approval because of the pressurized airframe. That was a major cost overrun.

Stan Woodward
via email

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Despite sophisticated instrumentation, LSAs still run out of gas, as this float-equipped CTLS did. There were no injuries, despite the flip over on touchdown.

AIRCRAFT SAFETY

LSA Accident Review: Nothing to Celebrate

Plagued by small-numbers syndrome, the light sport accident rate is clearly higher than that of legacy airplanes. But not so much to tank the ASTM idea.

by Paul Bertorelli

Two decades ago, when the light sport aircraft idea was being hatched, skeptics worried that lighter, cheaper airplanes flown by pilots without medical certs would lead to a spike in the accident rate. After all, without FAA oversight of design, manufacturing and pilot health, how could it not? The reality, while challenging to pin down, is mixed. According to our review, the light sport segment definitely has a higher overall accident rate than that of legacy certified aircraft. The fatal accident rate, by our calculation, is also higher at 1.6/100,000 hour compared to 0.93 for all of GA, but this varies by aircraft model and is a marginal difference because of such small numbers.

Stall/spins, left, remain a leading cause of fatal accidents in both LSAs and certified aircraft.

On the medical front, our review of more than 200 accidents revealed little evidence of medical incapacitation as an accident cause. In fact, light sport airplanes crash for the same reasons their heavier legacy brethren do: runway prangs, loss of control, stall/spins, fuel exhaustion and spatial disorientation, although the relative distribution of these causes is different for LSAs.

Judging the light sport segment is complicated by the low population of aircraft. Our study sample comprised only about 2000 S-LSA airplanes in the field since 2004, while legacy models date to the 1950s and total some 150,000 piston airplanes. This means that a handful of LSA accidents can bump the needle in an unfavorable direction. But in our view, that limitation is not reason enough to ignore the light sport safety record.

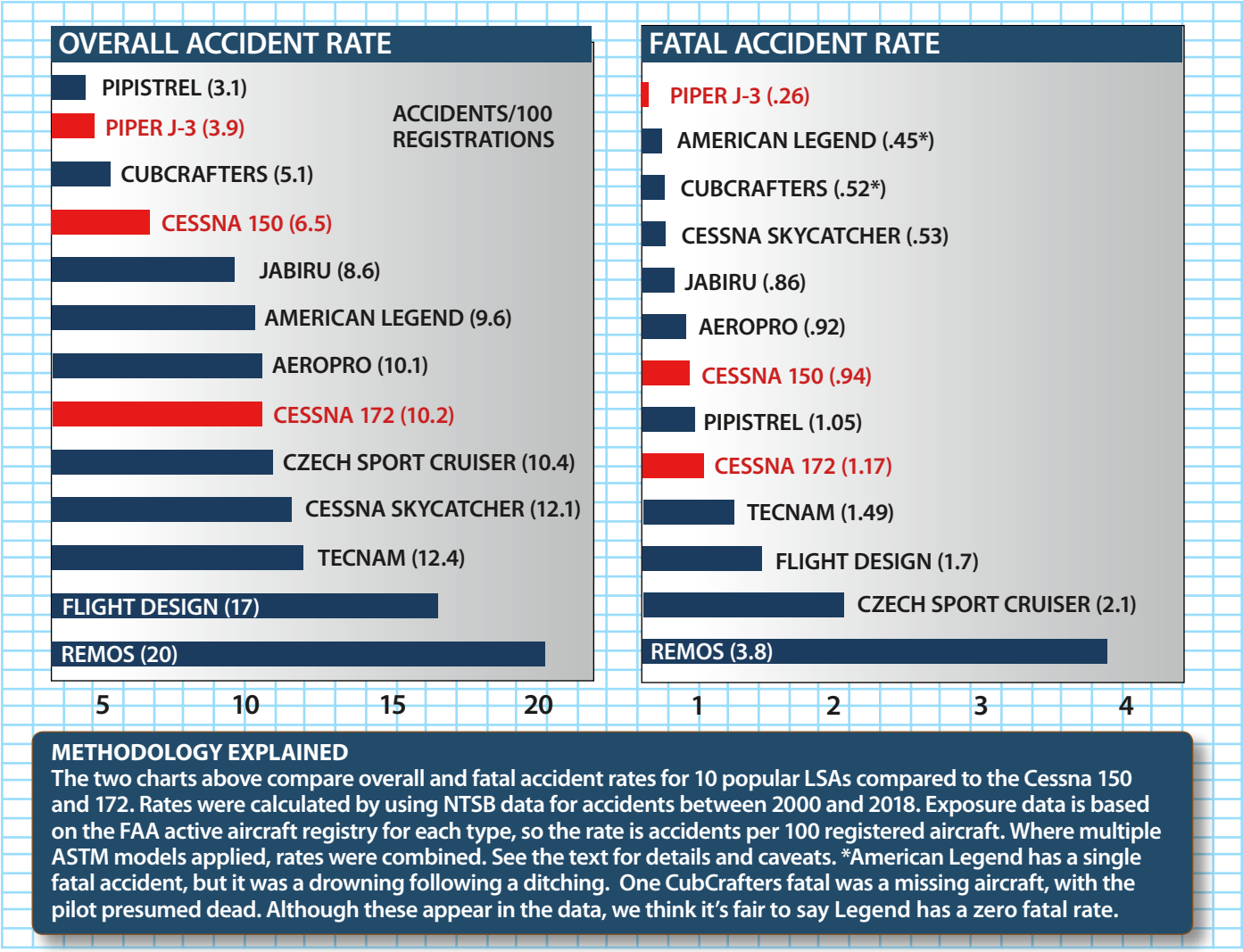
DETAILS AND CAVEATS

Calculating general aviation accident rates—especially by model or manufacturer—is fraught because although the accident data is available, the all-important accurate exposure data is not. Accident rates are traditionally calculated by dividing accident numbers by hours flown and are expressed in accidents per unit hours flown, typically 100,000 hours.

But we don't have reliable hours data by aircraft model. Because of this limitation, we estimated flight hours by model/manufacturer using the General Aviation Manufacturers Association annual flight hours estimate of 91 hours per year for GA pistons and 81 hours for LSAs. Given the decline in flight activity, these may be optimistic but we believe they're reasonable for comparison. We used NTSB accident and incident reports between 2014 and 2017 as the numerator.

To broaden the analysis, we also examined accidents per 100 aircraft registered. While this does give a longer view, the static registration data is blind to the fact that some models and some specific airplanes fly more than others and thus have more exposure.

A second caveat—and this applies even if flight hours are known—is that not all accidents and incidents are reported in the NTSB database. Take the example of a light sport that runs off the runway, rips off a gear leg and is recovered and repaired with no report to anyone, perhaps even an insurer. We know this happens; we



METHODOLOGY EXPLAINED
The two charts above compare overall and fatal accident rates for 10 popular LSAs compared to the Cessna 150 and 172. Rates were calculated by using NTSB data for accidents between 2000 and 2018. Exposure data is based on the FAA active aircraft registry for each type, so the rate is accidents per 100 registered aircraft. Where multiple ASTM models applied, rates were combined. See the text for details and caveats. *American Legend has a single fatal accident, but it was a drowning following a ditching. One CubCrafters fatal was a missing aircraft, with the pilot presumed dead. Although these appear in the data, we think it's fair to say Legend has a zero fatal rate.

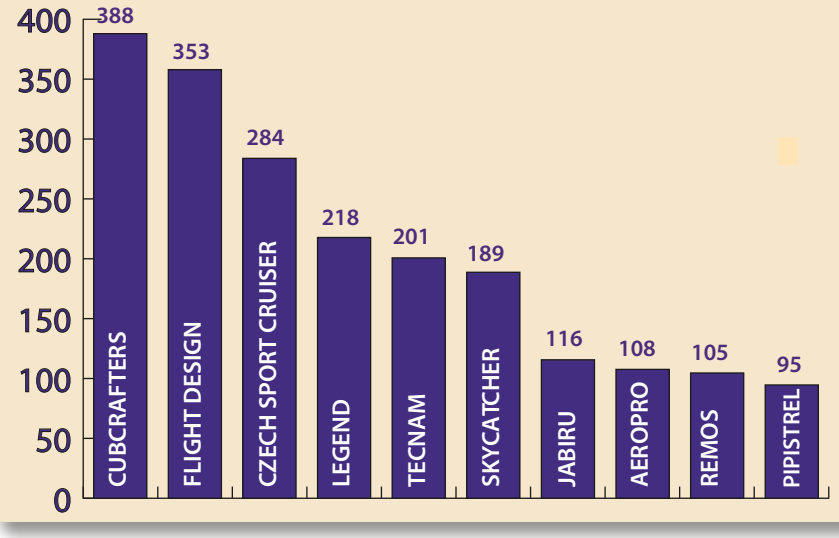
don't know how often it happens.

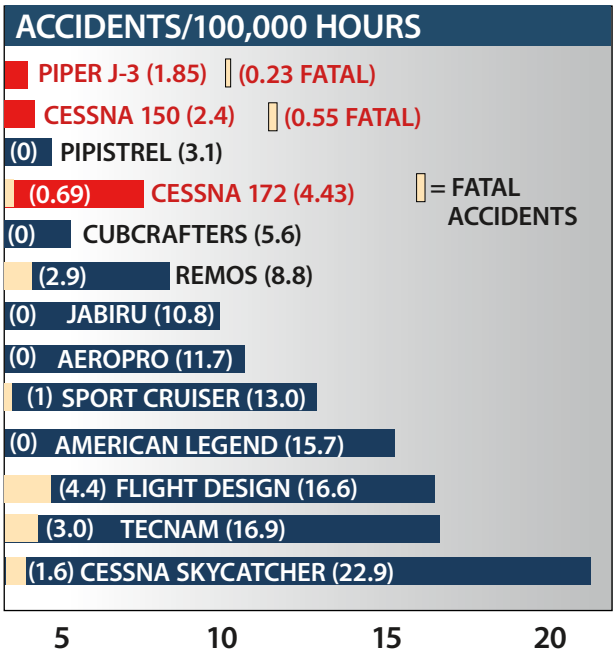
Last, miscoding occurs in both the FAA registration data and especially NTSB data, which sometimes reports models with different nomenclature so finding them requires multiple search terms. J-3, for example, returns 16 records; J3 yields 146. Bottom line: The registration data doesn't necessarily show all the aircraft in a discrete fleet and the NTSB data is not necessarily complete. Also, some manufacturers say that the FAA registry shows fewer airplanes than they claim to have sold, but we're sticking with the available published data.

SMALL NUMBERS

As shown by the market glimpse chart at right, in considering LSAs, we're dealing with small numbers. The top 10 manufacturers have placed about 2057 airframes into the U.S. market and Dan Johnson, head of the Light Aircraft Manufacturers Association, estimates the entire fleet

MARKET GLIMPSE
The light sport segment is defined by small production numbers, as shown in the chart below. The three market leaders have just over 1000 airplanes on the U.S. registry or about as many as the other seven in our survey population. Actual numbers may be higher due to registry errors. Other manufacturers have aircraft on the registry, but these samples were too small to consider.



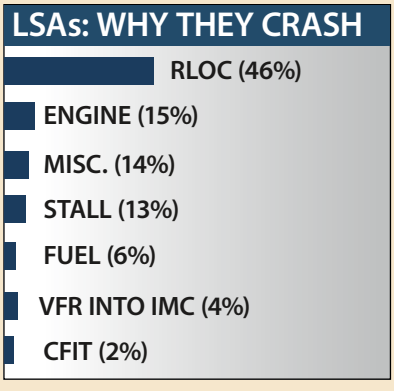


METHODOLOGY EXPLAINED

Charted data above is accidents per 100,000 hours for the four-year period 2014 to 2017. We calculated hours based on aircraft population and average hours flown as estimated by GAMA; 81 hours for LSAs, 91 hours for piston aircraft. Note that five types have zero fatal accidents during the period but the registration study over a longer period reveals fatals for all the types examined.

CRASHES SORTED

The graphic below sorts LSA crashes by cause. Because of sheer volume, we used broader categories than we apply to our Used Aircraft Guides. However, even by this metric, crash causes are consistent with certified aircraft we've examined, with one exception. Runway loss-of-control (RLOC) accidents appear to be more frequent in LSAs as a class and especially for high accident rate models such as the Flight Design, Remos and Czech Sport Cruiser.



comprises about 3000 fixed-wing airplanes built as LSAs. An additional unknown number of legacy aircraft are flown under the sport pilot rule, but aren't specifically LSAs. We didn't consider them in this survey.

Overall, for this group of 2057 aircraft, we found a composite overall accident rate of 12.9/100,000 and a fatal rate of 1.6. For general aviation as a whole, the overall rate, according to NTSB data, is 5.78 and the fatal rate is the lowest in years, at 0.94. Our accident rate by registrations analysis shows similar trends even though the numbers don't align precisely.

The charts—both hours and registrations—offer some perspective on LSAs compared to legacy stalwarts like the Cessna 150 and 172 and even the venerable Piper J-3. The 172, for instance, has an overall rate of 4.43/100,000 hours and only the Pipistrel fleet betters this, but on numbers too small to be credible. Of the top five light sports, CubCrafters has the lowest overall rate at 5.6, while the discontinued Cessna Skycatcher is highest at 22.9. (The registration analysis parallels this finding.)

Why the difference? Probably because the Skycatcher is used heavily in student training while the CubCrafters airplanes are not. This is also true of the Flight Design series, which has the second highest overall rate and the highest fatal accident rate. Many of these accidents are minor runway excursions and loss of control on landing or takeoff and, technically, aren't required to be reported. They are, nonetheless, part of the pattern that comprises the airplanes' operational history.

Diving into the details, the CubCrafter accidents are more widely varied and don't involve quite as many students. Since the Sport Cub and Carbon Cub are taildraggers, you'd expect to see groundloops and, sure enough, that's the case.

But the Remos airplanes have the same number of accidents as CubCrafters on less than a third of the aircraft population. The clearly discernible pattern is pilots botching the flare—usually too high—bouncing and departing the runway. Some of these are violent enough to cause injuries and many damage the airplane, an all-too-common complaint about LSAs.

The same pattern applies to the Cessna Skycatcher and the Flight Design aircraft. Both of these aircraft are used heavily in training and both suffer an unending bashing from stalls above the runway, low flares, crosswind careening, catching wings and just running into stuff. Judging by the number of landing gear parts sheared off, it's hard to imagine that these airplanes will survive years of training in the way that the 150 and 172 have. (Some 8600 150s have survived decades of everything students could throw at them.)

One of the puzzling findings of our research is how the Flight Design aircraft fared. As a fleet, whether judged by hours or accidents per registration, they appear to have high accident rates and have the dubious distinction of having the largest number of listed NTSB occurrences—three times that of CubCrafters on slightly fewer airplanes.

What's going on here? Again, mostly hard landings, botched flares and runway excursions. A lot of runway excursions, followed by noseovers, which are somewhat unusual for tricycle gear aircraft in general. These findings are surprising given that it's both one of the most comfortable and best handling LSAs we've flown. LAMA's Dan Johnson, who owned a CTLS, says speed control is likely the issue. "It lands fine at 55, but at 60, it's going to float. If the airplane has a flaw, that's it," he says.

Flight Design's Tom Peghiny challenged our findings, arguing that the company uses Aviation Safety Foundation data that shows 33 accident occurrences rather than the 61 we found in the NTSB records. "We also question that the raw data gives a fair analysis. Flight Design has had a larger fleet in operation than Cessna Skycatcher, Tecnam, CubCrafters (SLSA model) and Pipistrel for a

decade. We had 288 planes flying in the USA as of 2008 and it wasn't until 2013 that we had our first fatal accident. The statistically fair way to estimate is accidents and incidents per fleet hours," he argues.

Flight Design's fatal accidents—six total—show no apparent pattern. There were a couple of stalls, an engine failure and loss of control in a dust devil while landing.

We did see patterns in two other models, the American Legend and Czech Sport Cruiser. Half of the Legend's 21 accidents were caused by noseovers. CubCrafters also had such accidents, but not as many. We attribute the difference to heel brakes being standard in the Legend rather than toe brakes in the CubCrafters airplanes. The problem with heel brakes is that in a panic situation, say to arrest a groundloop, getting the feet positioned is difficult and can lead to locked wheels.

Legend's Mike Taylor told us the airplane's brakes aren't like the old wheezers in J-3s, but are powerful and require care. He says the airplanes are still highly rated by insurers.

The Czech Sport Cruiser's slick good looks come in part from its bubble canopy, which is hinged at the front. We noted a pattern of the canopy opening in flight, possibly because the pilot didn't latch it correctly. Although the POH says the canopy will lift a couple of inches and airplane's aerodynamics remain unaffected, this has proven distracting enough to be a factor in nine of the Sport Cruiser's 32 known accidents. One of these was fatal and all involved aircraft damage.

AGE, EXPERIENCE

If the FAA and industry stalwarts thought inexperienced and modestly trained pilots would have higher accident rates, the data is murky on this. In fact, the accident record reveals that LSA accidents involve pilots who are both older and more experienced; sometimes vastly experienced.

Our review found that the average age of accident pilots was 60 and the average total flight time was 2458 hours. Many pilots in the accident pool were in their 70s and 80s; a few were nonagenarians. Some appeared to be low-time private pilots or perhaps sport pilots getting back into flying after participating earlier in life. There is no apparent pattern that age-related pilot incapacitation was causal in the accidents we reviewed.

The data is fuzzy on how many of the accident pilots are actually sport pilots and not private or even ATPs exercising sport pilot privileges because they don't have a medical.

We counted 19 sport pilots in the group of 212 accidents or 8 percent. That's a definite overrepresentation since according to the FAA, as of 2017, there were 6097 sport pilots or a paltry 1 percent of the 609,306 total pilots in the U.S.

We counted nearly as many ATPs—14—and a bunch of private and commercial pilots, confirming what

continued on page 32

Half of American Legend accidents involve noseovers, left. Fuel spills are common; fire is not.

LIGHT STICK FORCES: THE DOWNSIDE

On May 6, 2011, NTSB investigator Paul Cox had an apparent mystery on his hands. The burned wreckage of a Piper Sport was found near Spring Hill, Florida, north of Tampa. Inexplicably, the pilot's body was found a third of a mile away. There was no evidence of inflight fire or structural breakup. The pilot's personal items were scattered along the radar path leading to the wreckage.

Cox's investigation revealed that the seat harnesses were burned but a belt adjustor was distorted in such a way to suggest rapid onset negative-g loading. An autopsy revealed the pilot's shoulders were bruised where the belts would have been.

The investigation concluded that the pilot was reaching for something in the baggage compartment and because of the Sport's exceptionally light pitch forces, he inadvertently applied enough rapid roll/pitch input to overload and break the belts and eject himself from the cockpit. Complicating the scenario was that the pilot was flying at night in an airplane not approved for night flight.

This accident is an extreme example of the danger of light stick forces, and the Sport Cruiser/Piper Sport are among the lightest we've flown. A few years ago, an instructor from Massachusetts sent us a picture of a light sport with a jagged hole in the top of the canopy. A student had overpitched with sufficient vigor to dislodge a fire extinguisher and drive it through the canopy.

In more benign circumstances, light pitch forces encourage the kind of ballooning flare that, if not immediately corrected, commonly leads to stalls, hard landings, excursions and not infrequent noseovers.

Excessively light pitch and roll forces complicate landings in gusty crosswinds because rapid corrections are needed and light stick forces encourage over-controlling.

FIELD REPORT

Aircraft Wash Shootout: Fleet Wash a Favorite

But none remove stains and grimed-up areas so you'll need to follow up with a cleaner and degreaser. For that, Carbon-X and N'viro Solve are top picks.

by Larry Anglisano

Let's not over think this. Picking a wet-wash product to clean the aircraft isn't much different than selecting one to clean your vehicle. If you trust it on your cherished Harley-Davidson or show-car paint and accessories, there should be equal confidence using it on the Bonanza. It should be gentle enough to hit everything, including the Plexiglas, not have corrosive properties and rinse off easily.

But there are an overwhelming number of aircraft-specific wet-wash products to choose from. Do a search for wet washes on popular aircraft supply websites and you'll understand. Wet washes are just that—dilute the soap with water in a wash bucket and go to town with a wash mitt or mop. Suds are a must.

We rounded up 11 products, including ones advertised to clean grime, grease and stains. The results were surprising.

WASH DAY

An advocate of regular washes to keep the custom paint schemes for which you invested big looking spiffy, Craig Barnett at Scheme Designers graciously helped organize our wash trial, while Air Bound Aviation at Essex Country airport in New Jersey kindly and bravely let us use one of its water- and floor-drain-equipped hangars.

Carefully plan where you'll wash. Before opening the spigot, understand the local rules for washing because dedicated wash bays may be your only option. Yes, we know operators who bend the rules, too. Wear anti-slip footwear that provides solid footing. You'll likely be working with stepladders, perhaps while balancing wash brushes that can damage control surfaces and antennas should you slip. The hangar floor gets slick. Ours was slickened from runoff and nine overflowing wash buckets filled with the proper mixture of soap and water. As we learned, some of the stronger washes work best when undiluted, while serious degreasing and stain removal mean applying the cleaner straight from the bottle. We tried those first.

BREAK OUT THE SHARPIES

Yes, Barnett let us write on his Cherokee with Sharpie pens so we could

Not all of those products to the left have the same strength, which means you'll be spot-treating and degreasing. N'viro Solve from Corrosion Technologies says its degreaser is good for the plane and the planet. We say it's easy to work with when cleaning around rivets.

CHECKLIST

- All of the aircraft washes we tried removed pollen, dust and bird droppings.
- But so did a high-quality car wash. Wash frequently and remove oil and soot before it gets caked on.
- Aggressively washing neglected surfaces with strong cleaners could damage the paint.

mark, label and test individual areas when spot cleaning, easily comparing surfaces after they dry. (Turns out the airplane was going in for a fresh paint job later that afternoon.) We didn't write on the hangar-kept Baron 58, which had original paint from 2001, or the slimed-up TKS-equipped T210 also used in the evaluation.

Before trying the wet-wash products, we tried four products marketed as heavier-duty stain and grime removers. You know, the layer of nasty oil and grime that builds on the belly around exhaust stacks, landing gear components and under control surfaces.

The products we selected were Extreme Simple Green Aircraft cleaner, Aero Cosmetics Belly Soap, Corrosion Technologies N'viro Solve and Arrow-Magnolia Carbon-X. While using them, we looked for the product's ability to easily clean around rivet heads, metal seams, antennas and plenty of other areas you'll be cleaning if you want to truly wash the aircraft properly. In doing so for the first time, you'll understand why some owners pay to have their aircraft washed. It's a lot of work and requires a lot of time.

First up was Extreme Simple Green aircraft and precision cleaner. Unlike the company's regular cleaner, the Extreme blend for aircraft meets a variety of non-corrosive cleaning specifications, including the Boeing spec for regular aircraft cleaning. It's available in multiple quantities, but we used the $15.95 (from Sporty's) spray-on container bottle for applying it directly to a section of the belly on the Cherokee and to an area on the Baron's landing gear door, let it soak and then wiped it off with a clean cloth. The biodegradable cleaner is advertised to not leave residue. It left some (taking several applications to dry clean), but did a good job of cleaning belly grime, penetrating under rivet heads and inside seams. The cleaner was also a go-to for grimed-up antennas.

The drill here is to spray the antenna, let it soak and then agitate the surface with a sponge or cleaning brush. Use caution not to put too much pressure on antennas, plus cleaning them will be much easier if you frequently wipe them with a spray-on dry wash.

Full-strength Carbon-X, top image, was a favorite for removing surface stains that wet-wash won't. Soak a portion of a clean rag and start scrubbing. N'viro Solve and Extreme Simple Green aircraft and precision cleaner were the runners up. They did a good job on grimy gear doors, bottom, but they still left behind a slight discoloration.

We were impressed with the Corrosion Technologies (the same folks that sell the CorrosionX treatment) N'viro Solve. This is a bio-based organic cleaner made from natural fruit and plant derivatives. Unlike the Extreme Simple Green, it required a single application on a section of the Cherokee's grimed-up belly. We sprayed it on undiluted, let it sit for 30 seconds and wiped it clean, where it cleaned around rivets and seams with limited rubbing effort.

But on the Baron the N'viro solve wouldn't touch a sooty area under one of the wing flaps with one application. After several tries, it finally cleaned the surface and left no residue, but all of our observers noted a slight brown appearance in the area cleaned. A 16-ounce trigger spray bottle is around $20 from Amazon.

Aero Cosmetics Belly Soap is intended to clean aircraft bellies and engine areas coated with baked-on hydraulic fluid and oils. Spray it on, let it sit for a minute and wipe it clean. For heavier grime, you can agitate it with a scrubber (we used the Aero Scrubber tool the company sent us), rinse and let it dry. It worked well on the Cherokee belly, leaving the surface clean with limited residue. It also worked well around rivets. On the underside of the Baron's sooty flap, the Belly Soap was again easy to work with, but our observers didn't think it left the surface as clean as the Carbon-X (next page) and Extreme Simple Green. The difference was the Cherokee's belly was moist with grease, while the Baron's flap was stained. A half-

Aero Cosmetics sent us its $95 telescoping Wash Wax Mop with wash pads, top. It's heavy, but useful on larger aircraft and for washing the underside of wings. All of the wet-wash products we tested easily rinsed clean with spigot water pressure. We liked the Arrow-Magnolia Fleet Wash, lower left, because it produced the most satisfying suds, it rinsed off easily and was the most effective on de-ice fluid.

gallon of Belly Soap is $39.95. It can be used while wet washing or simply sprayed on a dry surface. The Wash Wax All Degreaser is a heavier-duty version of the company's dry wash. We won't cover dry washes here, but it worked well when sprayed on dirty antennas and can be applied wet.

Finally is the popular Carbon-X stain remover from Arrow Magnolia, which sells for $24.95 (one gallon) at Sporty's. It's a water-soluble, biodegradable, nonflammable and non-toxic cleaner that meets both Boeing and Douglas Aircraft specs for external cleaning.

The instructions for using Carbon-X call for using one part water to one part Carbon-X, which we mixed in a wash bucket. The cleaner can be applied with a spray gun, with a brush or with a rag, although the instructions suggest applying it by hand for heavily built-up areas of grime. It can also used when steam cleaning by using one gallon of Carbon-X per 60 gallons of water. We followed the instructions and simply hosed it off after ragging it on. On the Cherokee's belly the diluted Carbon-X was mostly ineffective.

We double-checked the instructions to be sure we didn't goof (free a bunch of guys from their spouses on a Sunday—in the hangar, with a water hose—and things indeed get goofy). Turns out the solution was mixed properly, but the instructions do say that proper dilution can be determined through actual practice and use of the product. That's all Barnett needed to hear, so he applied the Carbon-X again, but this time undiluted. In doing so, it left the surface of the belly cleaner than any of the other products. It did a great job around the rivets and seams. Moreover, there was much less mess by applying it straight from a rag instead of applying it after mixing it with water.

On the Baron's gear door and flap, undiluted Carbon-X easily beat the other cleaners with a single application. It also worked the best at ridding the bugs from the Baron's nose, although it wouldn't penetrate the radome, where bugs are there to stay.

We also used the Carbon-X to wipe some staining off the side of the T210's cowling, where it made the area clean with little effort. But there's a caveat, and it applies to any of the heavier-duty cleaners and degreasers we tried: They'll remove paint—more easily on aging and oxidized paint.

We reached out to field support leader Richard Giles at Sherwin-Williams Aerospace Coatings who basically asked why we were even using these stain removers and degreasers on the paint's stripes in the first place.

"The secret to good aircraft paint maintenance is regular care, rather than once-per-year aggressive detailing," he told us. Giles attests that many of the aviation-branded cleaners are quite good at dissolving carbon, but the key is to not attack the paint surface. The best practice is once you remove the contaminants with a thorough cleaning, the next step is to polish and buff the surface so it's as slick as possible. This fights off future adhesion and ingress/etching of the paint, which gradually wears it down.

Giles even suggested a natural or synthetic clay bar treatment on some oxidized areas. If you're familiar with automotive paint work and advanced detailing, you'll know this is the process of using a highly elastic resin mixture to remove pollutants and contaminants from the paint surface.

The bottom line? Maintain the paint surface so you don't have to use degreasers and strong cleaners on a regular basis. That brings us to the first step: cleaning with a wet wash.

TIME TO GET WET

We properly mixed, labeled and lined up the wash products in 5-gallon

YouTube See a video of our wash trial at http://tinyurl.com/j95ht2a

SELECT WASH PRODUCTS COMPARED		
PRODUCT	**STREET PRICE**	**COMMENTS**
STAIN TREATMENT/DEGREASERS		
CARBON-X	$24.95 one gallon	A top performer for stain removal, but most effective when used undiluted. Works well on rivet lines. www.arrowmagnolia.com
EXTREME SIMPLE GREEN	$15.95 32 ounces	Leaves some residue, requiring a second application and wiping. Works well on antennas and around rivets. www.simplegreen.com
N'VIRO SOLVE	$14.95 16 ounces	Spray it on undiluted and in our evaluation it required just a single application and wiping, leaving surface clean. www.corrosionx.com
BELLY SOAP	$13.95 16 ounces	Spraying it on and agitating with a scrubber works best. Cleaned soot, but not as well as the others. www.aerocosmetics.com
WASH WAX ALL DEGREASER	$9.95 16 ounces	A stronger version of the Wash Wax All spray-on dry cleaner that can be used dry or wet. www.aerocosmetics.com
WET WASHES		
PRO WASH RX	$24.95 one gallon	Washes away dirt, but we wanted more suds. Some areas soiled with de-ice fluid needed several washes. www.corrosionx.com
AEROLIFE CLEANER/BELLY WASH	$28.21 one gallon	Didn't make enough suds, left slight streaks in areas heavily contaminated with de-ice fluid. www.aerolifeindustries.com
AERO WASH N WAX	$10.84 one gallon	Makes plenty of satisfying suds, seemed easy to rinse off, left an impressive shine. www.dwdavies.com
FLEET WASH	$21.95 one gallon	Easily washed away de-ice fluid, plenty of suds, leaves a smooth and shiny finish. www.arrowmagnolia.com
XHAUST & SOOT REMOVER	$20.95 one gallon	Not much of a shine, but effective for exhaust soot. Use undiluted for stains or diluted 20:1 with water for general washing. www.corrosionx.com
MEGUIARS GOLD CLASS	$10.99 64 ounces	Worked as well as the aviation cleaners, plenty of suds and left a shine. www.meguiars.com

wash buckets, using soft wash mitts to hand-wash the surfaces. After rinsing with the hose, we dried the surface with PVA (Poly Vinyl Alcohol) The Absorber drying towels. These are around $10 each, are extremely absorbent and work well for drying and cleaning. They won't glide across the finish, but they make drying a snap.

We were particularly interested to see how the wet washes would work on the T210 when it was slimed up with TKS de-icing fluid. This is the ethylene glycol-based fluid that seeps and runs back from thousands of laser-drilled holes in titanium panels on the leading edges of the wings and tail. We sent the T210's owner Scott Dyer around the patch and he brought back a big, slimy, dripping hot mess.

The $28 per gallon Aerolife Industries biodegradable aircraft cleaner and belly wash is advertised to eat oil and eliminate stains. It cleaned all of the surface dust, dirt, bird droppings and visible de-ice fluid, but we were disappointed at the lack of suds it made. Yes, lots of suds are important.

At $25 per gallon ($15 for a half gallon), the Corrosion Technologies Pro Wash RX is a concentrated pH-balanced shine-enhancing soap that's said to make long-lasting sudsy foam with more shine and fewer streaks. While it did clean the surfaces, it didn't make enough suds unless we hit the bucket with periodic blasts of water. More than one tester didn't get the sense it was cleaning because there weren't enough suds on the surface, although it did clean after washing and rinsing twice. On areas heavily contaminated with TKS fluid, we noticed streaking, which indicated that perhaps not all of the fluid was being removed.

Arrow-Magnolia's Fleet Wash is $30 per gallon and advertised to penetrate deep to remove bugs, grease and other contaminants. It made lots of beautiful suds and left a brilliant shine after rinsing and drying. It also seemed to more easily wash away the de-ice fluid without leaving behind any film.

Aero Wash N Wax from D.W. Davies & Co. (shown lower left on this page) made enough suds for our liking, was easy to rinse away and shined after drying. But it also removed some paint when we scrubbed the blue stripe on the Cherokee. At around $11 for one gallon, it's the least expensive.

We tried the Xhaust & Soot Remover wet wash product from Corrosion Technologies, which can be applied undiluted for cleaning soot or mixed with water for lighter-duty general cleaning. It worked well at removing bugs, but as we expected it didn't leave as brilliant a shine as most of the other products. If your aircraft is parked in a dirty environment, this might be the stuff to keep on hand.

Last, our wet wash trial wouldn't be complete without trying the go-to wash for our motorcycles and cars: Meguiars Gold Class car wash and conditioner. We're glad we did. It made lots of suds, worked nearly as well as the others, left an impressive shine and it was easy to rinse off. Others we talk with have good results using the Mothers California Gold wash.

OUR TAKEAWAY

We walked away believing all of these products—including a quality car wash or even liquid soap you'd use on Grandma's china dishes—work well enough for cleaning light surface dirt, pollen and bird droppings. As noted, washing just isn't enough. You'll need to polish and keep up with areas that collect grime and soot.

If we had to pick a favorite aircraft wet wash, it would have to be Arrow-Magnolia's Fleet Wash for its deep cleaning qualities, followed by Davies Aero Wash N Wax for the slick coating it leaves behind. That makes subsequent cleaning easier. For tough stains and soot, Carbon-X and N'viro Solve win. We'll look at polishes next.

Cessna HD T206H: Turbocharged Utility

A working pilot's airplane that's easy to load and fly, Textron Aviation's flagship Cessna piston single remains in a class of its own.

CHECKLIST

- The T206H typically has a full-fuel payload of around 820 pounds.
- It's an easy step-up from smaller high-wing Cessna models.
- The turbocharged Lycoming engine is a good match, but don't expect miserly fuel burn.

If you were shopping the new utility airplane market for a piston single that hauls six people and carries lots of stuff loaded through big cargo doors, the Cessna T206H is a no-brainer consideration.

BY LARRY ANGLISANO

As it's been since it started life in 1963 as the model 205 (a fixed-gear version of the wing-strutted 210), the current HD T206H turbo Stationair is neither fast nor slow and it's no looker on the airport lunch ramp. But what it lacks in sexy styling it more than makes up with in utility—lots of it. It works well on floats and on oversized tires and it easily carries a cargo pod on its belly. We know of more than one Stationair owner who loads motorcycles in the cabin.

The current Cessna Stationair is the most modern 206 to date and has a stylish but durable interior (think luxury pickup truck), is rock stable for instrument flying and has a simple fuel and flight control system. It can wear multiple hats, as much at home hauling supplies in the outback as it is sliding down an autopilot-coupled GPS approach to big-city airports.

To see just what buyers get when slapping almost $700,000 on the table for Textron's biggest Cessna piston, we loaded in our stuff and lived with a spanking new 2018 Stationair for a day. Here's a summary.

A BIG, BEEFY CESSNA

In that sense, the new T206H turbo Stationair is the same as it ever was. While the airplane now carries the "HD" marketing nomenclature, Textron Aviation's regional sales director Steve Kent told us HD doesn't necessarily mean heavy duty. But the new Stationair is heavy as far as piston singles are concerned. With standard six-passenger seating it has a basic empty weight of 2336 pounds and a maximum takeoff weight of 3789 pounds.

The airplane we flew was fully loaded and had the optional Kelly Aerospace air conditioning system, which yielded a 1341.5-pound useful load and a full-fuel payload of 820 pounds. That means four 200-pound humans and some bags. For going places, the T206H carries 92 gallons of fuel and 87 gallons is usable. The fuel system is stone simple. If you've flown a Cessna 172 or 182, you'll recognize the familiar fuel selector (off, left, right, both) located at the bottom of the center pedestal. Take off and land while drawing from both wet-wing tanks and you can switch to the left or right tank while in level flight.

But if you're accustomed to a 172 or a 182, the T206H will be noticeably larger. The Stationair's cabin is six inches wider than a 172 and four inches wider than a 182. From trim to trim, the cabin is 44 inches wide and 49.5 inches high. From the firewall to the aft baggage bulkhead is 145 inches. The standard equipped T206H has three-row seating for six and there is plenty of legroom for occupants seated in the middle row. We could easily and comfortably stretch the legs straight out across the cabin.

You enter the Stationair cockpit from the pilot's door (there isn't one on the copilot's side) and passengers

ingress and egress through the big aft cargo doors on the right side of the fuselage. Interestingly, the height of those double doors was predicated on the height of a 55-gallon drum, and the width is that of a standard pallet. Like we said—a working pilot's airplane. The rear door opens aft and the front opens forward, which makes for easy loading. We folded down the third row of seats (they can be quickly removed) and easily loaded in a couple of full-size snowboards. Golf bags for six? No problem in the Stationair.

The latest HD model offers another 189 pounds of useful load because quite frankly many Stationair pilots would load more into the airplane anyway. Now they can add more legally, while accepting a slightly higher stall speed. At 3600 pounds and wings level with a most rearward CG, power off stalls come at 56 knots indicated (with the flaps up and also at 20 degrees) and at 47 knots indicated with full flaps deployed.

CREATURE COMFORTS

Once inside, the latest Stationair has reasonable amounts of modern styling, although don't expect a new-Cirrus-like posh dwelling. Standard seating is synthetic leather, but there's an option for two genuine leather crew seats with leather door trim for an additional $4645. The first two rows of seats have inflatable AmSafe airbag seatbelts and for $3605 they can be added to the aft bench seat. There's vinyl-grip flooring in the crew area. Worth mentioning is the airplane can be configured with a single pilot seat (all other seats are removed), utility-grade carpeting, plus ruggedized interior panels and liners. That shaves 153 pounds. Save 116 pounds with pilot and copilot seats only.

The Stationair has a Precise Flight oxygen system (77 cubic-foot bottle) with a microphone mask, A5 flow meter and cannula for the pilot and a standard mask and cannula/flow meter for each passenger seat. The optional Thermacool air conditioning system is from Kelly Aerospace. It adds 56 pounds and $39,255 to a stock T206H. When external power is applied to the APU port, a finger-tap of a sensor on the side of the cowling turns on the air conditioning.

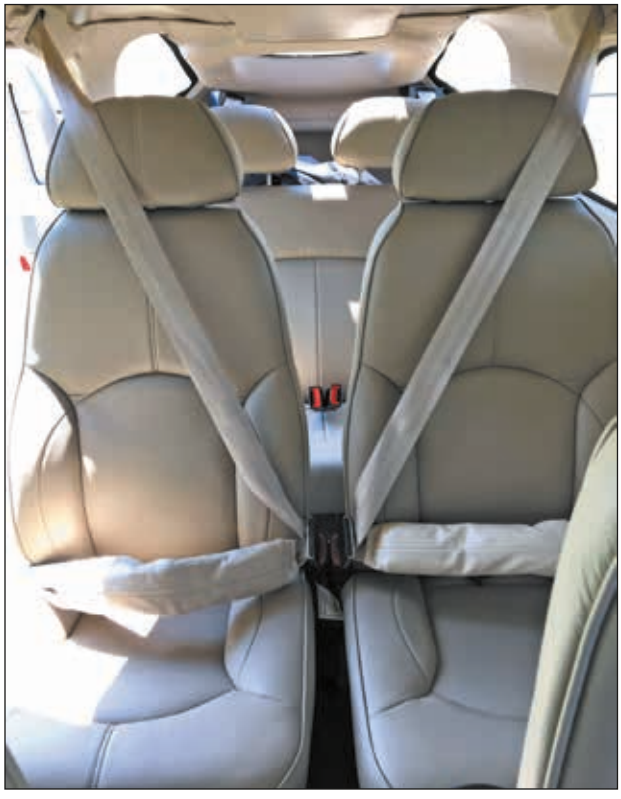
While the airplane has DC power ports in the front and rear cabin, it doesn't have USB charging ports—something we think buyers will want and expect in a new airplane of this caliber. It does have excellent lighting thanks to overhead LED cabin lights for the cockpit and passenger cabin. There's also an LED backlighted panel for the cockpit main switches.

The T206H has the latest Garmin G1000 NXi avionics with GFC700 autopilot, but still has round gauges for backup including a vacuum-driven attitude gyro, top. That's the optional air conditioning control panel, middle, and standard overhead oxygen controls in the bottom photo.

There are LEDs on the outside, too, including dual wing LED landing and taxi lights with integrated pulse recognition. These are connected to the onboard GPS so they automatically switch to pulse mode during the initial climb.

AVIONICS AND ENGINE

The T206H has the Garmin G1000 NXi integrated avionics with the GTX345R ADS-B Out transponder, so it's ready for the 2020 mandate. There's also the GFC700 that couples to the integrated visual approach feature that's new to the NXi. As we've reported in previous articles, the NXi has notably faster processors, brighter displays and the customizable HSI map feature. There's also the Flight Stream 510 cockpit wireless system for tablet computer/smartphone interface. It's compatible with both the ForeFlight and the Garmin Pilot apps and enables you to load the databases and



The multipurpose cargo doors, top, make loading stuff and people into the Stationair's cabin easy. Airbag seatbelts are standard for the crew and middle-row passengers, bottom.

flight plans directly to the G1000 from the tablet. Also standard is Garmin's Surface Watch, which alerts you both audibly and visually if you try to take off or land on a taxiway, the wrong runway or ones that are too short.

The G1000 NXi in the airplane we flew had autopilot controls on both the MFD and on the PFD. That means if one of the displays were to fail, you will still have access to all of the autopilot modes.

Garmin's SafeTaxi and FliteCharts are standard, but if you want Jeppesen Chartview electronic charting, it's an additional $4345. This is an electronic, color version of the domestic Jeppesen terminal procedure charts.

There's also the option for an Artex three-frequency ELT to replace the standard two-frequency, non-GPS-interfaced ELT. It's a whopping $9940.

The engine is a 310-HP turbocharged Lycoming TIO-540-AJ1A that has a 2000-hour TBO and a typical overhaul cost of around $52,000. The TBO is increased to 2200 hours when it is flown over 40 hours per month.

In general, pilot-friendly and big-block turbocharged engines aren't often used in the same sentence, but that's part of the sales pitch to prospective turbo Stationair buyers, given the airplane's maximum ceiling of 27,000 feet.

"There's little if any required leaning of the mixture until above 17,000 feet because the TIO-540-AJ1A thinks it's at sea level until then," Steve Kent told us. The sloped turbo controller allows for appropriate manifold pressure and overboost protection no matter how aggressively you advance the throttle. In theory should the controller fail, a mechanical relief valve opens to drop the engine just below boost, the controller catches up and "there's no teardown inspection required," Kent said.

By way of the engine cowling design, Cessna engineers worked hard to make the big Lycoming installation as thermodynamically stable as possible. Aside from the so-called shark gill vents on the lower side of the cowling, the main air intake has a gentle S-shape to it. At high climb angles, the air still flows in and over the top of the engine and then down and out of the shark gills and cowl flaps. In a descent with the cowl flaps closed, a molded hood in the cowling intake traps the downward ram air creating a high-pressure point and minimizing airflow.

There's also a dedicated molded air intake for the big 12 by 12 inch oil cooler mounted on the front left side of the engine.

FLYING IT

Part of what makes the Stationair a good short-field airplane (and lends to a slow stall speed given the weight) are the flaps, which are five feet longer (total) than the ones on a smaller high-wing Cessna. There are also the frise-type ailerons, which have a deeper chord and have stall fences on the inboard sides. As the wing stalls from the inboard to the outboard area of the wing, contaminated airflow cannot reach the aileron. As we found, the Stationair's ailerons remain extremely effective during slow flight.

What makes the Stationair a good soft-field airplane is the solid leaf-spring landing gear. It's not drilled to accommodate brake lines, but instead the lines run on the aft outside area of the spring. Plus, the nosewheel has more travel and cushioning than other Cessna singles.

For takeoff, the performance specs show a 1060-foot ground roll for a 3789-pound airplane on a hard-surfaced and dry runway. Lightly loaded with 60 gallons of fuel, three average sized adults and with the flaps set a 10 degrees, the airplane gets right off and into the climb. You can reduce the ground roll and the total distance to clear an obstacle by roughly 10 percent by deploying 20 degrees of flaps, but flap deflection greater than 20 degrees isn't approved for takeoff.

Feed in the power and once rolling the drill is to unload some weight from the nosewheel and the airplane flies at around 55 knots with some back pressure. With 310 horsepower, you need healthy amounts of right rudder, of course, but the large rudder is the right proportion for handling the torque.

The setting for best climb rate using max continuous power is limited to 39 inches of manifold pressure, 2500 RPM and a 34-GPH fuel flow. Normal enroute climbs in the T206H are made at 95 to 105 knots indicated, which makes for a comfortable deck angle over the glareshield.

At 2400 RPM and 30 inches MP we saw roughly 900 FPM in the initial climb. With a rich mixture and open cowl flaps, cylinder head temps hovered in the 365-degree range throughout the climb, while exhaust gas temps were around 1340 degrees.

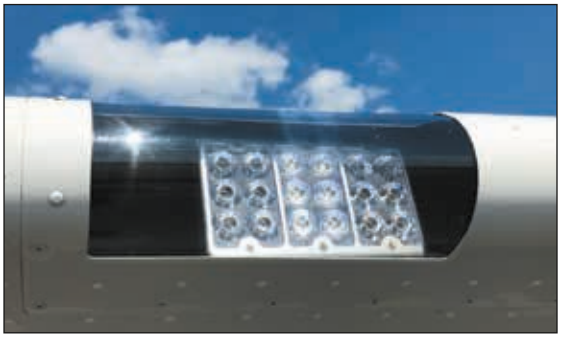
You lean the TIO-540 engine using TIT (turbine inlet temperature) and the engine page on the G1000 has a horizontal scale with an inverted triangle for reference while leaning. There's a lean assist mode for best power or best economy. Best power is achieved at 150 degrees rich of peak TIT and best economy is at peak TIT. Operating on the lean side of peak TIT is officially not approved.

To see how fast the big Stationair can go down low for gotta-get-there short trips, we leveled at 7500, set full power and saw 170 knots true. That burns a whole lot of fuel, of course—almost 34 GPH.

For contrast at the airplane's high-altitude sweet spot, at 17,000 feet making maximum power the T206H can do 180 knots true. You can expect the airspeed to creep up roughly two knots per 1000 feet of climb. Worth noting is that all of Cessna's book performance figures are calculated for an airplane that's loaded at gross weight and at a most unfavorable CG.

YouTube See a video review of the T206H at http://tinyurl.com/j95ht2a

The T206H comes with a McCauley three-blade constant-speed metal propeller with de-ice capability, top. Note the oil cooler air inlet on the lower left cowling, middle. Automated LED landing/taxi/recognition lights are recessed into the leading edges of the wings, bottom.



Pulling the engine back to a more typical 75 percent power setting (30 inches MP and 2400 RPM) yielded 19 GPH and 155 knots true at 7500 feet. No, the load-hauling turbo Stationair is not an economy cruiser.

Officially, the specs say the HD Stationair's maximum no-wind range and endurance is 676 NM and 6.3 hours and like all flying turbos, it's at its best up high.

Advertised cruise speed at 20,000 feet is 176 knots at 75 percent power, but we didn't fly that high on our demo. With the cowl flaps closed, the cylinder head temps were around 385 degrees.

For slowing the Stationair down for landing, the first 10 degrees of flaps can be deployed at 140 knots or lower, the 20-degree setting is used below 120 knots and full flaps come in below 100 knots. Roughly 80 knots works for typical short-field landings and you want to come into the flare at 67 knots indicated.

Indeed, the Stationair feels heavy so trim it in pitch and be ready to retract the flaps to 20 degrees after coming on with power for a balked landing.

GO DIRECT

Textron Aviation sells the HD Stationair (and the Skyhawk and normally aspirated Skylane) direct to customers and we were told sales of the HD T206H, which has a base price of $680,000, are strong. Its nearest new competitor might be the parent company's own Bonanza G36. But it has less useful load, retractable landing gear and a price that's north of $850,000, leaving the HD T206H in a class of its own. Contact www.textronaviation.com.

Multi-Engine Rating: Pricey, Challenging, Fun

We think it's realistic to be able to get the rating with 10 hours of dual in less than a week for under $5000 if you show up prepared and are willing to work hard.

by Rick Durden

A combination of flight training programs bulging at the seams as airline pilot hopefuls race to get their ratings and prices of light twins hovering at historic lows attracting buyers with the cash to maintain and feed them has led to more and more pilots seeking to pick up their multi-engine ratings. We surveyed a number of operations across the country that offer the training to find out what's involved, how long it takes and what it should cost.

Our conclusions: A pilot with a private or commercial ticket and instrument rating, who has been flying regularly—and is used to studying—should be able to add on the rating in less than a week of dedicated work that includes about 10 hours of instruction in the airplane, 15 hours of ground and simulator time and two hours for the checkride for a total cost of $5000 or less.

We think that programs that include simulator time help to keep the overall cost down. Based on conversations with numerous programs we also came away with the opinion that the least expensive way to complete the training is to do it in the shortest time possible—a week or less. Conversely, an effective way to drive the price of the rating into the stratosphere is to take dual at intervals of a week or more.

THE RATING

While being one of the most expensive ratings—per hour—that you'll ever get, the multi-engine add-on is often the most fun. What's not to like about wrapping your palm around two throttles, shoving them from quiet to noisy and experiencing greater acceleration that you've ever felt in a piston single? Yeah, if something goes wrong, it can go wrong fast and ugly, but you're there to learn about just that—handling a high-performance flying machine in all conditions.

Getting the rating is truly a blast, but it cannot ever be treated as a lighthearted romp in a hot rod airplane. After all, the training and checkride involve shutting down and feathering one engine—that's practice bleeding. Every once in a while that engine refuses to restart and your practice emergency transforms into a real one. In addition, the required Vmc demonstration means taking the airplane into a corner of its flight envelope—an action that must always be carried out with respect.

We strongly recommend that you pick a school that includes training in a simulator that reasonably replicates the airplane you'll be flying. It doesn't have to be perfect, but at least should have the levers for the throttles, props and mixtures in the same relative position and have avionics similar to the airplane.

The simulator allows you to safely learn the motions to go through when an engine does take a vacation without rolling you upside down if you make a mistake. After all, the push for high-quality simulators came about because of airline crashes during recurrent training—professional airline pilots, with professional airline instructors, flying empty airplanes were losing control and crashing when practicing engine-out procedures.

In addition to learning how to fly a twin on one engine, the chances are that the twin will climb, cruise and approach faster than what you've flown most of your career. You'll need a little time to adjust to and plan for the higher performance.

SYLLABUS

What can you expect in a multi-engine course? We looked at syllabi from several schools and found, not surprisingly, that they had a great deal in common. After all, they are targeted at a goal of a proficient multi-engine pilot who can meet the requirements of the FAA exam.

If you have a single-engine airplane rating, there is no FAA written knowledge examination involved in picking up the multi-engine rating.

A Beech Duchess with the right engine shut down and its propeller feathered for minimum drag.

Three of the more popular multi-engine trainers, starting with the top photo: Beechcraft Duchess, Piper Seminole and Diamond Twin Star.

With that segment of the normal FAA rating troika kicked aside, all you have to do is pass the oral and flight test.

SYSTEMS

As with any checkout for a new-to-you airplane, you'll start out with getting to know the systems. You'll see similarities to complex airplanes you've flown such as how the landing gear operates and the emergency extension procedure(s). The fuel system will be more complex than a high-performance single because it has two engines to feed plus, there has to be a way to crossfeed fuel from a wing tank on one side to the engine on the other.

Knowing the fuel system cold will be required because it may have quirks that can bite. For example, a twin may have auxiliary tank(s) that will only supply fuel to the engine on the same side of the airplane. Fuel in those tanks becomes nothing more than dead weight when the engine on their side is shut down. Fuel tanks may have to be used in a specific order. On some twins, when you depart with full fuel, the mains have to be selected for the first hour or so as the return fuel from the engines goes back into the mains. If there isn't room for the return fuel it gets pumped overboard.

On twins in which the aux tanks are placarded for use in level flight only, they aren't kidding. Due to their design, they cannot be relied upon to deliver fuel during takeoff and in climbs and descents.

Once you've studied aircraft systems you'll get into aerodynamics peculiar to single-engine operations in a twin and the speeds you'll need to know for the particular airplane and their significance: minimum control speed (Vmc), single-engine best rate of climb speed (Vyse), single-engine best angle of climb speed (Vxse) and safe single-engine speed (Vsse). You'll learn about the yaw induced by having only one operating engine and getting the maximum rate of climb on one engine by banking slightly into the good engine and applying enough rudder to minimize drag by flying with the ball off center in the race by half its diameter. You'll also learn why the airplane becomes uncontrollable in yaw if the airspeed is allowed to drop below Vmc with full power on one engine.

PERFORMANCE

You'll come to understand that loss of one engine means loss of 50 percent of the power available to make the airplane perform. Because the ability of an airplane to climb is dependent on the amount of power available in excess of the power necessary to hold level flight at Vy, loss of 50 percent of the airplane's power doesn't cut the rate of climb by 50 percent; it chops it by close to 90 percent. That's a huge deal and must be engraved into a multi-engine pilot's very being.

At sea level, on a standard day, most piston twins will climb at more than 1000 FPM with both engines turning. With one engine out, the prop feathered, flaps up, gear up, the cowl flaps closed and the pilot doing everything right to minimize sideslip and drag, almost none of those same twins will climb more than 230 FPM.

Take a moment and think of that in vertical feet per nautical mile. A good rule of thumb is 130 feet upward per one nautical mile horizontally. If you lose the engine as the gear hits the wells at 200 feet AGL, plan on covering more than six nautical miles before you get to a 1000-foot pattern altitude. You'll learn that if there are obstructions or high ground that you can't avoid in those six miles that it's probably better to pull the power back on the good engine and aim for something soft and cheap. While descending, be sure and maintain your speed above Vmc when you are using power from the good engine so that you don't make the upcoming landing inverted.

In the airplane you'll spend the first lesson or two flying with both engines running as you do all normal, crosswind and short field takeoffs and landings, steep turns, slow flight, stalls and emergency descents.

After that you'll begin to wonder whether the engines on the airplane are capable of operating simultaneously for any length of time. Your instructor will introduce you to and then have you handle engine failures on takeoff, in climb, cruise, on descent, approach, while maneuvering and just prior to landing. You'll learn about single-engine go-arounds—in many cases once the gear and flaps are down you'll sacrifice at least 500 feet of altitude reconfiguring the airplane before you can get even the most leisurely rate of climb—it may be better to just say no and land the airplane. Single-engine go-around

MULTI-ENGINE TRAINERS: THE AIRPLANES

The market for new twins that are regularly used as multi-engine trainers is, charitably, slow. Accordingly, the chances are that the multi-engine trainer you use will be a little long in the tooth. That's not necessarily bad if the flight school shells out the bucks to maintain its airplanes. The good news end of the equation is that the oldest of the types regularly used as a trainer—the Piper Apache—is one of the best because it is the most demanding of good pilot technique and teaches pilots that Vmc speed is to be treated with respect. We'll run through the types of airplanes most likely to be on the multi-engine training flight lines and give a little background on each.

• Piper Seminole

From our observations, the Seminole seems to be the choice of most multi-engine schools. The 180 HP per side twin has counter-rotating props that minimize Vmc. Its relatively low operating costs caused schools to largely move away from the Beech Baron, Cessna 310, Piper Seneca and Aztec as trainers.

Even though Seminoles are widely used, some schools told us that they can require quite a bit of maintenance because they don't always hold up to the pounding involved with training.

The 56-knot Vmc is the same as the flaps-up stall speed, so students don't get to experience the violent roll-off associated with slowing below Vmc. Essentially a twin-engined Arrow, the Seminole has benign handling—we think it's an easy airplane to transition into, helping to keep the time involved in obtaining a rating down. We saw rental rates ranging from $240 to $400 per hour.

• Diamond DA-42 Twin Star

Diamond's diesel-powered Twin Star elicited divergent opinions from multi-CFIs with many saying it was a poor trainer because it was too easy to operate. In the event of an engine failure the pilot pushes the power levers forward (FADEC means no mixture or prop controls), identifies the dead engine and flips its on/off switch to off. That's it.

We think that makes it a superb trainer for someone planning to move directly into jets who doesn't need to know how to shut down and feather a piston engine. Power management is jet-like, including indicators reading percent power and—as with a jet—there is a need to carry significant power on final with the gear and flaps down. Plus, the seven-bus electrical system is comparable to what pilots will experience in turbine equipment.

We saw rental rates from $239 to $360 per hour.

• Tecnam P2006T (Pictured below)

Powered by two 98-HP Rotax 912 S3 engines, the Tecnam P2006T meets or exceeds the performance of other light twins. Handling is precise, although it responds as one would expect in a twin heavier than the 2712-pound gross weight P2006T.

The small engines cannot drive big alternators, so engine shutdown may also involve electrical load-shedding—as is often the case in larger piston twins and some jets. Inflight visibility is the best of the light twins. Gear cycle time is 18 seconds—an eternity if an engine quits shortly after takeoff. The POH is poorly designed, with a user-unfriendly presentation.

We saw rental rates as low as $230 per hour.

• Piper Seneca

Even though it is a six-place airplane, the Seneca remains popular in the training world, particularly the non-turbocharged Seneca I. With counter-rotating props, Vmc is minimized because there is no "critical" engine. Handling is heavy and ponderous, making it an appropriate trainer for those who anticipate transitioning into larger twins.

Because the Seneca has larger, thirstier engines than other commonly used multi-engine trainers, we found prices to be slightly higher overall—in the $240 to $300 per hour range.

• Beech Duchess

With excellent handling (it doesn't have the quirky behavior on takeoff and landing of the Seminole—Beech did its T-tail right), decent performance on 180 HP a side and two cabin doors, the Duchess is a popular multi-engine trainer even though the marque was never produced in large numbers. Stall speed is, however, higher than Vmc, so some effort has to be made by CFIs to impart respect for minimum control speed during training.

Flight schools told us that replacement parts are a problem due to price and availability. We think that will result in the Duchess slowly fading from the training scene. We saw rental rates starting at $267 per hour.

• Piper Apache

We admit to being fans of the world's largest flying sweet potato as a trainer for several reasons: It's challenging to fly well, its roll-off at Vmc is for real and teaches respect for minimum control speed, pilot technique has to be precise to get what single-engine performance is available and the needs of its hydraulic flaps and gear require that a pilot understand complicated aircraft systems.

We saw rental rates in the $250 per hour range.

Beechcraft Duchess panel, top; Piper Apache, middle; Piper Seneca, bottom.

attempts have killed more than a few multi-engine pilots and pilots taking multi-engine dual.

If you have an instrument rating you'll then do much of the above under the hood and you'll have to demonstrate at least one single-engine approach on the practical test. You cannot opt to get a VFR-only multi-engine rating—you've got to do the instrument flying part. We think that adds about two hours to the training if you are instrument-current when you show up—if not, be prepared to spend three to four hours under the hood getting up to speed.

TRAINING PROGRAMS

Our survey of training uncovered programs that ranged in amount of dual instruction time from a low of five hours to a high of 20. Overall prices—not guaranteed—ranged from $2025 (cash; credit card $2100) for a VFR multi-engine course in an Apache to $8000 for a 15- to 20-hour IFR course in a Duchess. The former is at Prairie Air Service outside Wichita, which has been in the multi-engine training business for more than 30 years. Its proprietor, Herb Pello, told us that realistic numbers for an IFR multi-engine rating are 10 hours of dual and a total of $3500 for everything.

The $8000 price is at Sunstate Aviation, in Kissimmee, Florida, which only offers its multi-engine course to its students as a part of a program to obtain advanced ratings in preparation for a professional pilot career. Sunstate's Mike Camelin told us that it also reflects a need for aspiring professional pilots to have more than a minimum number of hours of multi time.

All of the training facilities we surveyed included time in flight simulators in their courses. One such school is HOVA, in Ashland, Virginia, which offers a 10-hour course in a Tecnam P2006T for $3980 plus examiner's fee.

We noted that a lot of schools have only one multi-engine trainer so if it breaks, you're sitting until it's fixed. Also make sure the school you're going to attend can schedule your ride with a DPE within a day of the end of your training—we've heard some horror stories about the DPE shortage in some regions of the country.

CONCLUSION

We think $5000 is a realistic price for a instrument multi-engine rating if the pilot follows some basic guidelines going into the training process:

Don't mess around. If you decide to get the rating, set up a schedule so that you can concentrate solely on your training and do so in less than a week—anything longer means you're going to spend more money and time getting through it.

If you're instrument rated, show up current on instrument flying.

Show up with an open mind and ready to learn. Cody Sivcovich of St. Charles (Missouri) Flying Service told us that the pilots who come in with the attitude that they are hot shots who know everything prove to be the ones who take the longest to get through training.

Have read all of the material the school provides in advance on maneuvers, multi-engine aerodynamics and the training airplane, and know the systems and numbers for the airplane.

Then go and do it.

Airtext LT Satcomm: Transportable Router

A follow-on to the Airtext HP cabin satcomm router, the Airtext LT can be moved between aircraft. We'd like a rechargeable battery and a mounting bracket.

by Larry Anglisano

When we evaluated the Iridium-based Airtext cabin router in the April 2018 *Aviation Consumer*, overall we found it to be a good performer with rugged hardware, reliable Bluetooth and a useful suite of smartphone apps.

But with a price that starts at around $10,000 the certified, permanently mounted Airtext is a stretch for the market's lower end. At $4995, the new Airtext LT transportable caters to both lower budgets and those who fly multiple aircraft. Here's an overview.

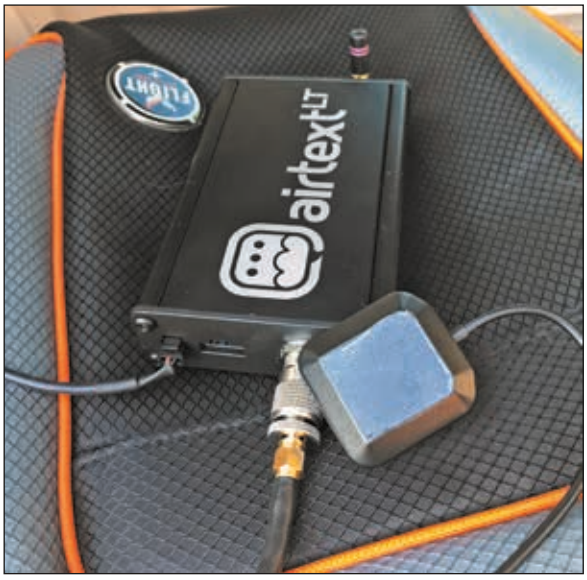
REPACKAGED

The LT version of the Airtext satcomm transceiver (it measures 5 by 3 by 1 inches) is a repackaged version of its big brother, which is 7.5 by 4.6 by 1.4 inches. That's not a bad thing because like the bigger one, the LT has a rugged feel thanks to a metal chassis and durable antenna connections.

The Airtext LT doesn't have a battery, something we think some buyers will want as an alternative to plugging it into ship's power. It comes with a DC accessory plug, but with many making the switch to USB panel power a long time ago, a USB cable could better the interface. There is no USB connection at the transceiver. Instead, the DC power cable plugs in via a two-pin connector.

At press time, Airtext said it's currently testing a USB power interface. As for the lack of battery, Airtext said with so many users carrying portable power banks, a built-in battery might not be missed on the device.

The system uses an external portable Iridium satellite antenna with a cable that terminates with an SMA connector that threads into a TNC for connecting to the transceiver. Some external Iridium antennas have cabling with TNC connectors, so the LT is equipped to connect with them.



The LT connects to smartphones and tablets that run the Airtext (and FBOLink) apps. The stubby Bluetooth antenna screws into the chassis via an SMA connection resulting in quick pairing with every device we tried.

Worth mentioning is that the Airtext and Airtext+ models can connect with up to 16 devices, but since the LT is targeted at smaller cabins, it's limited to six devices. The LT doesn't have voice capability like the Airtext+.

There is no mounting bracket with the Airtext LT, so it's up to the user to get creative in securing it in the cabin. Some possible solutions include laying it on the floor or on a seat, but it might be a projectile in turbulence or in a crash. Doing a new panel upgrade? Consider having the shop fabricate a storage shelf or even modify a glove box to safely house portable gear. In our use, we tucked the LT half in the pocket of a small flight tote. It's not the best solution, but it works. The LT comes with a carry/storage case. Data plans are $300 per year and include 1000 messages.

BRIDGE PRODUCT

For buyers who aren't ready for a full-up, permanently mounted Airtext or Airtext+ system (and can live without voice calls), we think the Airtext LT is a worthy choice, particularly for carrying on to different aircraft.

Moreover, as long as there is power available the system can be used in nearly any application where Iridium satellite connectivity is desired (Iridium has global coverage). Airtext already recognizes an opportunity in the marine market, where cellular connectivity is marginal if not impossible offshore. The LT transceiver has a four-pin connector input for a Bluetooth antenna extender (up to 32 of them when connected in series) so the device can work in yachts that have multiple rooms. "We see that some users fly the airplane to a yacht—or to a cabin in the woods for that matter—and need connectivity," Airtext's Davis Gray told us.

In the airplane, the LT has similar utility to the certified models, including interface with the Airtext app where you send and receive SMS messages on an iOS or Android device. There's also FBOLink, a messaging program that provides flight crews direct real-time communications with FBO staff. The LT retains weather data capability, including textual display of ASOS, METAR and D-ATIS (digital ATIS) for receiving the digital ATIS at the 73 airports that have the capability.

For more on the Airtext line, visit www.airtext.aero and phone 678-208-3087 in Atlanta, Georgia.

YouTube **See a video overview of the Airtext LT at http://tinyurl.com/j95ht2a**

Whither 100UL? Tested Fuels Fall Short

The FAA's PAFI called a halt to unleaded avgas testing and put out a call for more ideas. The outcome remains unsettled.

by Paul Bertorelli

The long, torturous road to replace 100LL with an unleaded alternative just got longer and more torturous as the FAA temporarily halted testing on the two leading candidate fuels in May. The agency said its testing revealed differences significant enough with 100LL to obviate further testing.

There's no officially viable replacement for 100LL in sight. The promised schedule has been slipped to December 2019.

The upshot: There's no officially viable replacement for 100LL in sight and the FAA has slipped the promised schedule for an announcement a full year, to December 2019.

What this means for owners is an utter unknown. The EPA is still mulling over what to do about lead in avgas. It has no timeline on ruling against lead. And while the shortfalls in the two candidate fuels are believed to be minor, neither the FAA nor the two companies—Swift and Shell—will comment on whether they can tweak their formulas to comport closely enough with leaded avgas to become realistic, marketable replacements.

BEAT GOES ON

At AirVenture 2018, a briefing by the FAA and so-called industry stakeholders revealed that the agency's long-term testing had revealed the two candidate fuels were "exhibiting some differences with potential impacts compared to 100LL." In mid-May 2018, the FAA concluded that the differences were too great to continue testing, the unstated conclusion being that neither of the submitted fuels would yield a suitable 100LL replacement.

The two fuels got to that stage through a complicated process called the Piston Aviation Fuel Initiative, an organizational framework consisting of FAA and industry technical and testing resources.

PAFI was created in 2014, at which time various potential fuel suppliers were invited to submit candidate fuels. The submissions varied and were wide enough of the mark that several were rejected outright. The two that made it into the second phase of PAFI testing came from Swift Fuel and Shell.

Little technical detail is available on these fuels.

Swift came out of the ground a full decade ago, claiming to be a biofuel to be generated from cellulosic feedstock rather than starch feedstock. At the time, Swift claimed its production costs would be cheaper than conventional petroleum-based avgas with its tetraethyl lead octane package. The fuel was described as a binary formula, consisting of mesitylene—also known a trimethylbenzene—and isopentane. These were to be synthesized from bio-derived acetone feedstock.

The fuel has since morphed into what we believe is a more traditional aviation fuel consisting of a high-octane aviation alkylate and some kind of octane package, probably aromatic hydrocarbons. Swift has declined to provide any technical details, but sources familiar with the PAFI testing tell us that Swift fuel doesn't lack for the required 100 octane.

While Shell is a major player in aviation, it no longer refines any avgas in its own refineries in the U.S. It has, however, imported finished product from a Shell refinery in Europe. Shell's entry in the PAFI sweepstakes was a surprise because none of the other majors—ConocoPhillips, Exxon Mobil and Chevron—expressed interest in entering PAFI. In conjunction with Afton Chemical, ConocoPhillips did submit an octane additive, but the PAFI requirement called for a finished fuel, not an additive.

TESTS HALTED

From its inception, the PAFI process has proved opaque, with no meaningful information coming from the companies or the FAA. Our recent queries to the FAA yielded no technical detail on why Swift and Shell fell short. But one source familiar with the testing said one of the fuels caused unacceptable swelling or damage to O-rings and seals, a major worry for a replacement fuel. Based on a conversation with one of the early testers of the fuel, we believe

GAMI's G100UL, above, has been under almost constant testing since 2011. The company pursued an STC approval process that the FAA sharply resisted at every turn.

this to be the Shell entry. It also reportedly caused paint damage.

The Swift entry is heavier than conventional avgas and has higher energy content. While the weight may not be a deal breaker, the higher heat content may suggest there are too-rich issues with Swift that the FAA is uncomfortable with. Again, the FAA wouldn't confirm this, but one of the testers said one of the fuels had "minor operational issues."

Unknown is whether these problems can be sorted out, the formula tweaked and resubmitted. In a response to our queries to the FAA, the agency said this:

"Under the Co-operative Research and Development Agreement approach that we have just announced, the FAA will only be able to conduct a limited number of engine tests on these fuels due to funding and resource/time limitations. Our focus will be on detonation, performance and operability testing using the PAFI test protocols to assess the maturity and potential viability of the fuels to advise potential follow-on test and approval activity.

These tests are a small subset of the extensive engine and aircraft testing being completed within the PAFI R&D test program. One of the most beneficial outcomes of the PAFI effort to date has been the development of a validated and industry coordinated set of test protocols to evaluate unleaded fuels for aviation applications."

Translated, this means that Shell and Swift are invited to tweak their formulas any way they like and resubmit to a more abbreviated PAFI testing protocol. Tellingly, the FAA is also inviting other companies to enter the PAFI process, although it's unclear how these fuels will be qualified in less than a quarter of the time it took to get this far.

When asked if the FAA has given up on finding a drop-in replacement fuel, the agency responded: "No. A better term to use in this case would be 'transparent' versus 'drop-in.' The term drop-in would imply the fuel or fuels fit within the existing ASTM D910 fuel specification in all aspects. Going forward at multiple levels we've anticipated that the new fuels may need to fit under different specifications."

Unanswered is whether such "different specifications" would require mitigations such as changes to aircraft fuel systems, ignition systems or modifications to ignition. Although this seems unlikely, no one is saying it's impossible.

GAMI IN THE WINGS

Hovering outside the PAFI process is General Aviation Modifications Inc., the Ada, Oklahoma, company that has had a fuel called G100 under continuous testing since 2011. GAMI has pursued an STC process rather than the formal FAA certification path represented by the PAFI process.

Although the FAA and segments of the industry resisted the STC idea at nearly every stage, GAMI's George Braly said in early June that the company is nearly done with its testing. Braly said the company needs to complete one more 150-hour test run on a Cirrus engine, flight testing on a Lycoming IO-540K-equipped Lance and operational testing on a Cherokee. That work could be done as early as the end of the year or early 2019.

Having seen the other two fuels come up short, at least temporarily, the FAA recently courted GAMI to submit G100 for the revised and abbreviated PAFI. Braly says GAMI isn't interested because PAFI is cumbersome and it doesn't allow adjusting the fuel formulation during testing. "That's the whole point of science," Braly says. If the majors, save for Shell, were standing by awaiting a solution, they've apparently noticed G100. GAMI is in discussions with refiners—they won't say who—to blend G100 under license.

And blending is the apt word. Like the Shell fuel, G100 requires a base stock of high-quality aviation alkylate, which is then dosed up with GAMI's proprietary aromatic octane package. As such, the alkylate can be sent to any terminal—probably by rail—and splash blended with the octane package.

GAMI is thus far the only company to put an estimated price on its fuel. At the terminal dock, Braly estimates it will cost between 40 and 80 cents more than current 100LL, meaning about that range retail at the FBO or self-serve. "But not less than that," Braly adds.

To use G100, pilots will need the STC, which GAMI hopes to provide for free as a simple download. The downside of the STC approach is that not every engine and aircraft combination will be initially covered, thus no fleetwide approval. Braly believes the approvals will eventually be expanded to cover all but a small portion of the fleet.

OUTLOOK

The FAA told us suspension of PAFI testing and extension of the R&D "should bring confidence to the marketplace and owner-operators that we are working hard to ensure the fuels within PAFI are rigorously evaluated and that we are working to evaluate all viable unleaded replacements for 100LL."

We think the reverse is true. Following the testing suspension announcement, a poll conducted by our sister publication, AVweb.com, found that 22 percent of respondents were worried by the announcement and another 40 percent said they were concerned. Only a quarter said they weren't worried at all.

By our estimate, the avgas market may be worth as much as $200 to $300 million in profits, given the exceptionally high margin the product enjoys for refiners. That's too much business to simply abandon; it's just unclear at this juncture who's able—or willing—to seize the opportunity.

Best Tugs: Sophisticated Towing

With an onboard computer and airplane-specific software, Best Tugs will shut down before applying enough torque to damage the landing gear.

by Rick Durden

In our July issue we published a survey of some of the tugs on the market that are suitable for moving airplanes weighing less than 6000 pounds. We reported on 20 tugs put out by seven manufacturers and found that electric models had come to dominate the field. We somehow managed to overlook one manufacturer: Best Tugs (www.besttugs.com) of Spanish Fork, Utah. Best Tugs offers three sophisticated electric tugs that fall within our under-6000-pound area of interest.

While all tugs move airplanes, a Best Tugs unit has an onboard computer with software installed that optimizes the drive system for the type of airplane involved. According to Best Tugs' Bryce Whittaker, the software is based on a combination of pull testing and mathematical modeling of the weight and landing gear geometry of specific types of airplanes so that the operator of the tug cannot cause the tug to damage the nosegear (or tailwheel) by accelerating or stopping too fast. The tug will simply refuse to apply more torque to the airplane than is safe for the gear. We note that tug-induced aircraft damage is a very real consideration—Cirrus Aircraft has issued a Service Advisory on the subject for the SR20 and SR22 line.

PROTECTING THE GEAR

Should a pilot forget to unlock the parking brake, a Best Tug will hit the torque limit established by the installed software and shut down rather than potentially damage the nose/tail gear. In addition, should the operator be pressing on the throttle when turning the tug on, the software will command a reset rather than allow the tug to suddenly apply torque to the gear. Once the tug is in motion, the software runs an autothrottle function to maintain a constant speed.

When buying a tug, the customer identifies the type of airplane to be moved and Best Tugs supplies a tug with appropriate software installed as well as the correct "quick lock" forks that mate the tug to the nose or tailwheel of the airplane. If more than one type of airplane is to be moved, the software installed is for the more fragile of the airplanes and forks for each are provided. Fork swaps appear to require less than 20 seconds.

THE LINE

The Bravo line of Best Tugs was the first developed and handles larger airplanes—we looked only at the B5, which is rated for airplanes up to 5600 pounds. The base price is $5800. It is a two-wheel drive unit, with differential, and picks the nose or tailwheel off of the ground by attaching a fork designed for the type of airplane to the gear and then winching the wheel onto the tug. Best Tugs come with all-season tires—a company video shows a B5 moving a single-engine turboprop up a sloped ramp through several inches of slush while not slipping once it got onto a polished hangar floor.

The B5's motor puts out 45 amps. The tug comes with a number of options, two of which we think are potentially very attractive to buyers because—when they are needed—they're incredibly handy: an air compressor with hose ($345), and a built-in GPU ($945) with capability to jump-start the airplane (it includes the appropriate cable).

The Alpha tugs use the same smart software as the Bravo line, but are for lighter airplanes. The 20-amp A2 ($2995) is for airplanes up to 2600 pounds and the 30-amp A3 ($3495) is for airplanes up to 3600 pounds. Both are two-wheel drive with a swiveling fork attachment that means the user doesn't have to lift the tug to make a turn.

While Best Tugs are more expensive than their competition, we think that the built-in protection against gear damage may attract more than a few buyers.

Best Tugs A models, right, and the B5 under a Cirrus, below.

Piper PA-46

If you're ready to commit to sizable maintenance costs, a Malibu/Mirage/Matrix pays back with its speed, efficiency and favorable styling.

If you're in the market for a used Piper PA-46, the good news is there are plenty of them for the taking, plus the oldest ones can be found for around $200,000. Moreover, a Malibu, Mirage or Matrix can wear a lot of hats. For pilots looking for experience in high-altitude, pressurized flying, a Malibu or Mirage is a logical step up. The unpressurized Matrix, with the same cabin as the rest of the PA-46 line, works as a comfortable people hauler with more simplicity and perhaps lower maintenance costs than its pressurized brethren.

Whatever the reason for considering a PA-46, the airplane is as much of a head turner today as when the first Malibu appeared in the mid-1980s. Aside from its ramp appeal, pilots were intrigued with its high-flying pressurized cabin, 200-knot cruise speed and decent range.

There was nothing quite like it and Piper soon found a loyal market for its new flagship product, mostly among owners who could afford to sink a half-million bucks into a new single and who flew the kind of missions where the Malibu shined.

Manufacturers proved that building a pressurized single isn't easy—Mooney's Mustang was a bust. Cessna pulled it off using a proven airframe in the P210, but it had its growing pains. But even Piper's execution of the Malibu was far from stellar. Although owners generally raved—and still rave—about the Malibu's impressive capabilities, it gained a reputation as a problem airplane. The engine and systems were finicky to operate and dispatch reliability ranged from barely acceptable to just awful for some years.

The PA-46's claim to fame is that it's a six-place airplane with cabin-class comfort.

As the model evolved and became the Mirage, its reputation didn't improve, thanks to engine issues. Yet, with time and the application of money, most of the problems got sorted out, and the fact remains, nothing quite does what a Malibu does. As one owner once told us, "It's expensive to operate for a piston single, but cheap for what it does." We think that fairly sums up the Malibu. Some words to the wise: Anyone contemplating buying a PA-46 (especially a pressurized one) should be ready to pay what we consider to be substantial maintenance bills. Their reward will be fast cruise speeds above the weather in pressurized comfort, with reasonable payload and plenty of handsome styling.

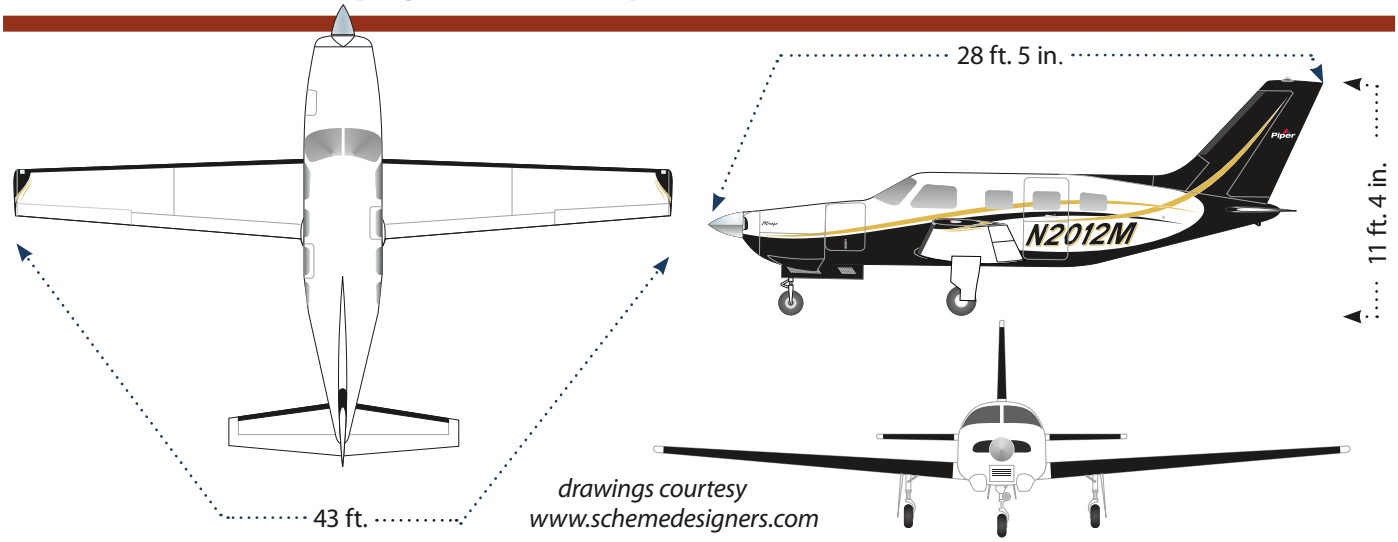
MODEL HISTORY

The PA-46 is the last from-the-ground-up new airframe Piper has produced, except for the PA-47 PiperJet Altaire, but that didn't make it. The turbine-powered Meridian uses the same basic airframe the Malibu pioneered but with substantial modifications. The Matrix is an unpressurized Mirage. The Malibu prototype emerged from the Vero Beach plant in late 1982, amidst much fanfare and excitement.

No one had seen anything quite like it. It had a long, rakish snoot

The Mirage, main photo, has timeless good looks and a fairly long takeoff run.

PIPER MALIBU-MIRAGE-MATRIX

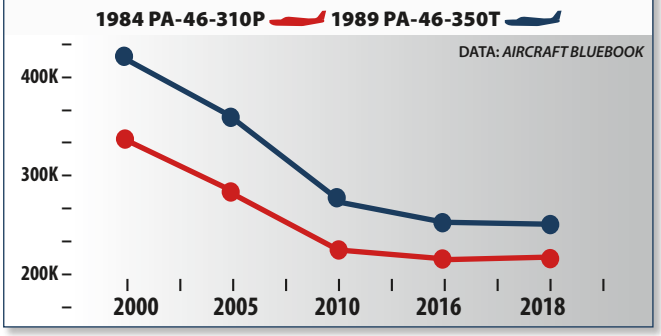


drawings courtesy
www.schemedesigners.com

PIPER MALIBU-MIRAGE SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1984 PA-46-310P MALIBU	310-HP CONTINENTAL TSIO-520-BE	2000	$55,000	120	1400 LBS	205 KTS	±$210,000
1988 PA-46-310P MALIBU	310-HP CONTINENTAL TSIO-520-BE	2000	$55,000	120	1400 LBS	205 KTS	±$250,000
1993 PA-46-350P MIRAGE	350-HP LYCOMING TIO-540-AE2A	2000	$75,000	120	1450 LBS	215 KTS	±$295,000
1996 PA-46-350P MIRAGE	350-HP LYCOMING TIO-540-AE2A	2000	$75,000	120	1400 LBS	215 KTS	±$345,000
1999 PA-46-350P MIRAGE	350-HP LYCOMING TIO-540-AE2A	2000	$75,000	120	1400 LBS	215 KTS	±$430,000
2002 PA-46-350P MIRAGE	350-HP LYCOMING TIO-540-AE2A	2000	$75,000	120	1350 LBS	215 KTS	±$480,000
2005 PA-46-350P MIRAGE	350-HP LYCOMING TIO-540-AE2A	2000	$75,000	120	1300 LBS	215 KTS	±$580,000
2011 PA-46-350P MIRAGE	350-HP LYCOMING TIO-540-AE2A	2000	$75,000	120	1300 LBS	215 KTS	±$830,000
2012-14 PA-46-350P MIRAGE	350-HP LYCOMING TIO-540-AE2A	2000	$75,000	120	1300 LBS	215 KTS	±$980,000
2008-10 PA-46-350T MATRIX	350-HP LYCOMING TIO-540-AE2A	2000	$75,000	120	1421 LBS	215 KTS	±$650,000
2012-16 PA-46-350T MATRIX	350-HP LYCOMING TIO-540-AE2A	2000	$75,000	120	1421 LBS	215 KTS	±$800,000

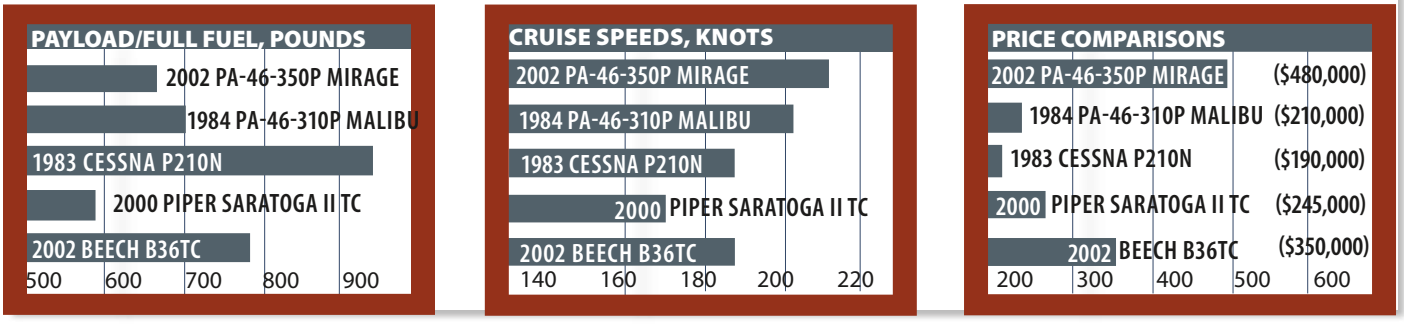
RESALE VALUES



SELECT RECENT ADs

AD 2013-13-01	INSPECT/REPLACE CERTAIN FUEL VENT VALVES
AD 2011-06-10	CLEAN, INSPECT AND CALIBRATE T.I.T. GAUGES
AD 2010-13-07	REPLACE V-BAND EXHAUST COUPLINGS
AD 2008-26-11	INSTALL STALL VANE HEATER MOD KIT
AD 2001-12-01	INSPECT/REPAIR INBOARD FLAP DRIVE BELL CRANK ASSEMBLY

SELECT MODEL COMPARISONS



Piper went with Avidyne's Entegra glass cockpit, top photo, in 2005 before eventually switching to Garmin's G1000, middle. It has a remote controller in the pedestal for data entry and GFC600 autopilot command, bottom photo. Older models had King Silver Crown avionics.

housing a six-cylinder Continental TSIO-520BE rated at 310 HP and with two turbochargers, providing enough bleed air to keep the cabin comfortably inflated at FL250.

With its 43-foot wingspan, the Malibu looked as much like a glider as a powered aircraft. As one owner said, the thing looked like it was going 200 knots sitting on the ground. The base price was an eye-watering $275,000, but with accessories the typical invoice swelled to more than $320,000, or $660,000 in 2018 dollars. Piper's current pressurized PA-46—the M350—is well north of $1 million.

Ironically, Piper launched the Malibu in 1984 into what was an overall GA slump. Yet Piper prospered with the Malibu because of its capabilities and luxury. Although the company succeeded, its success was haunted by engineering decisions made early in the program.

As is often the case, the production airplane was heavier than intended, but this was offset by a boost in takeoff weight. Useful load worked out to be 80 pounds less than planned; not a deal breaker, but a weight equivalent to fuel for IFR reserves.

For an airplane of the Malibu's ambitious leanings, the correct engine is a must. Piper never seemed able to find the right powerplant, however. From the beginning, buyers favored a Lycoming because of a perceived reputation for reliability and robustness.

The would-be owners turned out to be correct, at least initially. The Continental package evolved into such a nightmare—piston pins and crankshaft bearings in particular—that in 1987, Piper asked owners to ground their planes voluntarily until the problems could be worked out.

Many owners maintain that the Continental was and is a superior engine for the Malibu, but in 1989 Piper introduced the Malibu Mirage with a Lycoming engine. It was essentially the same airplane with a Lycoming TIO-540-AE2A of 350 HP. The new engine weighed 113 pounds more, but the maximum takeoff weight was boosted by 200 pounds. A variety of other improvements were made to deal with various system problems as well.

MORE THAN ENGINE WOES

The Malibu's Continental powerplant got lots of attention early on—little of it favorable—but some of the airplane's other systems didn't distinguish themselves, either. The complex nosegear, which rotates 90 degrees to fit into its bay, proved delicate.

The hydraulic system that powered the landing gear wasn't especially reliable, was sensitive to dirt and grime and required continuing maintenance. The hydraulics also ran the flaps on early models. To make the airplane appealing to what Piper thought was its core market, the company called for exceptional range well beyond the fuel specifics of most six-cylinder engines. Continental thus specified operating requirements for the engine that were unusual at the time, specifically lean-of-peak EGT operation.

To beat down the fuel flow, Continental required pilots to lean the engine to 50 degrees lean of peak for all operations below 80 percent power, which is the maximum recommended cruise setting. That went against what most pilots had been taught before the current understanding of lean-of-peak ops—and a

A big part of the PA-46's efficiency is the long wing, top photo. De-ice boots make the Mirage approved for flight into known icing. The PA-46 cabin, bottom, is tight, but has enough interior styling to impress the passengers.

fair number ignored the instructions and ran rich of peak.

Whoever was to blame for Malibu engine problems, squabbles between owners, Piper and TCM grew heated and ugly at times. The irony is that the fixes applied to the Continental made it as good as the Lycoming installation. Both are sensitive to proper operating technique. The lack of cowl flaps doesn't help matters.

DROP IN A TURBO LYCOMING

Substituting one engine for another didn't solve all of the Malibu's problems and it brought some of its own, not the least of which is higher fuel consumption.

Owners suffered through Lycoming's massive crankshaft recall of 2002 and 2003 and weeks to months of downtime.

The perceived reliability of the Mirage got so bad among some owners that a class-action lawsuit was filed in 2000 against New Piper and Lycoming. The suit was settled after the court failed to certify the class.

Engine reliability has not been good, although the airplane is such a good glider that many events didn't become an NTSB report because the pilot was able to land safely on an airport. Our most recent survey of accidents showed that 21 percent were engine-related—no change since we looked at the aircraft roughly four years ago.

Maintenance is, as one owner told us, "a serious activity" for PA-46 owners, regardless of the powerplant type. Alternators, vacuum pumps and, in particular, the exhaust system are all items mentioned by our survey respondents and matched the Service Difficulty Reports reported to the FAA.

What we did see is that things have improved over the years. Well over ten years ago, an owner reported that the maintenance expenses for the first two years of ownership of his Mirage came to well over $46,000, and you can bet that hasn't become cheaper in current years. While we have received reports of squawk lists on annuals reaching 25 percent of the value of the airplane, the majority of owners say that they recognize it's expensive to maintain a pressurized single and if they stay ahead of the game, the price is not outrageous.

On the low side (if you're lucky) an annual inspection could cost $6500, but owners tell us $9000 to $12,000 or more is more realistic. In our view, you'll play it safe by figuring you'll fly away paying closer to $10,000 for a thorough inspection, if you've been addressing minor routine squawks along the way. Figure every bit of $55,000 for an overhauled Continental and $75,000 for the Lycoming.

The PA-46 nosegear is tender and the hydraulic system continues to pose problems. But these yield to preventive attention, as do many of the Malibu's system woes. Even ardent supporters of the airplane admit that it requires frequent and ongoing maintenance. Owners emphasize the value of having a knowledgeable maintenance shop doing routine and ongoing work on the airplane. The Malibu is not an airplane that just any shop can fix and we don't recommend bringing one to a shop without PA-46 experience.

But owners really like their airplanes. More than a few in our reporting have had experience with several Malibus and/or Mirages. Is one better than the other in terms of maintenance? Our impression is that they're about the same and that any owner contemplating buying a PA-46 should simply budget a pile of cash for annual maintenance and fix stuff as it breaks. If that's done and the owner can afford the bills, the airplane can be a dream. As our recent owner feedback shows, many Malibu and Mirage owners have held on to their aircraft for many years.

MIRAGE AND MATRIX

With the introduction of the Mirage, some of the quirky systems were addressed. The hydraulic system was improved, the engine cooling system was redesigned, the cabin door was improved, the seats were strengthened and the flaps were changed from hydraulic to electric operation. (Actually, some of the later Malibu models got the electric flaps and improved hydraulics for the gear.)

The Mirage also got some big-airplane type features that owners appreciate, including a dual-bus

PA-46 PRANGS: OTHER, ENGINE, RLOC

In the process of reviewing the 100 most recent PA-46 accidents, we were pleased to find that the accident rate was low enough that we had to go back to the last year of the last century, 2000, to find the full 100 mishaps. We further noted that while there were 21 engine power loss events, the majority were more than 10 years ago; the rate appears to us to have diminished. That was also the case with gear collapse incidents, almost all of which were more than 10 years ago.

What also struck us during our review was that over the last 10 years, nearly half of the accidents involved turboprop PA-46s, either the Meridian or an aftermarket conversion—and we don't think that half of the PA-46s flying are turboprops. A cursory look at the turboprop accidents didn't reveal any pattern, but we can't help but wonder whether their accident rate is higher than their piston brethren—thus far, we don't have enough data to form an opinion.

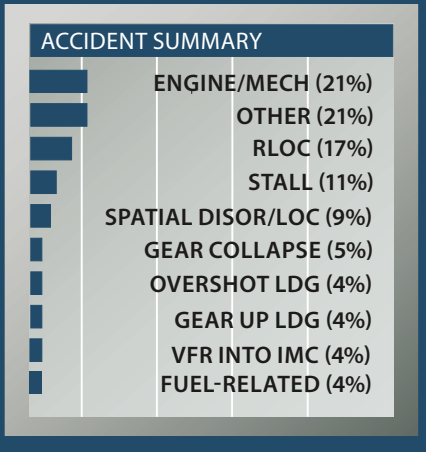
We were pleased to see that the number of fuel-related accidents was so small—a strong indication of a user-friendly fuel system with effective warnings that fuel is getting low. Of the four accidents, only one involved fuel exhaustion. Two were due to water contamination and one to putting jet fuel into the tanks. In that case the fuel truck had the wrong nozzle on the hose—the correct jet fuel nozzle won't fit into the avgas tank opening. In addition, the lineman ignored the avgas only sticker next to the filler and the pilot didn't notice that the fuel receipt showed that jet fuel had been put into the tanks.

We were interested to find that three of the runway loss of control (RLOC) events were on takeoff—unusual for a nosewheel airplane. PA-46 pilots did demonstrate some difficulties controlling the machine on rollout after landing in crosswinds—which surprised us as the wide-track gear should make for good ground handling. To our amazement, three pilots were going so fast down final that when they tried to force the airplane onto the ground they hit the prop.

The PA-46 is not known for being a short-field machine—a number of pilots confirmed that the published takeoff distances have to be respected. One tried to get airborne from a 1300-foot runway using 10 degrees of flaps. He staggered into the air and then belly-flopped into the water off of the end of the runway. He claimed the engine lost power. Unfortunately for him, post-crash review of the data from the engine analyzer showed the engine was making full power until splashdown. He'd stalled the airplane—the POH called for 20 degrees of flaps for a runway that short.

Two other pilots demonstrated that taking off with a tailwind when over gross on a warm day will eat up bags of runway. One ran off the end of a 5800-foot-long runway. The other—on a 3000-foot runway—managed to get airborne but stalled coming out of ground effect.

We saw no indication that PA-46s are more allergic to ice than any other airplanes, but a pilot who didn't remove the snow from his wings barely staggered off of a 4500-foot runway before crashing into gently rising terrain. Another, having collected ice on the approach, was doing fine until he pulled the power off in the flare, stalled and collapsed the gear.



electrical system, internal windshield deice, standard dual alternators and vacuum pumps and an auxiliary heater for the cabin. It needed it. It's cold back there in the flight levels, even during the summer. Again, some of these mods appeared on later Malibus.

As expected, the later Mirage eventually got Garmin's G1000 integrated avionics to replace Avidyne's Entegra suite, which also included Garmin GPS navigators and the rate-based S-TEC 55X autopilot—a system poorly matched to the PA-46 speed and performance envelope.

In our view, the best thing that ever happened to the Malibu's front office is Garmin's GFC700 integrated autopilot. Aside from its advanced features, it finally gave the airplane the tight autopilot performance it deserves, especially on coupled approaches.

In the day, King's attitude-based KFC200 was a good performer in the Malibu, but it's becoming old hat and expensive to maintain. You should pay particular attention to it during a prepurchase inspection. Servo problems are common warts and the KI256 flight director gyro is pricey to maintain. Some versions aren't supported at all. We suggest finding one that's had a glass upgrade.

Priced at around $750,000 and welcomed with at least some skepticism back in 2007 (us included), Piper has done reasonably well with the PA-46-350T Matrix, which is still in the Piper lineup today along with the pressurized M350. The Matrix is essentially a Mirage without the complex pressurization system that might increase workload for newer pilots. Plus, removing all of the pressurization hardware from the airframe bumps the useful load up to 1421 pounds, while fuel capacity remains the same.

It's easy to see how buyers considering a new Cirrus SR22T or Cessna TTx can be swayed by a used Matrix and its luxurious six-place cabin, club seating, airstair door and its big-airplane look and feel.

We found a few early models (2008) on the current market for around $500,000. That's less than an optioned-out new SR22T. A 2011 Mirage has an *Aircraft Bluebook* suggested list price of $830,000. For those willing to deal with oxygen nose hoses,

The Matrix, above, is lighter and less complex than a Malibu/Mirage without its pressurization system.

rather than cabin pressurization, the savings in maintenance costs, operational simplicity and perhaps lower insurance premiums give the Matrix appeal.

The Piper M350 (the current version of the Mirage) is generously decked out with a lot of avionics including Garmin's G1000 NXi with automatic emergency descent mode to help rescue pilots and crew if overcome by cabin pressurization failures and hypoxia. Older Malibus might have a variety of retrofit gear.

CABIN, COCKPIT

The PA-46's claim to fame is that it's a six-place airplane with cabin-class comfort. Starting up front, however, the cockpit isn't exactly cavernous. Getting into the seats requires minor contortions through a narrow aisle between bulkheads walling off the rear cabin.

Pilots who are wide of girth and long of leg will be cramped up front; the seats don't slide back as far as they do in a Mooney or a Cessna. The cockpit is well-designed in both models with well-placed gauges and plenty of room for all the avionics you could ever want.

Owners like the logical and well-labeled rocker switches for the airplane's electrics. Later models have overhead switches that are a challenge for the presbyopic set and concern us from a crashworthiness standpoint.

The cabin arrangement is superb, with the Mirage somewhat better than the original Malibu. The airstair door is a plus, making for relatively easy entry and egress.

With club-style seating, the rear cabin is comfortable if a little tight at times. Rear-seat passengers complain about too little heat—fixed with the aux heater—but the air conditioning/pressurization system is quite good, when it isn't broken. Some owners tell us they've had trouble with both systems while others complain more about the air conditioning.

Cabin and cockpit noise are on the low side as GA airplanes go. The Continental in the Malibu is noticeably less vibey than the Lycoming in the Mirage, based on the ones we have flown.

Like most airplanes, the Malibu is not a fill-the-seats-and-tanks six-seater. But it will comfortably carry four people and baggage with full tanks, yielding a nonstop range of about 1400 miles for the Malibu and 1000 to 1200 miles for the Mirage. Typical useful loads are 1400 pounds and 1300 pounds, respectively.

Baggage space is generous, with two baggage bays, one just aft of the engine compartment and the other behind the rear seats, making loading within limits easier. Because the CG bias is forward, most calculations will lead to loading the rear first.

The Mirage's Lycoming engine is larger and the accessory layout is different, so the forward baggage bay in the Mirage is a bit smaller than that of the Malibu. The inclusion of

A Malibu parked outside of a maintenance shop isn't a rare sighting. Columbia Air Services in Connecticut is one that specializes in the PA-46. Jerry Blank, bottom, knows a bit about Malibus, too. He's owned four of them including the two pictured here.

an access panel in the firewall is a good tradeoff, since it makes it much easier to get at the backside of the powerplant.

PERFORMANCE, HANDLING

Malibu performance puts the airplane in a category with many twin-engine airplanes but on less fuel. Malibu pilots report cruise speeds of 205 knots TAS at FL220 at 67 percent power and 210 knots true at FL250 at 75 percent.

Mirage pilots pay more at the gas pumps but in exchange, they go a little faster, with speeds typically of 220 knots at FL230-250 at 75 percent power burning 18.8 GPH.

Owners of both models say they can fly 1100-NM trips with IFR reserves. But we have our doubts about the fuel-guzzling Mirage matching range with the Malibu in real-world conditions. The power setting and leaning would have to be right. The -310P, with its lower fuel consumption—as much as 4 to 5 GPH when flown by the book—has nearly 25 percent better range and is only about 5 percent slower. One owner cited this as the reason he chose the Malibu over the Mirage.

On trips of any length, most owners climb rapidly into at least the high teens, but the airplane is perfectly at home up to FL250. One place it's not at home is taking off from short runways. Initial acceleration is sluggish, although the airplane will get in and out of 3000-foot strips at sea level with relative ease. We would be sure to be on the game while operating out of 2500 feet or less.

How about handling? Does it match the airplane's sexy looks? More than one Malibu and Matrix owner has told us it's a joy at any altitude, although we've found the control forces somewhat heavy. We've always felt that the PA-46 is an autopilot airplane.

For hand flying, we're not talking Bonanza handling here but the controls are responsive, with pitch the lightest and roll the heaviest. The PA-46's long, high-aspect-ratio wing is good for climb and high-altitude performance, but along with it comes a low maneuvering speed in the mid-130s KIAS at gross, decreasing as the airplane gets lighter.

The long wings produce another undesirable trait: The roll rate at slow speeds is somewhat ponderous compared to other singles. Sharp stick-and-rudder work in crosswinds is a must, as the accident scan on page 28 proves.

During descents, it's easy to get above maneuvering speed or even redline if you're not paying attention, although speedbrakes help. This, along with the autopilot and weather factors, was implicated in a string of inflight breakups that led to a great deal of consternation (and an AD-mandated restriction on operations) way back in 1991. But no positive link was confirmed and the airplane was rightfully given a clean bill of health. There was a lesson.

Speed control is a must. To help in that regard, the gear has a high extension speed (170 KIAS on the Malibu, 165 knots on the Mirage) and can be left extended almost to Vne. We've done it in a rapid descent. Yes, it's uncomfortable.

The first notch of flaps can be extended at the same time as the gear. Pilots report that the gear makes an effective speedbrake. Retraction speed is much lower, at 130 knots (Malibu) and 126 knots (Mirage) KIAS.

The wreck reports show that many PA-46 crunches occur during landing. There isn't anything particularly difficult about landing a PA-46, but the long wing encourages floating and when lightly loaded, the CG

is forward. These two characteristics sometimes lead to abuse of the relatively delicate nosegear. Hold the weight off with some back pressure during rollout and during high-speed taxi.

MAJOR MODS, SUPPORT

As owners consistently report in our PA-46 surveys, the PA-46 is well-supported by one of the best owner groups in general aviation, the Malibu/Mirage Owners and Pilots Association found at www.mmopa.com. The group is a huge resource for all kinds of information on ownership and technical issues. Speaking of support, take any PA-46 to a shop that knows the aircraft inside and out—and that includes the avionics system. This is even more important for pressurized models.

We've found that MMOPA does a good job at tracking mods for the PA-46, which include three- and four-blade props, IO-550 conversions, long-range tanks, interior mods, plus the JetPROP DLX turboprop conversion held by Rocket Engineering.

Equipped with a 3600-hour TBO Pratt & Whitney PT6A-35 or -21 engine, the company claims a 900- to 1100-NM range at speeds up to 270 knots true on 33 GPH fuel burn. With a Hartzell or MT four-blade reversing propeller, landing distance is reduced to nearly 1000 feet.

We've seen nearly 3000 FPM climb rates on DLX conversions we've flown. The company also does avionics upgrades to older models.

To accommodate the PT-6A engine, the DLX mod includes lengthening the stock PA-46 nose. The resulting forward baggage area is an impressive 33 cubic feet. Contact www.jetprop.com, 509-535-6445. The company is based in Spokane, Washington.

Malibu Aerospace (www.malibuaerospace.com, 763-536-9553) in Minnesota has a variety of products and STCs for the PA-46 including the M-1 cooling modification. This is an altered lower cowl with additional cooling baffles intended to decrease scorching CHT temps on both Continental- and Lycoming-powered PA-46 models. The mod is priced at $2095 with installation. The company also offers a tail ice light, wheel well fairings, LED lighting kits and engine monitoring upgrades—essential, in our view.

OWNER COMMENTS

In 1986, I made a decision in which I am still reaping the rewards: I downsized from a Cessna 414A twin to a Piper Malibu single. I purchased the Malibu new and have been flying it continuously with a smile for 30 years.

I have an ATP rating and have logged 9000 hours of flight time. The reward of my downsize includes dispatch reliability just below 99 percent. I have flown my Malibu over 3800 hours (mostly for business) and about 70 percent IFR, year-round.

Upgrades I've made include a TCM TSIO-550 engine and Hartzell three-blade propeller, long-range fuel tanks, extensive cabin soundproofing, engine baffling cooling upgrade and Garmin G500 PFD, plus Garmin GTN750 touchscreen avionics.

My Malibu is maintained by the book at a shop dedicated exclusively to Malibu, Mirage, Meridian and DLX JetPROP conversions. Other than oil changes, it generally does not require additional maintenance between annual inspections. These inspections average $10,000 to $12,000 per year, with a low of $4500 and a high of $20,000.

Other than smoke in the cabin related to a burnt resistor, I have not experienced any inflight emergencies. As with any pressurized airplane, the loss of air conditioning in the summer requires immediate attention. The pressurization system has been flawless.

About 50 percent of my flights are under 140 miles and the rest are over 750 miles. Most long flights are above 18,000 feet. Generally, at altitudes above 23,000 feet, the airplane engine is not happy and requires perfect operating etiquette. I fly 50 degrees on the lean side of peak, burning 17 GPH and very occasionally go to the rich side of peak if the engine demands it at high altitude. Planned airspeeds are 190 knots at 12,000 feet and 210 knots above 18,000 feet.

The Malibu is a pleasure to fly in any weather, but you must be comfortable with a choppy ride in turbulence due to the long wings. The payback is an excellent glide rate.

Although it is approved for flight into known icing, flight characteristics change significantly with ice on the structure. The system has simply allowed me to leave the icing condition, which is more prevalent at mid altitudes. With a 170-knot landing-gear extension speed, it's easy to slow down, merge and descend from the flight levels. Range in no-wind conditions is 1400 NM with reserves and three people on board.

My biggest dislike about this aircraft is that it came from the factory with a Plexiglass windshield, which interferes with visibility and the heating element. The cost to upgrade to a glass windshield is painful—plan on roughly $35,000.

My advice to potential buyers is to not purchase a poorly maintained PA-46 and demand an expert inspection on any one you consider. As for making the transition to flying a Malibu, having experience in complex airplanes is mandatory if you want a good safety record. Based on my experience, the PA-46—when properly flown—is in a class by itself when it comes to capabilities and comfort.

Guillermo DelCastillo
via email

I have owned a 1987 PA-46-310P for 15 years. It is a Continental-powered machine and there are many people in each powerplant camp. It is a great airplane with a specific mission. The interior is comfortable, but not exactly roomy.

As you get older climbing over the spar is tougher and the relief tube more appreciated. I think that the bang for the buck is quite good in the PA-46. I fly routinely at FL160 with no traffic, cruising at 205 MPH. We can go higher but the fuel burn in climb is 38 GPH so there needs to be a good tailwind payback.

I fly 150-300 hours a year. Fuel burn at cruise lean of peak is 13.7-14 GPH. Oil change every 25 hours. I have been through one engine overhaul by Barrett Precision Engines (great job) and one avionics upgrade which may become two.

As for operating expenses, insurance is largely based on hull value and experience. My insurance is $4000 per year, the BASE annual inspection is $2500-$3000 plus repairs. Annuals of $10,000 can easily occur if you have a number of correc-

The Aviation Consumer

LSA Accidents

(continued from page 7)

LSA manufacturers have been telling us: The market is driven by so-called step-down pilots who are selling their Bonanzas and Mooneys to get into something cheaper and by re-treads coming back now that they're nearing retirement and can afford it.

For certain models, the discontinued Skycatcher, for instance, and the Flight Design series, student presence in the accident record is higher, but for others, like the CubCrafters Carbon Cub, it's lower if not non-existent. The Remos suffers a high accident rate, apparently for the high number of runway loss-of-control events. Two of the Remos fatals were due to pilots failing to correct the airplane's quick-disconnect control circuitry correctly.

CONCLUSION

Some broad conclusions: Pilots crash airplanes for basically the same reasons they always have and light sport hasn't changed that. Runway loss of control remains the leading cause of non-fatal accidents. Stall/spin tops the list of fatal crashes, with engine failures a close second. Pilots still occasionally try to run engines on air and it still doesn't work.

It's not clear if, by dint of less structure, LSAs in general are less crashworthy. The crash numbers are too small and the data just doesn't inform this judgment. But it is clear that in some accidents, failed landing gear *caused* an accident that might not have otherwise happened because the gear just didn't stand up as well as it would have in a Cessna 150 or 172. Not for nothing are those 40-year-old airplanes still in daily service.

Based on our analysis, the light sport accident record in general is nothing to celebrate. In our opinion, it suffers from small numbers syndrome, but even if the fleet numbers and hours are notionally doubled, the accident rates are still higher. A 2016 study by the FAA's Civil Aerospace Medical Institute found a light sport accident rate of an alarming 29.8/100,000 and a fatal rate of 5.2. These are much higher than our findings, possibly because they include E-LSAs and used personal flying hours rather than total hours. If the CAMI study overstates the case, the directionality confirms our research.

Tecnam's Shannon Yeager observes that one reason for the higher accident rates is that all LSAs have low wing loading and pilots stepping down from heavier legacy airplanes can be slow to adapt. Even with the higher rates, Yeager believes the ASTM consensus idea isn't diminished.

While we agree with that view, we think light sport manufacturers can and should address aircraft and training shortcomings. For example, it's reasonable to suggest that if American Legend offered only toe brakes, not heel brakes, it would have the same noseover rate as its competitor, CubCrafters.

Flight Design offers customers a five-hour training program, but it might follow the Cirrus example and embark upon a dedicated training program to address landing techniques in that aircraft, perhaps on a recurrent basis. The manufacturer with one of the lowest accident rates, CubCrafters, offers a tiered training program that can take up five days and 30 hours. The numbers seem to suggest that approach is working.

FEEDBACK WANTED

COMMANDER 112/114

We're preparing a report on the Commander 112 and 114 piston singles in an upcoming Used Aircraft Guide in *Aviation Consumer.* We want to know what it's like to own these airplanes, 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 that can be helpful for buyers considering one. Send correspondence by September 15, 2018, to:

Aviation Consumer
Email at:
ConsumerEditor@hotmail.com

USED PA-46

(continued from page 31)

tive repairs happen to befall you.

Annual training is always fun but depending on travel costs runs $2000 more or less. Operation basically costs less if you fly more, but using average flight hours, fuel costs, annual inspection and reasonable reserves would put my experience in the $250 per hour range.

James Smith
via email