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The Aviation Consumer

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Aviation Social Networking Might Pay

In the December 2012 issue, I commented on what renters had a right to expect at an FBO when they make the decision to exchange their money for flying time. The feedback I received ranged from recitations of unpleasant experiences at unscrupulous or indifferent FBOs to pilots trying to find the right place to rent. What struck me was that number of the pilots looking for a place to rent weren't so much trying to find an FBO that had well-maintained airplanes with reasonably clean interiors as they wanted a place where they could not only fly, but spend time with others who shared their passion for the sky. They were in aviation for the fun of it, had a budget to pay for it and socializing with other pilots meant they flew more.

I also learned of an innovative few FBOs and flying clubs that reached out to the local pilot community and organized events. Gatherings included safety seminar evenings, fly outs for a morning or weekend, adult beverages in the hangar with the airplanes locked up or cook outs at the FBO. The pilots I spoke with—twice at dinners organized to get area pilots together—were unanimously in favor of the idea. I observed pilots encouraging student pilots to get their ratings, pilots clustered around iPads discussing aviation apps and pilots making flying plans with each other for an upcoming weekend.

I'm paying attention to organized social networking in aviation and may report on it in a future issue. My personal experience with semi-organized social networking—"Hey, I'll meet you at…"—it is that it seems to work. A CFI friend has a standing reservation for a table at a restaurant once a month. He invites his students and other pilots to show up—no, he can't afford to buy the dinners. It's been going on for years. It may help student retention; he's sure busy.

In a few days I'll be going to Cadillac, Michigan, where, for the 15th successive year, a group of pilots and their families, from all over the country, get together to fly little airplanes off of lakes. In the summer the lakes are liquid; in the winter, frozen. It's all because a cool FBO has a creative bent when it comes to marketing its vintage airplanes. Northwoods Aviation has a J-3 Cub and a Super Cub to which it attaches the appropriate landing gear for the season.

Over the course of a weekend, weather permitting, the group gets to do some non-plain-vanilla flying—the photo on this page of the Super Cub blasting off was taken by Hank Conrad at skiplane weekend a few years ago. The FBO makes a little money, local motels get a little extra business, and pilots, and those who might like to become pilots, get to fly historic airplanes in their natural habitat. Family members who aren't sure flying is all that great get a weekend in a resort community with lots of things to do. Mom or Dad may be off flying, but the rest of the family is close by, having fun.

The group gets together for dinner Saturday night and maintains a tradition of no after-dinner speeches and limits business to whether it wants to do this again next year.

I've noticed that FBOs and flying clubs that are proactive do better than those who wait for business to walk in. It's not that difficult to create a shared weekend to fly something a little interesting, not necessarily exotic, something to be proud of in the logbook, even for just an hour. Tied in with family activities during the day, an FBO might be able to create a profitable niche market with happy, return customers. —*Rick Durden*

ADS-B

Nice article by Larry Anglisano on ADS-B in the January issue (Which Traffic Now?). I agree with Larry that the portable solution for ADS-B in should be given good marks over the installed solutions.

One point that I feel is important is that I don't think the geographic limits of the weather information available is understood by users. A friend was returning from Florida to the D.C. area and when he could not get TAFs and METARs more than 250 NM from his position, he thought there was an equipment problem, not realizing that low-tier stations have a 250 NM look-ahead range.

I guess I am spoiled by XM Radio, but I like to look at the METARs and TAFs in my destination area when the weather may be marginal and I'm still well over 250 miles away so that if things start to go south, I can land early or take other appropriate action. As a general rule, 250 NM is not a satisfactory look ahead.

Folks at MITRE tell me that this is a bandwidth issue. I guess that must be true, but TAFs and METARs are text-only and are only updated every six hours (TAFs) and every hour (METARs), unless conditions are changing.

So, I am disappointed, but I don't see that we are going to get much choice. Eventually sufficient folks are going to change to ADS-B that XM will stop providing services for aviation.

Vince Massimini
Via email

180 for 180

With regard to your article "Speed: Buying 180 Knots for $180,000" in the January 2013 issue, I have owned two Bellanca Vikings over a 15-year period. The only maintenance issues I have experienced are unrelated to the airframe per se. All the systems are parts-shelf items. The only constraints I mention to potential buyers are:

1. Buy a well-maintained plane that is inspected by a shop that knows wood aircraft and Bellancas in particular. It's no different in this respect than a P210—buy a crummy one and get ready for misery and expense.

2. It's not a good IFR plane for people who are not able to hand-

fly an airplane IFR, which seems to include most people now. My Decathlon had more longitudinal and lateral axis stability. To most Viking pilots, this is a feature and not a bug. The wing is designed for performance, not stability, and pilots who need 7 degrees of dihedral need to find themselves an idiot-proof wing.

I fly my airplane back and forth between Iowa, D.C. and Morristown, New Jersey. In the past 15 years I've had only two AOG experiences, a cracked oil cooler and a failed vernier cable.

I've had more trip interruptions in my 1991 Decathlon.

William Eginton
Via email

Alternator Repairs

Pretty good article on alternator repairs in the February 2013 issue. I agree with almost all of the user comments, however, the article stated that alternators are run-to-failure items. A prudent operator follows, or at least takes note of the manufacturer's recommendations.

One owner came to me expressing reliability concerns regarding his alternator—original on an engine approaching TBO. I told him not to worry, assuming his regular shop had inspected the brushes every 500 hours per TCM's recommendations. He called his shop and they told him they never open alternators.

I examined an alternator that failed at 700 hours on a Cessna T206H. The alternator can only be purchased from Cessna, and it has no inspection protocol of any sort beyond seeing that it hasn't fallen off the engine.

I think that's ridiculous. In my opinion, there should be inspection procedures for an alternator, and it should be possible to inspect for brush wear without having to open it.

Seeing an alternator suddenly fall off line is a good indication that brush wear is a problem. In a quiet hangar, rotate the prop and listen to the alternator. If you hear a grinding, crunching noise, it's not good.

Thank you for having the courage to mention the problems with Kelly alternators. I've never heard anyone say anything nice about their products.

Ted Stanley
Via email

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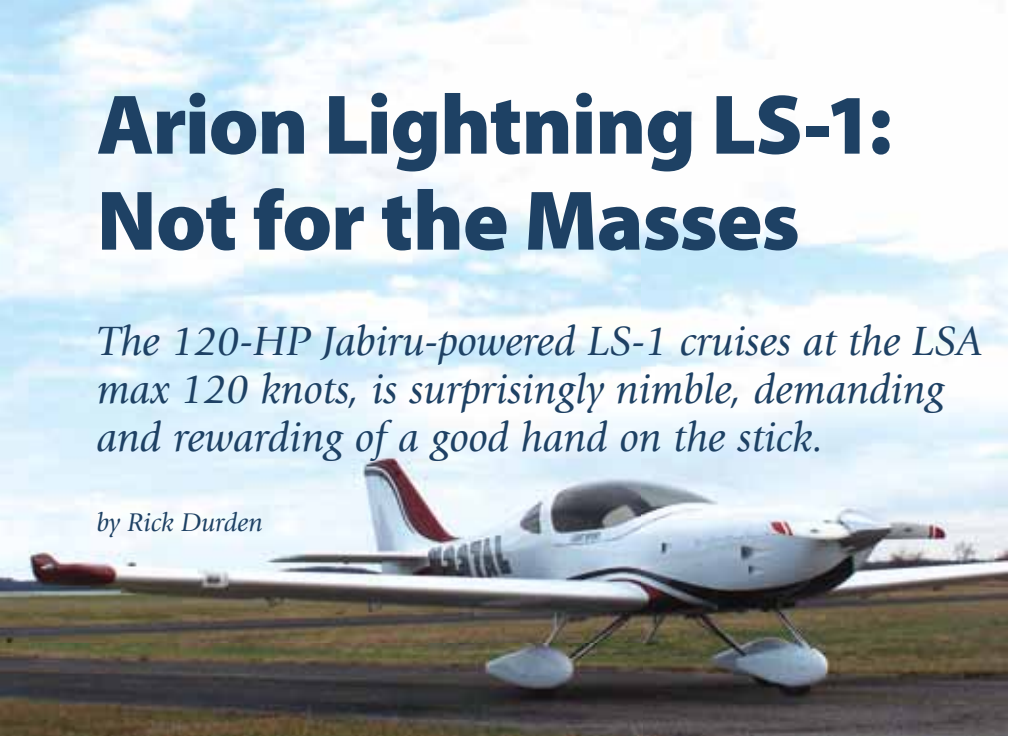
Arion Lightning LS-1: Not for the Masses

The 120-HP Jabiru-powered LS-1 cruises at the LSA max 120 knots, is surprisingly nimble, demanding and rewarding of a good hand on the stick.

by Rick Durden



CHECKLIST

- 120-knot cruise speed on 5.5 GPH gives good speed and range for one.
- Beefy structure and Jabiru engine means empty weight is a little high.
- Handling is delightfully quick, but may be too light for some pilots.

How about this for a challenging design concept? Start with a two-seat speedster with fighter-like handling, slow it down to meet the LSA 120-knot speed limit without excising any of the structure necessary for the stresses of the higher speed, then jump through the ASTM hoops to turn it into a production machine. That is exactly what Arion Aircraft did with its Lightning LS-1, an LSA that is finger-on-the trigger responsive in flight and among the fastest LSAs out there.

The Lightning is one of the few LSAs that is not intended to be used as a primary trainer. "Although a very few buyers have learned to fly in their Lightnings, we did not design it for flight training," explained Arion's Nick Otterbach, one of the lead designers of the airplane.

AIRCRAFT FLIGHT TRIAL

Not joining the masses by creating an airplane targeted at every pilot took some courage, in our opinion, in the dog-eat-dog LSA market. After flying the consequence of their decision, we think Arion has created a pilot's airplane that is as close to high-performance as the LSA rules allow, while staying just on the safe side of the "I hope I don't lose it on this landing" feeling faced by someone checking out in a Pitts Special.

Bottom line: Light controls mean that this is not an airplane for every pilot. In our opinion, a pilot who has time in the Grumman American series and knows what rudders are for will check out quickly. A pilot reared in the Piper Cherokee line will take a minimum of five hours to get to an acceptable level of precision, another five to get comfortable and should expect to over-control rather badly on the first flight.

BASICS

As evolved from the homebuilt Arion Lightning EAB, the Lightning LS-1 is a composite, semi-monocoque airframe made primarily of fiberglass, with carbon-fiber reinforcement in the wing-roots. The wing spars are fiberglass-wrapped spruce. The basic airframe is the same as the EAB, which has a gross weight of 1530 pounds and cruises above 140 knots. At the LSA max gross weight of 1320 pounds, the structure has been tested to withstand over 9 G positive, although Arion only claims the LSA requirement of 4.4 G.

The engine is a 120-HP Jabiru 3300 with a TBO of 2000 hours, although the manufacturer calls for a top overhaul at 1000 hours. It is a six-cylinder, horizontally opposed, air-cooled powerplant with an ingenious ignition system. A magnet on the engine flywheel creates an electrical field as it passes the two individual magnetos, which then generates the electrical impulse that fires the spark plugs. The system will not work at all below 300 RPM; thus while it is impossible to hand-prop a Jabiru, it also means that the chances of someone being hurt by a prop as a result of repositioning it by hand and causing the engine to fire are essentially zero.

Otterbach pointed out to us that the Jabiru engine requires a plenum over each bank of cylinders for proper cooling. "In addition, the cooling system requires the correct ratio of air through the cooling intakes on each side of the cowling to the other intakes such as the carburetor and oil cooler. Otherwise, the cooling air flow is not adequate. We've found over the years that the engine will run well over time so long as the installation allowed adequate cooling air where it was needed. We have a Jabiru-powered Kitfox in our hangar that cruises at 75 knots, and the engine cooling is no problem at all."

The 30-gallon—28 usable—fuel system carries the fuel in two fiberglass-wrapped wing tanks aft of and protected by the spar.

CRASHWORTHINESS

We liked what we saw from the crashworthiness standpoint. Fuel storage was well protected, occupants had four-point harnesses and sat semi-reclined and the landing gear was designed to collapse under shear loads to reduce the chance of flipping the airplane in a forced landing. The Plexiglass canopy could be kicked out to allow egress if inverted, the tail and engine will support the airframe inverted, with the occupant's head clear of the ground, and the engine mount and cabin are designed to remain intact as the remainder of the airframe collapses/crushes on impact.

There has been an impact sequence involving the removal of a wing via a telephone pole during a half-wit buzz job, leading to an inverted impact. The pilot survived with minimal injuries.

With a max cruise fuel burn of 5.5 hours and a cruise speed of 120 knots, endurance with full fuel is over five

hours with VFR reserves. That puts still air range, with reserve, at 600 NM, more at reduced power.

The more realistic endurance is with two fast-food-inflated occupants. The Achilles heel of the LSA world is useful load and the structure for a faster airplane, and the Jabiru engine makes this one of the heavier examples. Our demo airplane had virtually every option possible, so useful load was 487 pounds. Figuring a realistic 200 pounds per person, it left 87 pounds for fuel. That's a little over two hours of flight, with reserve.

Preflight of the airplane is conventional, everything is easily observed, leaving one to try to figure out where the drag is in this slippery airframe that allowed keeping the cruise speed down to 120 knots. Primarily it's in the landing gear, the struts are not faired in and the wheel pants are as basic as they get. There is a wing extension outside of the ailerons that moves the flaps up, stall speed down to 44 knots and adds a little parasite drag.

INTERIOR

The forward-hinged canopy has an easy-to-operate latch—if unlatched, the canopy streams open about an inch or so and does not affect handling, however, it cannot be closed in flight. After years of looking at just plain ugly, utilitarian interiors in LSAs, the Lightning is a nice change. It is attractive and welcoming, with materials and coverings more associated with Part 23 airplanes. The non-adjustable seats are set in a comfortable reclining position—think Mooney—with adequate headroom for this reviewer at 6'4". The rudder pedals adjust over a long range.

Starting the Jabiru means pulling on the choke and turning the key while keeping the throttle at dead idle. Once running, the avionics master is turned on and the Grand Rapids Technologies Sport SX EFIS comes to life with the AHRS aligning while the engine begins to warm up and the choke is no longer needed. Once an oil temperature of 90 degrees F is reached, RPM can go above 1200.

Taxiing is similar to other aircraft steered via differential braking. We had no difficulty tracking the centerline in a quartering tailwind. There is no recommended maximum wind for operation of the Lightning, as there is for some LSAs. When asked about maximum wind, Otterbach initially thought we meant the maximum demonstrated crosswind velocity—15 knots—and was surprised at the idea of a maximum recommended wind speed for the airplane.

The panel is dominated by the GRT Sport SX EFIS, top. Baggage area can carry 50 pounds, has reasonable volume, center. In-flight handling is quick, requiring good technique, bottom.

Takeoff is with half flaps. Otterbach suggested being ready for the need for right rudder immediately and to apply back pressure very early, similar to a soft field takeoff. Firm right rudder proved to be necessary in what was a brief event—120 HP on 1320 pounds of airplane makes for smart acceleration—and raising the nose early meant the Lightning rolled briefly on the main gear and smoothly launched, transitioning rapidly to a climb at 70 knots.

There is a distinct pitch change with flap movement, once up, with speed at 85–90 knots the rate of climb steadied at slightly over 1000 FPM with the airplane at gross weight. It was immediately obvious that the controls were lighter than most general aviation airplanes, not as quick as a Pitts Special, but a little more sprightly than the Grumman-American line. We agreed that this would not make a good primary training machine.

CONTACTS

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931-680-1781
www.flylightning.com

At left, the plenum required for cooling has been removed from the right cylinders of the Jabiru engine. To keep the speed down to LSA max, the gear legs are not faired in and the wheel pants are basic, below left.

The rudder is cable-activated, the ailerons and elevator use push rods. We expected an airplane as responsive as the Lightning to not want to stay put for any length of time, however, that proved not to be the case. It was pleasantly stable and rode the increasing turbulence well, with less displacement than other light wing loading airplanes.

The electric trim had a predictable rate and was easy to use during all speed and configuration changes. Maneuvering was, frankly, a lot of fun. Stick forces were light and the controls are well harmonized. Speed and power changes did require more use of the rudder than we'd experienced in most GA airplanes.

RUDDER USE

The immediate comparison that came to mind was the P-51 Mustang, which requires large rudder inputs with speed and power changes—the Lightning was similar on a smaller scale. The rudder forces were far less, but they were necessary to keep the ball centered, which, along with the nimble handing, were something that appealed to the Walter Mitty in us. We haven't thought of the Mustang when flying any other LSA.

Stalls provided no surprises with the power-off, full-flap stall breaking at 43 knots. There was some tendency to roll, easily caught with the rudders, and the airplane was flying again once back pressure was released. The full power stall came at an impressive deck angle and required good rudder coordination to avoid roll off.

In the pattern, the Lightning behaved predictably. Because the airplane is so clean, landings are made with full flaps. Final approach speed is 52 knots and should not be above 60, otherwise the airplane will float. Otterbach explained that extra speed should not be carried on final. There is plenty of energy to flare at 52 knots because of the clean airframe. A go around is not a big deal—applying full power will almost immediately generate a rate of climb well above 500 FPM even with full flaps.

The light controls meant getting used to how little effort was necessary to flare to a nose-high attitude prior to touch down. Our experience was that any extra speed was an invitation to overcontrol when close to the runway.

There was more than enough control authority for the five- to eight-knot crosswind we experienced. Interestingly, slipping the Lightning does not noticeably increase the descent rate or scrub off excess speed—it's too clean.

The POH includes a syllabus for checking out in the Lightning, something we applaud. The $120,00 basic purchase price of the airplane—about $130,000 well equipped—includes a five-hour checkout, which, in our opinion, is probably about right.

The Lightning LS-1 is not as stunningly quick as a Pitts or Extra, but is one of that species that rewards a pilot who has a sure touch, is on her game and desires something that rewards an extra effort to excel.

Noise Suppression: Lone Star Eliminates

Ridding audio system interference is challenging and expensive. Noise filters help, but aren't a cure-all.

by Larry Anglisano

CHECKLIST

- Lone Star has a complete line of filters for targeting different sources of noise.
- Noise filters are inexpensive and easy to install in most aircraft.
- Noise filters won't repair problems in the charging system.

For the owner who's invested thousands of dollars for a high-end audio system upgrade, electromagnetic interference or EMI, is a frustrating and common problem.

While it's natural to point the finger at the shop who just performed an otherwise high-quality avionics installation, there's a good chance the source of the noise has been there all along—and now amplified by the clarity of a new audio system and ANR headsets. Unfortunately, this could mean extra repairs that weren't budgeted for.

In this article, we'll look at the common sources of electromagnetic interference and popular noise suppression products that could eliminate most of it.

CHARGING SYSTEM WOES

It's easy to blame the aircraft alternator for audio noise. In older aircraft, charging systems are expected to support more avionics equipment than initially intended. An aircraft that has a stock, 60-amp alternator, for example, might not be up to the challenge of efficiently supporting the current draw of new avionics.

While it's a good idea to consider an alternator upgrade, STC eligibility often limits this option. In alternate, it's imperative to keep the system healthy, while respecting the current draw of proposed avionics, particularly for lesser electrical systems.

Alternator noise is commonly recognized as a high-pitched whine in the headphone audio. It almost always changes in pitch with change in power settings or RPM. The whine may get worse or might only be present when transmitting on the comm radios. When the alternator and its internal diodes is the culprit, the whine usually gets worse under the heavy electrical load of exterior lighting, blower motors, pitot heat and radio transmitters.

Alternator whine is also caused by poor electrical connections at the aircraft battery. Speaking of the battery, corroded terminals and cables, and even a faulty cell, can be a source of noise.

DC power line filters can put the finishing touches on a new avionics installation but they won't fix problems in the charging system.

In some cases, alternator noise can be easy for pilots to troubleshoot, especially in aircraft with split alternator and master switches or a pullable alternator circuit breaker. Take the alternator off line, and the noise should go away. But for shop-level troubleshooting, you'll need a shop that has the ability to troubleshoot down to the component level, including the ability to analyze the alternator output.

The first thing a shop might do if they suspect alternator noise is inspect the alternator noise filter. This is a capacitor that's connected on the alternator power output. These capacitors suppress RF noise and the harmonics which comes from the diodes inside the alternator. The health of this filter should be checked during annual inspection, but it's often overlooked.

It's important to note that swapping an alternator with a remanufactured unit might not solve noise issues. The diodes in the replacement unit may be noisier than the old one it replaces.

One step in troubleshooting an alternator is connecting an oscilloscope on the output line and measuring how much AC, known as ripple noise, is present on the line. Unfortunately, not all shops are equipped with oscilloscopes and other charging system diagnostic equipment.

Problems downline of the alternator might present symptoms which are far more difficult to pinpoint, perhaps sending technicians in the wrong troubleshooting direction. We know of a Cessna 150 that developed what the pilot referred to as loud static in the headphone and cabin

Lone Star Aviation makes a complete line of specialty noise filters. The $59.95 alternator filter, upper left, has double the capacitance of most OEM alternator filters. The $69.95 magneto filter, middle, works at killing ignition noise. It attaches to the P lead and grounds at the magneto body. High frequency filter, lower left, filters noise generated by Piper blowers and fuel pumps. The Eliminator, upper right, is an effective power line conditioner and noise suppressor. It can silence annoying alternator whine, strobe popping and rotating beacon noise. It's priced at $150. Installation of any of these filters might be accomplished in under an hour.

speaker circuits. After multiple test flights, it was determined that the loud static was actually the comm radio opening squelch, even though the squelch was adjusted to the proper sensitivity threshold.

In the process of turning systems on and off in flight, the tech found that while the electrical system was under the heavy load of landing light, pitot heat and other sources of electrical draw, the squelch would remain closed. In the end, it was an overvoltage condition that induced so much noise into the comm radio receiver that it opened the squelch—mistaking interference for receiver signal. To make matters worse, the pilot failed to recognize the overvoltage lamp illuminating on the other side of the panel because it was too dim. After days of troubleshooting radios and audio system components, the aircraft ultimately needed a trip to a maintenance shop—not an avionics shop. Be sure to do as much in-flight troubleshooting as you can before handing the aircraft to a shop. It could save you money.

WIRING MATTERS

Aircraft audio wiring is highly susceptible to numerous sources of EMI and RMI interference. This includes lighting systems, blower motors, flap and landing gear motors, autopilot servos and comm radio transmitters, to name a few.

Poorly maintained and non-shielded wiring is especially susceptible to interference and nuisance noise. Avionics upgrades should be the time to address poor ground connections, wire splices, frayed shielding, corroded connectors and improperly routed wiring bundles.

Unfortunately, competitive bidding on the shop level isn't always good for the customer. Be mindful of projects that may be low-balled, as they might not include a complete rewire job. While it can be completely acceptable to utilize existing wiring with newly installed equipped, it's not acceptable to splice into substandard audio wiring just to save time and labor dollars. Ask the shop how much of the new wiring will be utilized and what, if any, options exist for replacing existing wiring.

The same can be said for antennas and coaxial cabling—another source of audio noise. Most new fiberglass antennas are treated with an anti-static coating. This invisible top coat helps prevent static buildup, but as the antenna ages, the coating breaks down and you might notice annoying static in the comm radio reception when you fly in static-inducing weather conditions.

In many cases, the signal cabling

SOURCING AUDIO NOISE

- **Alternator:** Whine, varying in pitch with RPM change
- **Strobe lights:** Popping, in unison with strobe firing
- **Ignition:** Static, crackling, pop, may vary with either mag
- **Faulty ground:** Constant background whine, static
- **Ground loop:** Whine, static in intercom/aux input circuit

connecting the antenna to the radio could be as old as the aircraft and subject to deterioration and wear from years of rattling around. Consider, too, that old coaxial cable is likely non-shielded RG58 or older and could be the source of interference that's worked into the radios and audio system. The standard practice these days is to install twin-shielded, low-loss cabling—an effective way of eliminating RF interference.

IGNITION NOISE

Interference from ignition components—including arcing magnetos and ignition lead noise, might present itself as pops in the headphones. This might be a symptom worth watching closely.

Consider a Piper Arrow with an otherwise noise-free audio system, including new avionics wiring and a PS Engineering audio panel. At certain power settings, there was a noticeable crackle and pop in the headphone audio. During engine run-up, the popping would go away when switching magnetos. The engine ran fine until a half hour into flight, and then it ran rough. Ultimately, the problem was a faulty magneto coil. When magneto coils fail, they often break down when they're hot, which was the case of this failing magneto which, other than noise, exhibited no symptoms during a mag check.

Lone Star offers a feed-through design magneto filter, which is FAA and PMA approved, and attenuates the low—and high frequencies noise of Bendix ignition systems.

From our experience, it's often unnecessary to install magneto filters as long as shielded leads are used and the shielding is properly grounded at both the magneto and the ignition switch.

BRINGING IT IN

When tackling noise problems, it's not uncommon for owners to bounce from maintenance shop to avionics shop or vice versa. Some avionics shops simply don't want to deal with noise issues because they know the problem isn't related to avionics. On the other hand, some maintenance shops just aren't comfortable dealing with avionics problems. This game of service ping pong is frustrating for the owner who just wants to have the problem solved.

Some avionics shops have experienced airframe and powerplant technicians on staff who might be versed in charging system problems and their effect on avionics performance. Lone Star offers a noise evaluation kit, which contains a variety of noise suppressors. When equipped with this kit, shops can qualify the proper noise filter for a particular problem.

Speaking of solving problems, while there are excellent noise filtering products that can make good audio sound even better, you're setting yourself up for disappointment and more frustration by expecting a filter to correct problems related to old wiring and failing electrical components. Our advice is to solve the problem first and then add filters to get rid of minor audio imperfections.

STIFLING GROUND LOOP NOISE

One of the sweet benefits of installing a new audio system is the ability to plug in a cabin entertainment source into the intercom headphone circuit. Unfortunately, entertainment input circuits create vulnerable sneak paths for unwanted noise—including the signature interference of audio ground loop noise.

Audio ground looping is a condition where an unintended connection to ground is made through an interfering electrical conductor. In aircraft audio entertainment input applications, the resulting 60 Hz hum, hiss and popping noise occurs when current flows through the audio cable shield connections, usually between the portable source device and the audio system entertainment input jack. Improperly grounded satellite receivers, like Garmin's GDL69A, can be a source of ground loop noise. That's because, like portable units, the system is wired through the intercom entertainment input circuit.

Worth mentioning is an available field mod for Garmin's GMA340 audio panel, which increases the gain of the entertainment input source. Garmin warns that while the resistor change will increase the input gain, it can also increase the presence of unwanted noise. From our experience, noise filters can help.

The Lone Star Ground Loop Filter was designed with low-frequency isolation audio transformers, which isolate normal audio from unbalanced AC noise interference. The plug and play filter incorporates RCA, 2.5 mm and 3.5 mm connectors for compatibility with a variety of portable devices, including iPod, MP3 players plus portable GPS units, which have stereo line output for satellite entertainment.

We tried the Lone Star ground loop filter—a portable unit housed in a 1.15 x 1.50 x 3-inch case, connected to our Sony MP3 player and noted improved entertainment input performance, eliminating ground loop whine in a Garmin audio panel. The only hassle we encountered was having to deal with yet another portable device and patch cable, although the filter assembly can be mounted to the surface of the instrument panel or perhaps in a glove box.

If noise-free and portable cabin entertainment is your plan, we think a portable ground loop isolator is worth the hassle and the $89.95 investment.

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iPad Ground School: Plenty of Options

Gleim and King Schools have good online courses accessible via iPad. ASA's Prepware is a good value and e-Books are another option.

by Rick Durden

With new iPad apps appearing every day, it was inevitable that ground school, written prep and aviation reference materials would hit the tablet market. And sure enough, there's plenty out there for someone looking to add a new rating or to just have a convenient reference library.

We limited our app search to the instrument rating because it's a popular and useful rating. We looked at the one app that's available, Sporty's, two online instrument written courses, ASA's Prepware app and two e-Books.

Overall, Gleim and King Schools got good marks for their online courses, and while we felt Sporty's app was good, it needs improvement. We liked ASA's inexpensive Prepware for final brushup for the written and the two e-Books we reviewed.

ASA

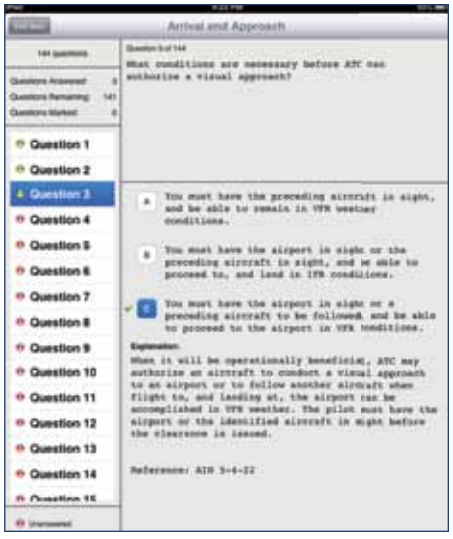
ASA offers what it calls Prepware apps for the iPad, iPhone and iPod Touch. For the instrument rating, ASA has taken its long-time Test Prep Book ($24.95) and turned it into a $9.99 app. We found the Prepware to be intuitive to use. Simply tell it whether you want to do study questions—in which you get feedback and explanation as soon as you touch your answer to the question—or test questions. It then simulates the FAA knowledge test by giving you no feedback until you finish the test and push the button to grade it.

There are eight general areas of test questions, each averaging just over 100 questions. Once you select an area, the questions pop up in clear, easy-to-read screens. For $9.99, we think this is a great way to review and prepare for the FAA knowledge test. There is a $49.94 version for a computer that has more features and allows you to obtain the hard copy endorsement that you need to take the FAA knowledge test.

ASA offers, as an e-Book, one of the better textbooks ever written, the late William Kershner's *The Instrument Flight Manual*, seventh edition, which is the most current update, edited by the original author's son.

ASA also offers an instrument oral exam guide in e-Book format for $9.95 and hard copy for $12.95.

We liked that ASA's website included a section on how to read e-Books on computers and mobile devices, however, we did find the site itself a bit clunky when trying to navigate to find e-Books and apps.



ASA Prepware app for the instrument rating covers several versions of the rating, far left. In study question mode, it gives explanations for both correct, left, and incorrect, answers.

CHECKLIST

- There are good online courses accessible via iPad.
- ASA Prepware is well done and a good value; e-Book textbooks are excellent.
- Sporty's instrument ground school app good, but needs improvement.

GLEIM

Gleim has long been the no-frills, least expensive, we'll-give-you-what-you-need-to-know-to-pass-the-test training organization. It has not put together any apps for ground school training, but has an online ground school series. In reviewing the $99.95 online instrument ground school, we found it to be in keeping with the company's philosophy of efficiency with no extraneous material. The course can be viewed on the iPad, although you must install a browser that allows use of Adobe Flash to watch the video segments, which are a necessary element.

The course is organized into three stages that contain three or four study units. Each study unit contains a detailed outline, not a textbook, of the areas covered in the study unit. It's

recommended, and we agree, that the outline be printed out. You view the video for the study unit, and probably mark up the hard copy of the outline, as there's substantial information not included in the outline. You then go into the study session, which consists of a series of questions that must be answered with a score of at least 70 percent. Immediate feedback is given upon selecting the answer to a quiz question, and the system requires that the student correct any wrong answers before advancing to the next question. As you finish, you're required to review the questions not answered correctly the first try.

At the end of each study unit, there's a test quiz in which feedback is given at the end of the quiz. Once passed, the study unit is complete. The Study Unit Selection page clearly shows the student what has been completed and what remains to be done.

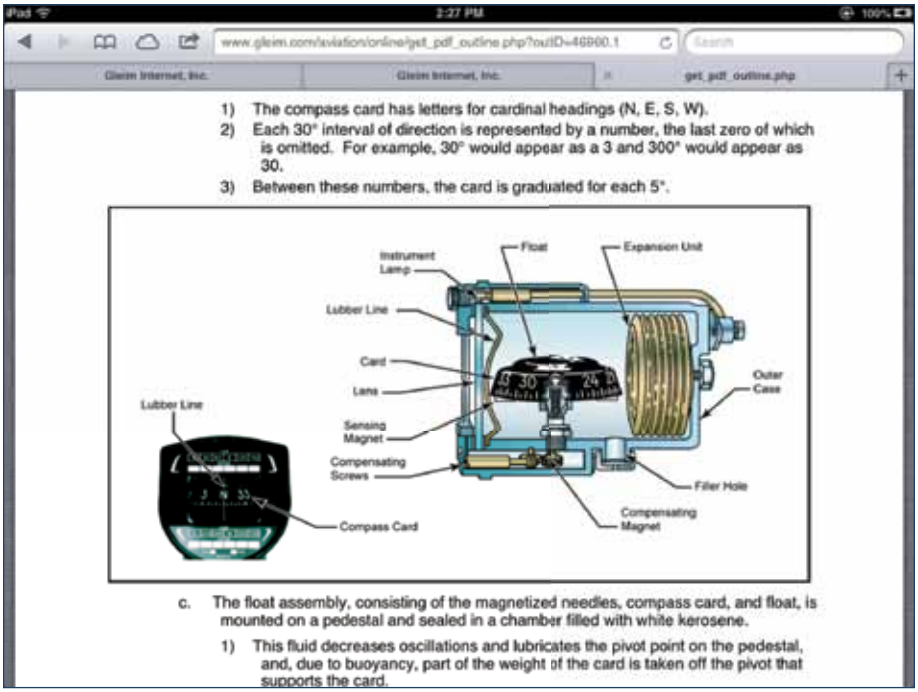
There's a stage test at the end of each stage, or group of study units and an end-of-course test that allows the student with a passing score to receive and print out the required endorsement for the FAA knowledge test. We liked the fact that there were also five practice tests available for further test prep.

This is truly a product stripped to the essentials—the video is essentially two-color PowerPoint screens with narration—no on-camera humans appear.

JEPPESEN

Chartmaker Jeppesen acquired leading aviation ground training company Sanderson Films in the last century. As such, we expected to see Jeppesen among the leaders in the instrument training world, with an online course and perhaps an app. We found that Jepp has no training apps and its online offerings were limited to the private pilot rating.

For the instrument rating, Jeppesen offers an e-Book format of its *Guided Flight Discovery Instrument Commercial Textbook* for $79.99; the hard copy is $86.95. While it covers more than the instrument rating, it is, in our opinion, one of the best textbooks in the industry. It goes well beyond the minimum required by the FARs for aeronautical knowledge for the written exam. In our view, it's an outstanding textbook and a long-term reference that should be in a pilot's library.



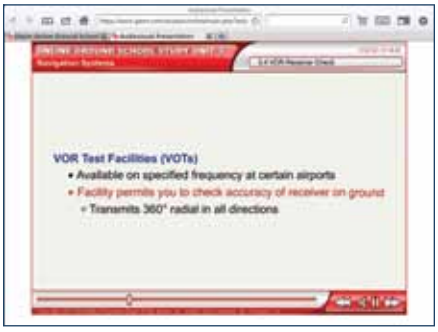
Strangely, 10 minutes of hunting around the Jeppesen website did not disclose the existence of the e-Book. We could only find it on iTunes.

KING SCHOOLS

King actively advertises its courses for the iPad. It has a number of apps for $29 on various subjects, although none that were specifically applicable to the instrument rating. The $279 instrument rating knowledge test course is an online course and requires adding a browser to the iPad to accommodate Adobe Flash. It recommends storing or printing the PDF of the course notes and figures used in the various quizzes and tests.

The course itself is set up as a flow through 11 sections. Each section is broken into various subsections that consist of a full color, video presentation of either John or Martha King showing graphic depictions of the subject, such as an enroute chart. After the video you take a quiz, which gives immediate feedback on each question. Once you have given the correct answer to each question on the quiz, you have successfully completed the subsection.

The introductory graphic shows what you have completed and what is yet to come. However, it's limited to the sections you have completed, not the subsections within, something we would like to see. We found it difficult to move among the subsections



Gleim outline is clearly presented, top. Video is a "just the facts" presentation, above.

within a section, even after watching the explanatory video twice. It wasn't intuitive. The videos themselves were good, but the slider used to scrub forward or back within a video is tricky to move on an iPad.

Once through the course, there are practice questions to review as well as practice tests that simulate the FAA knowledge test. You must take three practice tests and receive a score of at least 70 percent on each to receive and print out an endorsement for the FAA knowledge test.

SPORTY'S PILOT SHOP

Sporty's $199.99 universal iPad and iPhone instrument rating—not just the written—app is the only way we found to do instrument rating ground school without access to high-speed broadband. While it does require that

Sporty's videos are the best we saw, top. King Schools uses a flow chart to track progress toward the written exam, above.

you download the individual video segments before watching them, a little planning ahead means you can watch this course anywhere, any time.

Sporty's has put out a lot of good aviation apps, but we think that maybe they hurried this one. We like the convenience of the course, but had trouble figuring out its organization. There are over 12 hours of top-notch videos—the best of the courses we reviewed. They are not limited to just the material on the FAA exam. However, they are not connected to practice questions, as with the other courses.

The written test prep section is the $14.99 Sporty's Study Buddy app incorporated into the course. The Study Buddy is set up to either present sample written test questions with immediate feedback and explanations after each, as flash cards, or a test mode that simulates the FAA knowledge test with time limits and grading the answers at the end of the test.

The Study Buddy topic arrangement is not tied into the topics covered in the videos, so immediate review after a video is not user-friendly.

There is a full, 72-page training course outline designed for the flight portion of the instrument rating. We did not see any reference to the videos or Study Buddy segments of this app, although it did reference FAA documents to review prior to a flight lesson. It appeared to be a standalone instrument rating syllabus added to, rather than integrated with, the app.

There's a video maneuvers guide that is well done, as is the interactive Practical Test Standards study guide that ties into videos.

Once all of the videos have been viewed and you pass two practice tests with a score of 80 percent or better, you can receive an endorsement to take the FAA knowledge test.

The Sporty's app came across to us as too much self-guided learning, particularly when it comes to having an instrument student sort out which practice questions should be reviewed after a video lesson segment. We would like to see the app organized a little better so that a student can easily access pertinent review questions for each training segment and track progress in mastering each segment, as is done in the Gleim and King online courses.

CONCLUSION

The good news is that there are credible instrument written online courses that can be viewed on the iPad, even though some part of each will need to be accomplished on a computer. The bad news is that there's only one instrument course app, and we don't think it's quite ready for prime time. If money is the driver, the Gleim online course is a good value. While it's bare bones, it doesn't omit anything. For a higher-quality course that includes more than just the legal minimums, we think the King course is worth it. ASA's $9.99 Prepware app is definitely worth the money for test question review at any time you're carrying your iPad. For truly rounding out training and to have in an aviation reference library, we recommend Jeppesen's Instrument Commercial Textbook, either in e-Book or hard copy form, even though it's pricey.

CONTACTS

ASA
800-272-2359
www.asa2fly.com

Gleim
800-874-5346
www.gleim.com

Jeppesen
800-799-9090
www.jeppesen.com

King Schools
800-854-1001
www.kingschools.com

Sporty's Pilot Shop
800-776-7897
www.sportys.com/PilotShop

FIELD REPORT

GTN Owner Survey: High Satisfaction

Owners are mostly pleased with Garmin's GTN700/600-series navigators. Nits include high price and touchscreen issues in turbulence.

by Larry Anglisano

When Garmin introduced the GTN700 and 600-series navigators nearly two years ago, buyers hoped for substantial improvements over the dominant but aging GNS530 and 430. The wish-list for the second-generation, all-in-one navigators included a more modern display and integrated charting—including airways. Skeptically, the market expected a touchscreen feature set. Garmin delivered all of the above, of course.

But are the improvements enough to satisfy the demands of buyers ready to put their 15-grand-plus on the shop counter for a single-box upgrade? Does the touchscreen create havoc in turbulence as many feared?

To find out, we recently conducted an in-depth GTN owner survey on our sister site, avweb.com, where we heard from 256 owners. The survey revealed a healthy level of owner satisfaction and perceived product value, although we heard a smattering of complaints.

TOUCHSCREEN

Despite the personal touchscreen standard, not all pilots endorsed touch operation on the new GTN navigators, given the potential for issues in turbulence. For some in our survey, these concerns were valid. For others, it's a non-issue.

"Turbulence can cause mistaken selections, but it is only an occasional nuisance that is more than offset by the GTNs ease of use, its functionality, and its clear and intuitive displays," said GTN750/650 owner Dan Owen.

"In turbulence is the only time I would say the touchscreen is a little cumbersome. Other than that, I love it," commented another owner.

The $16,900 GTN750 and $11,400 GTN650 represent the latest and greatest integrated navigators, suitable for a wide variety of applications. Owners have few gripes when it comes to reliability but some bark at their high cost.

"The touchscreen interface requires more finger-touching to accomplish a given task than I was expecting," said Bob Brown of his GTN750.

When it comes to the perceived added utility of the touchscreen, some owners still aren't sold.

"I'm not sure the touchscreen adds all that much compared to knobs and buttons," commented GTN650 owner Tom Werner.

"I don't like having the entire display obscured each time I have to enter data. The entire screen becoming obscured with the virtual number pad for frequency entry is, in my mind, a poorly designed architecture," griped GTN650 owner Richard Ossoff.

In Garmin's defense, the units have dedicated knobs for tuning the radios, so using touch for this task is optional. Garmin designed the bezel on the GTN with finger rails, to assist in keeping a steady hand in turbulence, but many users, like Cessna 421 pilot Morgan Gay, develop their own process.

"I find that I don't use the hand holds on the sides of the unit. Instead, I usually place my index and middle finger on the upper rim of the audio panel, which is mounted above the GTN, and touch the screen on the GTN with my thumb," said Gay.

"It works very well for me and turbulence is no problem. Being able to manage multiple items on the screen reduces workload and it's easy to access information. I am surprised that the screen does not need as much cleaning as I anticipated. I don't worry about it needing to be cleaned of fingerprints," said GTN750 owner John Marcinkevich.

A couple of respondents operate the GTN units wearing Nomex flying gloves, with good results.

MISSION CAPABILITY

Some of the success of Garmin's earlier GNS-series navigators was the system's ability to serve a broad mission profile, including a mix of VFR and IFR flying. Based on our survey, the same can be said for the new GTN. For example, 45 percent of the respondents fly a combination of VFR and IFR, 39 percent fly mostly IFR and 16 percent always fly VFR. Some GTN owners we spoke

with said their units are far more advanced than their current flying mission, but they acknowledge that the units offer large amounts of growth potential, particularly when it comes to achieving an instrument rating. "The primary reason I bought a GTN650 was to hopefully make my instrument training easier. In that sense, so far it's earning its keep," said the owner of a Cessna Skylane.

LEARNING CURVE

As expected, some users struggle with a steep learning curve and can't find quality instruction. We heard comments like: "Finding instructors who know the GTN system better than me is very difficult. The familiar operating logic of the GNS430 doesn't transfer well to the GTN."

Speaking of training, 45 percent in our survey are self-taught and some had a few complaints with Garmin's training materials. "The CD that I got with the unit to learn with did not work. Plus, the pilot guides leave a lot to be desired. I had better success with an iPad training app," said Tom Srachta.

But there was praise for the GTN simplicity, even without a manual. "As a low-time pilot, I found the unit incredibly easy to learn and understand," said one GTN750/650 owner.

According to Paul Bannister, "Taking the Garmin class in Olathe was a necessity, but it would have been beneficial for the class to have a second day, to help master some of the subtleties."

CONCLUSION

Based on our survey, Garmin's GTN units earn a 72 percent satisfaction rate—favorable, in our view. Better yet, and in Garmin tradition, is the reported high level of unit reliability. We expected higher scores for product support, although it's acceptable.

Despite the touchscreen getting some dings for performance—particularly when operating it in turbulence, 73 percent are still satisfied with its overall performance. But based on some of the written comments, we still think a total touchscreen interface isn't for all pilots.

For those who struggle with it, Avidyne's IFD-series hybrid navigators, which are being designed with a combination of touch and traditional keys, could be a solution.

GTN INSTALLATIONS: COSTS ALL OVER THE BOARD

Unless it's a basic installation—if there is a such a thing these days, it's almost impossible to nail an across-the-board cost for installing a GTN navigator. This came through loud and clear in our survey, since there are numerous configurations in which a GTN can be installed.

Owners reported project costs well south of $10,000 and a couple days installation down time—after trade of an older GNS navigator, to well north of $200,000 and six months on the install floor. That pricey project was in a turboprop that included other work.

"My GTN750/650 installation took about a week and cost roughly $15,000 with the trade in of my two-year-old 530W/430W combination," said Eric Lipper. Installations like his might be the easiest. That's because the interface wiring is already in place, although the GTN units are wired differently than the vintage GNS models they replace. Shops can utilize this wiring but have to re-pin the GTN connectors. In many installations, the existing WAAS GPS antenna and cabling can be utilized, saving the hassle of removing interior components to route new cables and drilling new holes in the airframe to accommodate a different antenna.

According to Cliff Gerber, his GNS430W to GTN650 upgrade took one week to install and cost $5985 after trade-in. The large GTN750 is more of challenge. It sits taller in the radio stack—often requiring stack reconfiguration, radio relocation and in some cases, the installation of Garmin's GMA35 remote audio panel and or GTX remote transponders.

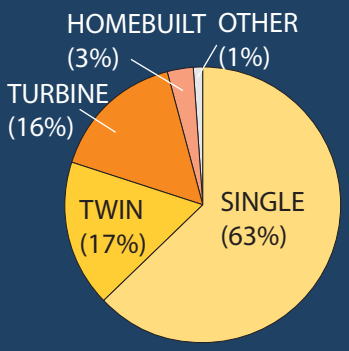
Not every installation is created equal. For this reason, you'll need to choose a shop that has experience interfacing with a wide variety of non-Garmin systems, including Aspen's PFD, Avidyne's traffic system and Bendix/King autopilot systems, to name a few.

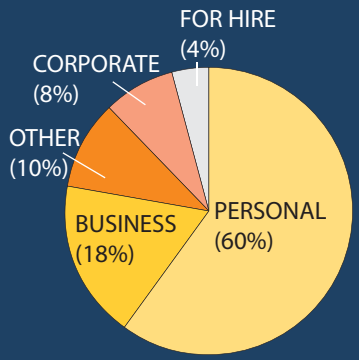
But even the best shop might not be able to interface the system exactly to your liking, since the interface potential is governed by software compatibility.

"I'd like to integrate the GTN650 with a third-party ADS-B unit, but the GTN output protocol is proprietary. Had I known this, I would probably have not purchased the GTN," said an owner of a GTN650 which is installed in his homebuilt.

Last, owners reiterate that the cost of GTN ownership doesn't end at the avionics shop. As GTN750 owner Denny Breslin notes, "The databases you need to subscribe to are expensive and never-ending. Bundle pricing helps, but if you want IFR charts—which I don't due to cost, the price skyrockets just for database currency."

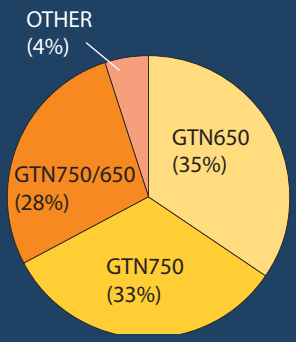
AIRCRAFT AND FLYING MISSION



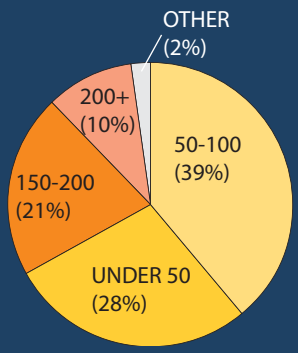


PRODUCT, USAGE AND REPAIRS

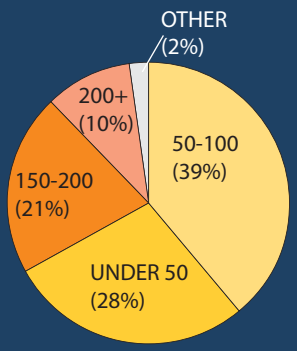
What type of GTN navigator do you own?



About how many hours have you flown the GTN?

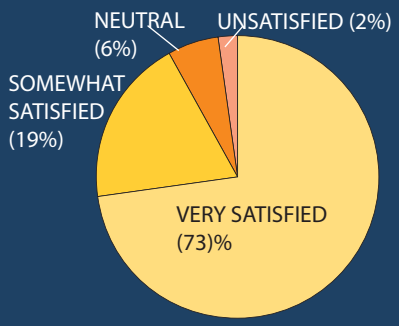


How many repairs have you had on the system?



EASE OF USE AND TRAINING

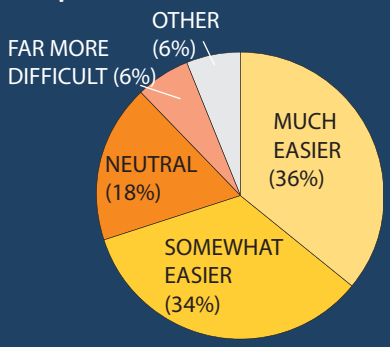
How would you describe your level of satisfaction with the touchscreen?



How did you learn to operate your GTN?

INITIAL TRAINING	
I TAUGHT MYSELF	38%
GARMIN MULTIMEDIA	39%
OTHER	12%
AVIONICS SHOP	7%
CFI TRAINED	4%

If you have experience with previous avionics products, how does the GTN compare in ease of use?



SUPPORT AND PERFORMANCE

Overall, how would you rate Garmin's support of your GTN?

PRODUCT SUPPORT	
VERY GOOD	43%
SATISFACTORY	26%
NEUTRAL/NOT SURE	25%
NOT VERY GOOD	5%
POOR	1%

How satisfied are you with the overall performance of the GTN?

OVERALL SATISFACTION	
VERY SATISFIED	72%
SOMEWHAT SATISFIED	14%
NEUTRAL	4%
SOMEWHAT UNSATISFIED	3%
VERY UNSATISFIED	1%
OTHER	6%

How likely would you be to buy another GTN?

WOULD YOU BUY IT AGAIN?	
VERY LIKELY	68%
SOMEWHAT LIKELY	19%
SOMEWHAT UNLIKELY	2%
VERY UNLIKELY	4%
NOT SURE	2%
OTHER	5%

TELL THE ENGINEERS

What suggestions would you make to the Garmin GTN engineering team?

I would like to see an on/off or power switch. There is no way to turn the unit off without pulling the circuit breakers. In a professional grade cockpit, there needs to be a way to recycle or power off the individual unit. Avionics bus power off is unacceptable, since that would also shut down EFIS components.
— Jonathan Hollada

The GTN takes more button pushes to achieve what the older GNS530 can do in less. The team should work towards reducing rather than increasing work load.
—Doug Stewart

Although I'm happy with the functions of the box, and how easy the system is to work with, I am most unhappy that Garmin does not play well with others and in particular, its desire to not share code with other companies. I have dual Aspen screens in the airplane and would love to move to the Aspen Connected Panel, the wireless gateway interface for iPad connection.
— Bruce Kaufman

GTN devices are nice products, but they are simply too expensive for mere mortals to afford. The cheapest of them is 1/3 the cost of the entire airplane. This is quite ridiculous.
—Joe Intagliata

Why not take the plug and play approach, like Avidyne's IFD series?
—Peter Halbauer

Oxyfly: Good Concept, Poor Execution

Having an oxygen concentrator on board means not having to mess with refills. Unfortunately, Oxyfly has, in our opinion, serious construction shortcomings.

by Rick Durden

An oxygen concentrator is a way to have a supply of oxygen without having to deal with bottles or worry about whether they can be filled. We definitely like the concept, especially as we've "been there, done that" when it comes to getting an oxygen fill.

Durr Technik developed Oxyfly and Oxyfly Light, two oxygen concentrators that will provide oxygen for up to six people at altitudes up to 18,000 feet. The units automatically compensate for altitude. They are designed to be portable, rather than installed equipment—although the Oxyfly weighs 55 pounds and the Oxyfly Light weighs 48.5 pounds—so they do not have to comply with FARs or equipment guidelines, just like your portable GPS.

For our evaluation of the unit, we worked with two experienced A & P maintenance technicians, Terry Shafer, head of the shop at Vector Air on the Erie, Colorado Airport, and Michael Maya Charles.

While we have our disagreements with FARs, we, and the mechanics we consulted, are of the opinion that something to be wired into an airplane's electrical system draws as much as 25 amps, has a compressor that heats up to 250 degrees F and has to deal with the turbulence and vibration of flight, should use aircraft-quality components and assembly techniques.

After a ground demonstration of the Oxyfly Light and a visual inspection by the mechanics, the mechanics advised us that aviation-quality components and assembly techniques were not used in the construction of the unit. Because of that, we were unwilling to put it into an airplane.

Messrs. Shafer and Maya Charles directed us to the FAA's Advisory Circular AC43.13-1B, *Acceptable Methods, Techniques, and Practices—Aircraft Inspection and Repair*, and suggested that if Durr Technik followed those guidelines, the Oxyfly could be turned into a safe, practical and valuable device.

Below left, the unit is 19 x 9 x 17 inches. Wire and oxygen line routing and chafing concerns, below right.

THE UNIT

We were impressed that Durr Technik was able to create an oxygen concentrator this small and light. It's able to supply six people—if using Oxymizer-style oxygen-conserving cannula—four if using ordinary cannula. It's about the same size and only marginally heavier than the home units that supply one person.

The Oxyfly provides oxygen by compressing ambient air and using a mechanical/chemical process that removes the nitrogen. We don't know the effects of dumping nitrogen into cabin air—we have seen nothing that indicates it is a problem.

The resultant oxygen goes through three filters and a radiator to get rid of the heat of compression, returning it to about room temperature.

We were advised by representative Gabriel Tordai that no regulator is needed, simply a splitter that directs the oxygen from the outflow port to individual cannula. The output is 90-95 percent pure oxygen.

One of the benefits of the oxygen

CHECKLIST

- Concentrator provides an unlimited supply of oxygen.
- Oxyfly can supply six but draws 25 amps as an uncertified, portable unit.
- Construction flaws make the unit one we can't recommend.

CONTACTS

Durr Technik
516-214-5659
www.oxyfly.com

concentrator is that it's plug and play—there is no need to periodically inspect bottles. So long as the aircraft electrical system is working, oxygen is available. The unit has a TBO of 4000 hours.

As we learn more about the insidious effects of hypoxia, we like the fact that there is no need to delay going on oxygen for fear of running out.

Prices are steep, the Oxyfly is $13,900; the Light version is $13,500.

SHORTCOMINGS

Section 6 of FAA Advisory Circular AC43.13-1B, *Aircraft Electrical Wire Selection* begins with the sentence: "Aircraft service imposes severe environmental condition (sic) on electrical wire." A compact oxygen generator with a heat source that can generate 250 degrees F, living in the vibration and turbulence world of aircraft and drawing up to 25 amps should, in the opinion of the two A & Ps we consulted, use aircraft quality wiring. They reported that their visual examination of the Oxyfly Light showed that not only was aircraft wiring not used, the wires were poorly bundled and subject to chafing against other wires, stainless steel braided cable, components within the unit and the steel case.

Their conclusions were that wire routing and protection was poor. Connectors appeared to be not aviation grade. The oxygen line rubbed against a braided cable. The fan for the oxygen cooling radiator appeared to be for a computer. Having had an avionics cooling fan fill a cockpit with smoke, we feel that fans should never be considered insignificant pieces of equipment.

The hot side of the air compressor was recessed about an inch from the case. There was nothing to keep something loose in the aircraft from coming into contact with it. The compressor was shock mounted, however, the mounting was so soft that the compressor moved around enough that it could impact the casing and radiator in moderate turbulence.

The steel case had sharp edges and no means of easily securing the unit.

In our view, given the shortcomings, we're not comfortable with either flying with or recommending the Oxyfly until the shortcomings are rectified.

PRODUCT REVIEW

Pulse Oximeters: Inexpensive Safety

Pulse oximeters offer protection against hypoxia at a range of prices. The 9590 Onyx Vantage is best, but even the $32 Contec is acceptable.

by Rick Durden

Ever since the price of personal pulse oximeters dropped out of the stratosphere, we've owned one because it is a fast and easy way check to see if we are at risk of doing something foolish because the lungs aren't delivering enough oxygen to the brain. Now that the selection of pulse oximeters is confusingly large, with prices from about $25 to over $200, we decided to examine a cross section.

We found that the lowest priced units worked pretty well, the others under $100 weren't necessarily much better, and the most expensive was worth the money if you are going to be using it frequently, want a warranty and may subject it to a rough environment.

HOW THEY WORK

A pulse oximeter shines light through the blood vessels of a fingertip and uses the color of the red blood cells to determine the percentage of blood oxygen saturation. For a "normal" person, the percentage, at sea level, is usually between 95 and 100. Without supplemental oxygen, the range drops steadily with altitude. For example, it is usually 70-75 percent at 20,000 feet.

WHY BOTHER?

We learned in pilot school that a shortage of oxygen to the brain, hypoxia, causes progressively worse cognitive impairment while simultaneously convincing the brain owner that all is wonderful. FAR 91.211 gives the rules for supplemental oxygen use, however, it came into being before the advent of pulse oximetry and the recognition that one size doesn't fit all when it comes to protection against hypoxia. We interviewed four physicians and found that none of them felt the FARs were adequate to protect a pilot against the dangers of hypoxia.

A pilot can legally climb to 13,000 feet and fly there for 30 minutes without supplemental oxygen, although his or her blood oxygen saturation at that altitude will be between 83 and 88 percent.

Dr. Bruce Chien of Peoria, Illinois, pointed out that most hospitals will not accept an "informed consent" from a patient that has a saturation below 90 percent—sobering thought.

Dr. Brent Blue of Aeromedix has published guidelines that recommend use of supplemental oxygen to avoid

Checking blood oxygen saturation in flight with a pulse oximeter is painless.

From left, the Contec CMS50D, Contec CMS50DL, the Fingertip Pulse Oximeter, 9590 Onyx Vantage and Oxi-Plus Pro.

physical and cognitive impairment when a person's blood oxygen saturation percentage drops 10 percentage points below what it is at the person's home altitude. He also recommends that a person is less likely to suffer less fatigue if supplemental oxygen is started when the percentage is five points below what it is at home.

In our opinion, the use of Dr. Blue's guidelines, more conservative than the FARs, will allow the pulse oximeter-using pilot to make an informed decision as to safe altitudes to fly if supplemental oxygen is not available and when to start using it when it is.

WHAT'S OUT THERE?

We went through some aviation supply catalogues and arranged to evaluate three pulse oximeters targeted at pilots. We also ordered one from Amazon, as it was the cheapest we could find and threw in one that we had had been using for two years.

We based our evaluation on speed of startup, ease of reading the screen, accuracy, durability and warranty. It turned out that startup speed was a dead heat; all of the units required six to seven seconds.

Only one unit, the 9590 Onyx Vantage, was a "medical unit," meeting accuracy and durability requirements for use in hospitals—and requiring a prescription to buy, which the seller will arrange as part of the purchase price. We used it as our control when checking the units on volunteers on a flight, with supplemental oxygen, to 17,500 feet. All units were within two percentage points of the Onyx at all altitudes.

For $24.95 plus shipping, we received a Contec CMS50DL from Amazon. The display on the Chinese-built unit was adequate, but hard to read in direct sunlight and with only one orientation, finger pointed at the person reading it. It has no warranty.

We have owned and used a Contec CMS50D for two years, and found it offered for sale on the Internet recently for $32.00 plus shipping. We like the display, as simply pushing the power button changes its orientation and size to the user's preference. On one test at 17,500 feet, it took some time to get a reading on one of our subjects. We were advised that this is not unusual for persons with poor circulation. It was the only unit that displayed any reluctance to give a reading and then only once. It comes with no warranty. We have dropped the unit a few times and it has survived thus far.

Sporty's offers the Oxi-Plus Pro, a U.S.-made unit for $49.95, recently marked down from $99.95. The adjustable brightness display is easy to read, even in direct sunlight. The orientation is rotated 90 degrees each time the power switch is pressed after initial start up. The unit comes with a soft carrying case, a nice to have but not essential item, in our view. No warranty is offered.

The Fingertip Pulse Oximeter from Aircraft Spruce and Specialty is a Chinese-made unit priced at $89.95. No warranty is offered. We did not like its display, as the pulse rate and blood oxygen saturation percentage could only be read with the finger pointed directly toward or away from the user—the power switch changes the orientation 180 degrees each time it's pressed after startup—however, the pulse and saturation labels were turned 90 degrees to the actual numbers, making it difficult to quickly tell which number was which. Even though the display was moderately easy to read in sunlight, the potentially confusing presentation caused us to not care for the unit.

Aeromedix offers a pulse oximeter that uses components and technology that make it a medical device rather than a consumer product, thus it requires a prescription—which Aeromedix arranges when you order the 9590 Onyx Vantage. This U.S.-made device from Nonin Medical, Inc., a company that specializes in medical monitoring equipment, is priced at $179.00, down from $225.00. It is the only oximeter we examined that came with a warranty, a whopping four years. The unit is slightly more compact than the others and feels more robust. We observed a video in which one was dropped on to a tile floor 50 times from a height of about 30 inches and functioned normally. The display was clear and easy to read in sunlight, although it set up such that the finger had to be pointed at the observer.

CONCLUSIONS

If accuracy, a warranty and durability matter, we recommend going with an oximeter that meets the standards of a medical device and purchasing the 9590 Onyx Vantage. At the other end of the scale, because all of the oximeters we tested were within two percentage points of the medical unit, and because we feel strongly that having and using a pulse oximeter can improve decisions relating to safety of flight, we see nothing wrong with going with an inexpensive unit such as the Contec CMS50D. We say this with the warning that it is a consumer, not a medical, device and may or may not last any length of time, but for $32 it gives valuable information and if it does fail, it doesn't cost that much to replace.

CONTACTS

Aeromedix
888-362-7123
www.aeromedix.com

Aircraft Spruce and Speciality
877-477-7823
www.aircraftspruce.com

Sporty's Pilot Shop
800-776-7897
www.sportys.com

Spin-On Oil Filters: Champion or Tempest?

Which oil filter for your engine? We favor the Tempest for its metal-catching inspection magnet and a lower price.

by Larry Anglisano

While there are currently two choices of readily available, spin-on aircraft oil filters—Champion Aerospace and the Tempest Original, made by Aero Accessories, what goes on your engine during an oil change will likely depend on what your maintenance shop has on its parts shelf. It may also depend on which brand of filter is currently on the engine.

For this article, we put the two filters head to head. We bought one each Champion and Tempest 48108-series filter—which fit Continental engines—and sifted through their technical specs. Thanks to some help from the Total Aircraft Maintenance shop in Hartford, Conn., we cut each filter open and scrutinized their design. Here's what we found.

OIL FILTRATION 101

We all know that oil filters help keep engine oil clean by filtering metal, dirt and other contaminants. Plus, replacing the filter at regular intervals is key to engine protection, although as the sidebar on page 21 explains, we might not be changing oil as often as we should.

Spin-on oil filters from Champion and Tempest share basic characteristics. They come with a one-inch, wrench-off, hex nut built into the filter's top with safety-wire lugs. Internally, they use a paper-like media to perform the actual filtration and they fit the engine the same way. Both are available in short and tall design. Tall filters, of course, have more filtering media, which some believe are effective for longer service intervals.

Oil filters for certified engines carry TSO and PMA approvals. Further, Aviation Recommended Practices (ARP) defines the design, manufacturing and testing of oil filters used in piston aircraft engines—a standard that satisfies the FAA.

The effectiveness of the filtering media is measured in porosity, and it's said that the average porosity of aviation oil filters is 40 microns. This means the filtering paper might catch contaminating particles sized 40 microns and larger. Smaller particles potentially enter the engine, of course.

Some filters have an internal filter bypass—a mechanical fail-safe pressure-valve that opens if oil flow through the filter element becomes restricted. This happens if it becomes clogged with contaminants or if cold oil is too thick to flow through the filter. Dirty oil is better than no oil. Since most Lycoming engines have a filter bypass somewhere on the engine, the Lycoming-specific 48110-series filters omit the bypass valve. However, the 48108 series we tested has internal bypass, and we noted a distinct difference between the two brands.

We think both Champion and Tempest oil filters provide effective protection against contaminants, but Tempest could make it easier to get a visual on fine metal.

TEMPEST

Despite rumors that it's built by a third party, the Tempest Original filter, which has a list price of $29.49, is manufactured by Aero Accessories in their own North Carolina plant. The Tempest has a nearly identical outer housing as the Champion. That's because before Aero Accessories took over the line—and reengineered it internally—the filter was built by the same company that built the Champion. Compared to the Champion,

CHECKLIST

- Both Champion and Tempest use proven filtering technology.
- Frequent oil and filter change is critical to engine longevity.
- Which filter goes on your engine depends on what your shop has on hand.

The Champion filter, upper photo, uses a heavy, floating coil spring for mating the two-piece gasket with the filter. The Tempest, center, is designed with four oil inflow holes compared to the eight on the Champion, but this might not effect filtering capability. We like the protective cup of the Tempest's bypass valve and its ring magnet, lower photo. That's the Champion's bypass valve to its left.

we like the heavier nut-welds on the Tempest hex nut. Oil filters should be snugged to the engine with a torque wrench and the heavier welds guard against breaking. Tempest claims their nut welds are so strong that the filter can body will bend before the welds break.

Internally, we counted 63 pleats in the filtering paper and measured .0275-inch thickness using a vernier caliper. We stretched the filtering paper on the work bench and both filters measured around eight feet in length. We had to work hard to access the filter bypass mechanism, which is nothing more than a pressure valve-spring cage that, when open, allows oil to continue to flow toward the filters outlet. But unique to the Tempest design is a by-\pass valve safety containment cap. This cap surrounds the bypass valve in case the valve were to disintegrate at the securing spot welds—potentially spewing bits of the valve into the engine, or blocking the filter outlet hole, starving the engine of oil. Tempest president and engineer Tim Henderson said that to his knowledge, this has never happened to one of his filters. He showed us photos of a competitor filter where the by-pass spring cage broke loose and occluded the filter outlet. The resultant oil pressure in the filter built so high that it burst the seam on the filter case. It also resulted in an in-flight engine shut-down and emergency landing. For this reason, Tempest continues to include the retaining cup design as a prophylactic measure.

Also unique to the Tempest is an internal filtering ring-magnet. Its purpose it two-fold: It's intended to catch fine particles of steel which might pass through the filtering paper. But the sizeable benefit, in our estimation, is that the magnet makes it easier for a mechanic to spot critical metal during an oil change. It's easy to see larger pieces of metal in the filtering paper but nearly impossible to see particles of fine steel, the result of valve guide, lifter and cam wear, for example. The presence of these fine particles would, according to Tempest, create a fuzzy appearance on the surface of the ring magnet.

A veteran technician told us the ring magnet is the first thing he looks at when changing a Tempest filter. "The fuzzy appearance of fine metal stuck to the magnet is my first clue that something might be going on in the engine—something that might not be easy to spot in the filter paper".

CHAMPION

Once built by Purolator, the Champion filter has a list price of $34.95 and several shops we spoke with told us they install more Champion filters than Tempest. We suspect the Champion brand recognition may have some bearing on this.

For Continental applications, the Champion's bypass valve is a separate assembly inserted into the element's end opposite the base, which is sealed with a fiber gasket. Our sense is the larger valve induces more travel, which may or may not play a role in more oil pressure and flow when the filter goes into bypass. Speaking of more flow, the Champion filter uses eight inflow holes while the Tempest only uses four. On the other hand, both filters have the same size outflow so it's unlikely that more inflow makes a

sizable difference in performance.

Champion uses a two-piece gasket in its filters, compared with the smaller, single gasket in the Tempest. Champion says its gasket design helps prevent stress cracking. The inner part of the gasket assembly is harder than the thinner, outer ring. It was obvious to us that the gaskets in the Champion seem more substantial than the one used in the Tempest. The same is true for the Champ's beefy coil spring, which keep the filter element mated to the internal gaskets.

Like the Tempest, Champion 108—and 109-series filters have an anti drain back or ADB valve. ADB valves prohibit oil in the filter from draining back into the engine when the engine is off, retaining oil in the filter thereby providing a continuous flow of oil during engine start-up.

WHAT THEY SAY

During our research, both Aero Accessories and Champion tenaciously proclaimed their filters are better than the other. For instance, according to Champion, its resin-injected filter traps and holds more dirt and harmful particles than Tempest—a claim we couldn't confirm or deny without extensive lab testing.

We were nearly sold on the ring magnet concept and asked Champion why they don't build a ring magnet in their filter. According to Champion's Kevin Gallagher, Champion feels that commercially available oil analysis services are a better way of monitoring engines for wear metals.

"Engine wear metals contain both ferrous and non-ferrous materials. With a magnet retaining only those

continued on page 32

CONTACTS

Champion Aerospace
www.championaero.com
864-843-1162

Aero Accessories (Tempest)
www.aeroaccessories.com
800-822-3200

RETHINKING OIL CHANGE INTERVALS

It's well-established that changing the oil and the oil filter is one of the best preventive maintenance items you can do for your aircraft engine. For engines with spin-on type filters, both Lycoming and Continental call for a 50-hour change interval. For engines with screen filters, that number is decreased to 25 hours.

But industry experts we talked with don't necessarily concur with the standard 50-hour change. There are other factors, including calendar time, engine design and climate considerations to support the argument for more frequent changes

Ed Kollin, a petrochemical chemist and developer of the CamGuard oil additive, told us that changing your oil every 25 hours is a smart idea—perhaps essential—for some engines, including the high-output Continental IO-550-series used on Cirrus SR22s and the Cessna Columbia/Corvalis. "Unless you fly 250 hours or more per year, engine component wear rates go up substantially after 25 to 30 hours, as does oil consumption."

Kollin says that a 25-hour oil change can be critical on engines that use small oil sumps—which includes the Cirrus and Columbia/Corvalis—due to a high concentration of lead particles. Kollin also thinks extending the replacement interval of tall filters, despite their larger filtering capacity, is a big mistake. His testing showed that some filters on big Continental and Lycoming engines went into bypass—which, in general, is at a 12-PSI pressure drop, after just 30-50 hours.

Regardless of whether you use Kollin's CamGuard product or not, part of the problem is the invisible oxidized, pulverized carbon particles which come from fuel blow-by. The oxidation of the fuel originally starts as a lacquer or varnish and then gradually builds to a softer carbon, ages and hardens. Ultimately, sludge forms when the varnish captures combusted lead particles.

The theory here is that more frequent oil changes get rid of oil that's contaminated with fuel, hopefully lessening the build-up of varnish in the first place, while also ridding the sludge and lead particles. Kollin made it clear that you want to fly the aircraft to drain the oil when it's hot, to rid as much of the suspended lead particles as possible out of the engine.

Rob Midgley, Technology Development Manager, Aviation Fuels and Lubes at Shell Aviation, noted that a 25-hour oil change proposal might be more effective in tackling the calendar interval problem many operators face.

"My experience is that owners are pretty rigorous at changing their oil on an engine hours basis, but are either ambivalent about or ignorant of the calendar interval. If engine time is their driver, then changing oil at 25-hour intervals may have the same end result (changes at least twice a year) as a calendar interval. The issue is that long-term exposure to liquid contaminants including free water, hydrolyzed organic acid species (resulting from oil oxidation) and also the presence of strong acids from exhaust byproducts, has a much more significant effect on engine longevity," said Midgley.

Last, climate conditions should play a role in oil change intervals, especially for engines that sit for longer periods. As one expert put it, "Oil that sits in an engine in the moist climate of southern Florida should be changed more frequently than oil that lives in the much drier Scottsdale desert."

Regardless of climate, we concur with the experts that changing the oil and the filter between 25 and 30 hours—especially for low-use engines—is a good idea.

Active Winglets: Bolt-on Efficiency

By reducing drag and kicking up lift, Tamarack Aerospace's active winglets appear to offer measurable range increases for high-performance aircraft.

by Paul Bertorelli

In the imaginary world of ideal airplane design, wings would be infinite of length and short of chord, yielding lots of lift and little drag. In the real world of airplane design, that's not an option, so we resort to aerodynamic tricks to whittle away drag. One of these is winglets, a retrofit idea being aggressively pursued by Tamarack Aerospace.

Although winglets may appear as stylish cosmetics implying speed and modernity, Tamarack claims they're a lot more practical than that. Winglets mimic the characteristics of a high-aspect-ratio, low-drag wing, so on high-performance aircraft, they increase climb rate and improve efficiency by allowing equivalent cruise speeds at lower power settings.

But it's not as simple as that, at least for the retrofit market. Even as they add lift, winglets impose additional structural loads on the wing that can exceed its certification limits. Tamarack's solution? Make the winglet active and capable of dumping the lift in flight regimes where the wing would otherwise be overloaded. Tamarack has been developing its active winglets for several years and made an appearance last fall at AOPA Summit with the system installed on a Cirrus SR22.

Tamarack's initial winglet cert project was on the Cirrus SR22, top photo, but its core market will be jets such as the CJ1, lower.

While you can buy active winglets for the SR22 ($59,649), Tamarack's Nick Guida told us that the core market for this product is high-performance aircraft flying at high altitudes, meaning jets and turboprops. Tamarack, which also sells throttle and baggage compartment mods for the Cirrus airplanes, used that model primarily as a certification entré to lay down an approval path for aircraft like the Citation line, which it's now flying as a test bed.

We flew the company's winglet-equipped CJ last fall and while we couldn't collect comparative data with a stock aircraft, we did see the winglets in action. And we do mean action.

THE THEORY

Fixed winglets improve performance by mimicking a higher-aspect ratio wing. Although they add some parasitic drag, they more than make up for it by reducing induced drag. But there's no free lunch. Besides the weight of the winglets themselves, the wings also require enough structure to support the load of the additional lift. That adds more weight and is a tradeoff against the improved performance and efficiency. For the would-be retrofitter of winglets, it also presents a potential non-starter. Yes, the winglets add impressive efficiency,

CHECKLIST

- ⊕ Winglets appear to perform as claimed. based in initial test data.
- ⊕ For select jet models, improved efficiency may add more than an hour of endurance.
- ~ Given the price and lesser performance Delta, winglets for small aircraft aren't as attractive.

but the weight, cost and complexity of the required additional structure may make a net gain elusive in cost if not efficiency.

Tamarack's solution is to make the winglets—or at least the *effect* of the winglets and a longer wing—active through a network of sensors that constantly monitor wing loading in all phases of flight. When loading is approaching design limits for the wing structure, a small flap—a spoiler, really—instantly deploys, dumping the lift and relieving the wing structure of any potential overload. In flight, the spoiler activates so quickly that it's sometimes difficult to see it. (See the accompanying video demonstration.)

In the Tamarack installation on the Citation, the wings get an additional five feet of total length, with the winglet attached outboard of that. The spoiler system—which Tamarack calls ATLAS for Active Technology Load Alleviation System—is on the trailing edge of the added section of wing.

It's activated by fast-acting electric actuators, which are in turn controlled by an onboard computer system capable of calculating load factors quickly enough to react to turbulence bumps and rapid maneuvering in real time. In the event of system failures or faults, potential winglet overloading is rendered inert by speed envelope limits.

As mods go, this isn't a cheap one. At $196,000 for the CJ, it can amount to up to 40 percent of the value of an early Citation I, but obviously less for newer models, where it's more likely to be installed. What does it deliver? Tamarack's Guida says the winglets are transformational for jets designed during an era when fuel prices weren't a concern and neither was long range.

"The flight test results we are getting are just extremely impressive," says Guida. "We are talking about way more than an additional hour of range. As compared to book, we are seeing between 8 and 10 percent improvement in specific fuel consumption," he adds.

Much of the efficiency comes from getting to altitude quickly because of a higher climb rate, according to Guida. "We get to 410 at gross with a little under 600 pounds of fuel. In the stock airplane, you get can't get to 410 in the first hour, without burning off fuel. It's not even in the book," he says. At 30,000 feet, the modified airplane at gross weight is still climbing at 1500 FPM, says Guida, compared to 200 FPM for the stock airplane.

The active winglet spoiler section, above on installation, and right in flight, deploys when wing loading exceeds a given value.

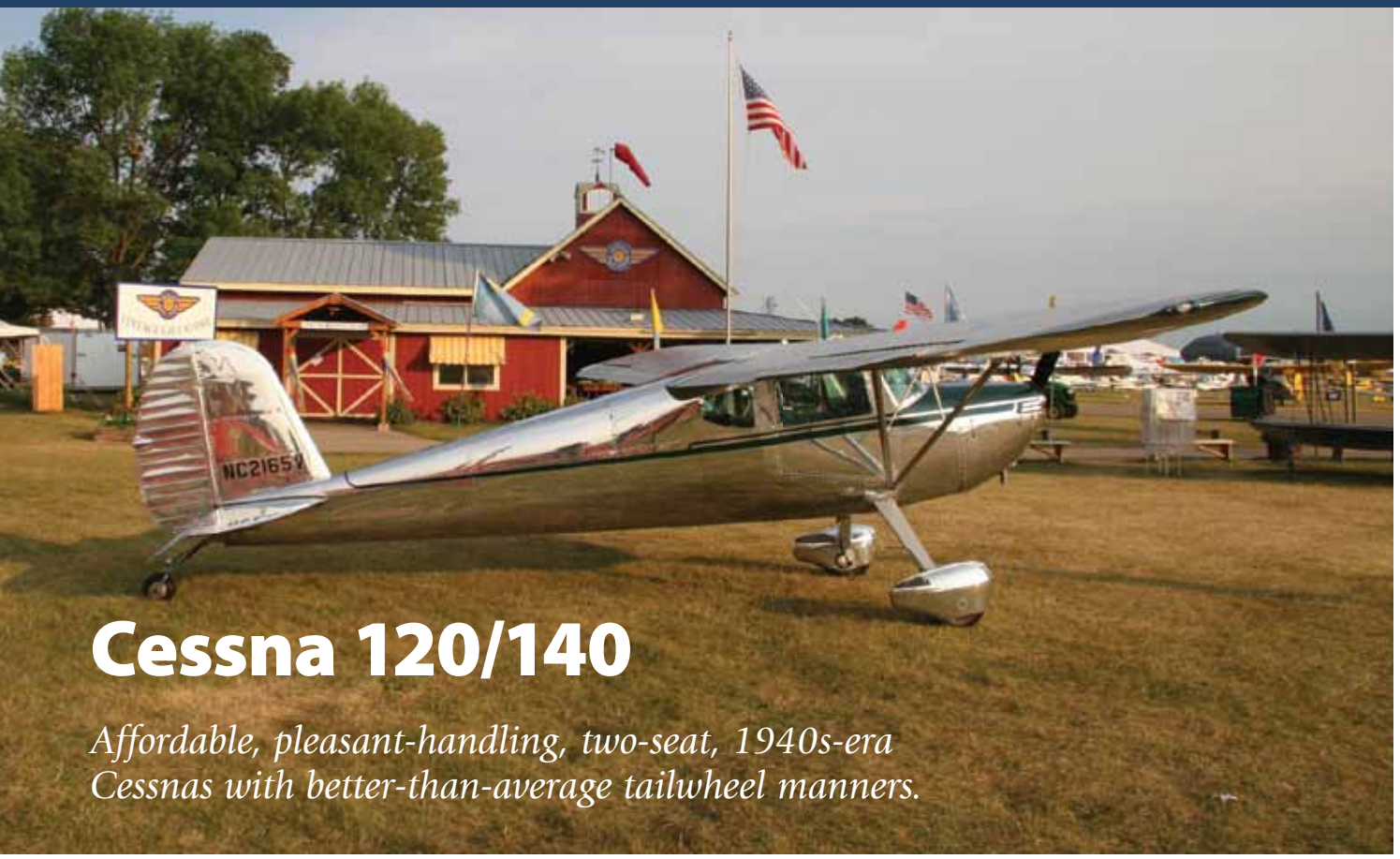
FLYING IT

Along with Tamarack's pilot Brian Willett, we flew the company's test aircraft on a turbulent day in Florida last fall. Although we couldn't confirm its performance numbers at high altitude, we did see the ATLAS system perform in turbulence and in 1G-plus maneuvering. On takeoff, the airplane behaves normally, but on climb out, we could see the winglet spoilers activating and de-activating in response to turbulence loading.

They respond quickly enough in some circumstances to be almost invisible. At altitude, we tried some mild-G maneuvering to see how the spoilers deployed and noted that they act more slowly and predictably. Willett told us roll control is comparable to the stock airplane, despite the longer wings. With no basis of comparison, we'll take his word for it until another Citation pilot who has flown both airplanes tells us otherwise.

For the right CJ operator who needs additional range or payload over shorter range, Tamarack's winglets may pencil out to make economic sense. We doubt if they make as much sense for a Cirrus owner, since the benefits of winglets accrue at higher altitudes and speeds and a $59,000 upgrade is a large piece of change for limited performance improvement.

For more on Tamarack's active winglets, contact the company at www.tamarackaerospace.com or 208-255-4400.



Cessna 120/140

Affordable, pleasant-handling, two-seat, 1940s-era Cessnas with better-than-average tailwheel manners.

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

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

With a few exceptions—Beech's Bonanza or the Ercoupe, for example—most offerings were tailwheel machines. The first of Cessna's to be built in volume was the diminutive Cessna 140, followed a month later by a stripped-down model called the 120. At the time, the Cessna 120/140s were perfectly serviceable and practical two-place airplanes. They were reasonably priced to buy and economical to own. Although they all initially had fabric wings, they were made mostly of metal, avoiding the periodic need for recovering.

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

MODEL HISTORY

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

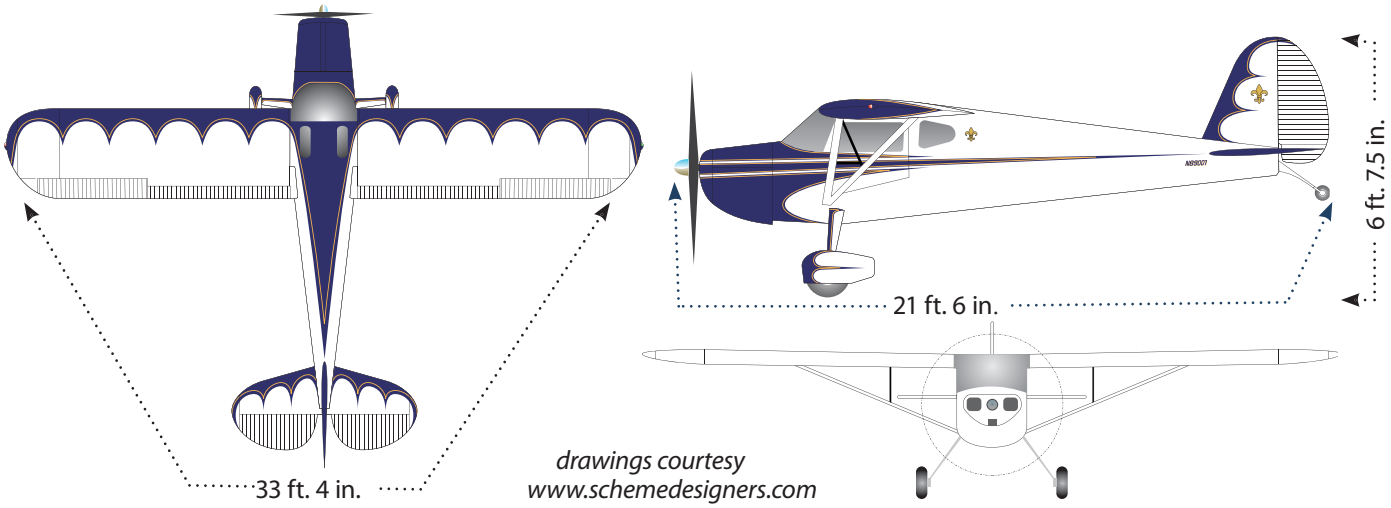
Can you imagine finding a new, factory-built, FAA-certified, trainer for $31,000 today?

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

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

To go even more upscale, Cessna followed the automotive industry of the time and offered a "luxury" version, dubbed the 140. It came with flaps, an electrical system, fancier seats and a pair of rear windows on either side of the fuselage (but not the wraparound, Omni-view configura-

CESSNA 120-140

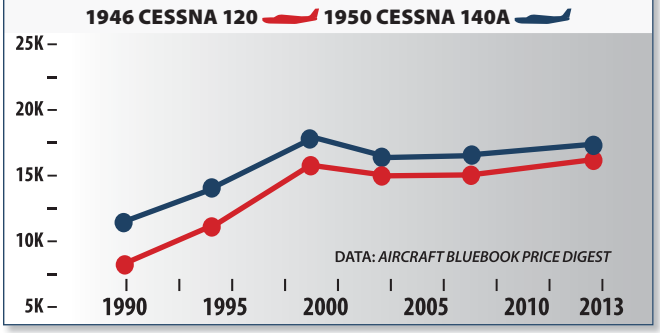


drawings courtesy
www.schemedesigners.com

CESSNA 120-140 SELECT MODEL HISTORY

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

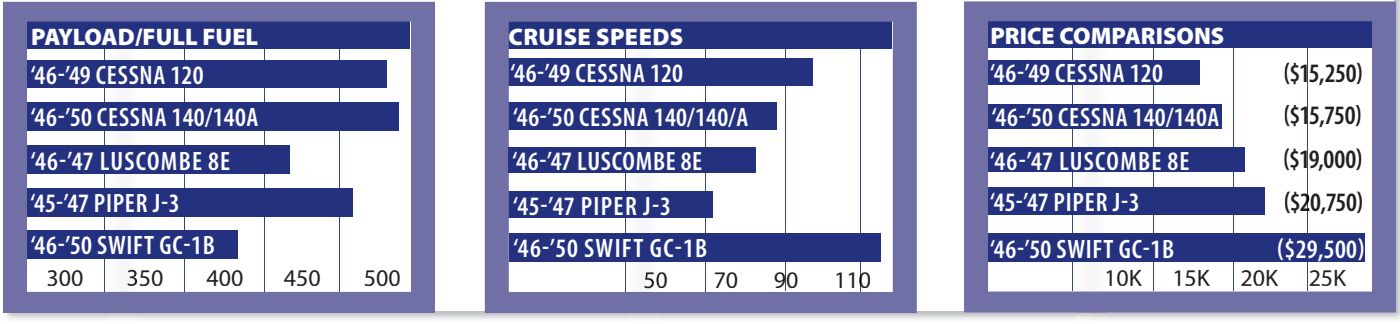
RESALE VALUES



SELECT RECENT ADs

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

SELECT MODEL COMPARISONS



120s and 140s had two wing struts; single strut did not come along until the 140A. 120s also had no flaps, top photo, and no rear window, this one has had a rear window added. Restored vintage panel, left middle. Vintage panel with modern instruments installed, bottom left.

tion that later became standard in Cessna's single-engine line).

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

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

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

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

CONSTRUCTION, SYSTEMS

As noted and in contrast to Piper's

Polished aluminum that will withstand a close up requires a lot of time and effort.

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

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

No matter the model designation, systems are stone simple. The fuel system includes a 12.5-gallon tank in each wing, connected through a left-right-off valve. Later models had a "both" position and a fuel-tank crossover line. When originally delivered, airplanes with electrical systems had generators and a few flying have them still. These days, the better set-up is an STC'd alternator conversion.

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

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

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

CABIN, ACCOMMODATIONS

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

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

Moving into the cabin, you'll find primary controls consist of a pair of side-by-side yokes grouped in the center of the panel. Anyone with passing familiarity with a Cessna 150 knows how cramped the seats and interior are. The Cessna 120/140 is no better; the seats are 1940s-style bench designs and both shoulder and leg room is limited.

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

Visibility from the cockpit is marginal, at best. It's not bad out the side windows, but 120s without

ACCIDENTS: RLOC AND NOSE-OVERS

When we research the Used Aircraft Guide accident scan for tailwheel airplanes, we expect a healthy dose of RLOC, or runway loss of control, accidents. The Cessna 120-140 series proved to be no exception. Of the 100 random NTSB reports we looked at in a 10-year period, 61 percent fell in the RLOC category—some with unpleasantly dramatic results, including cartwheels, flip-overs and plenty of nose-overs.

Because there's little option for placing much weight toward the rear of these small tail-draggers, they have a tendency to nose over, even with the extended main gear mod—especially when pilots become a bit too enthusiastic while braking or operating on runway surfaces that are unsuitable for the aircraft.

Speaking of unsuitable runways, a ski-equipped 140 sustained substantial damage after nosing over while landing on a frozen lake. According to the NTSB report, the previous takeoff on a frozen and slushy surface stressed the skis to the point of breaking during the accident landing.

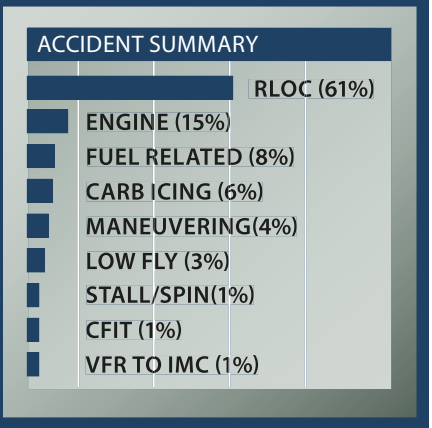
Another 140 on skis crashed and nosed over while touching down on uneven terrain because the pilot misjudged the landing area due to the flat light conditions created by a combination of overcast sky and the snow cover. Another pilot found himself and his vintage Cessna in a ditch following his first attempt at taking off on his newly constructed, rocky runway. According to an FAA inspector, the runway was in no condition to accommodate an airplane.

Engine and mechanicals problems came in second in our statistics, at 15 percent. We found a couple of catastrophic engine failures, including one engine with broken crankshaft cluster gear bolts, plus one instance of oil exhaustion due to a dislodged crankshaft expansion plug. That engine failed just 39 hours after it was overhauled. Another engine failed on initial climb because an unidentified mechanic installed the wrong carburetor.

There were also a few airframe failures, including one accident airplane that lost a large section of the left wing's fabric. How large? Large enough to leave nine wing ribs plus a handful of rear spars visible. So much for the fabric patch work, which was accomplished during the process of a number of repairs.

Ranking third, at eight percent, were fuel-related accidents. One pilot learned that managing fuel in his crashed Cessna 120 is different than managing fuel in the Cessna 180 he normally flies. That's because in the 120, the middle position of the fuel selector is for the right tank only, unlike the 180, where the middle position selects both tanks. Another fuel-related crash was no fault of the pilot. The fuel selector in his 120 was improperly installed—drawing fuel from the opposite tank from the one indicated by the selector. Not surprisingly, there was no logged record of this bone-headed maintenance event.

There were four fatalities in the 100 crashes we studied, among them a departure stall and spin, and a continued VFR in IMC conditions carried out unsuccessfully by an airline pilot making the first trip in his newly purchased 140. That's a proportionally low number of fatalities, but it still proves that even a basic little tailwheel machine deserves respect.



a rear-window modification essentially blind the pilot from getting a good look at what's behind and to the sides. The 140s, with their rear windows, are a bit better. Meanwhile, visibility out the front isn't up to modern standards, either.

Trainers like the 152, Diamond Katana or even the Piper Tomahawk excel in this area in large part thanks to their tricycle gear. But the 120/140's taxi stance is not so sharply pitched a pilot can't see over the nose; the short cowling and somewhat flatter deck angle are a real plus compared to other tailwheel airplanes. You don't need to sashay down the taxiway making S-turns to keep from creaming another airplane coming the other way. But it might not be a bad idea. One thing that aids ground handling is toe brakes, a vast improvement over the heel brakes found in the typical aircraft of this vintage.

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

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

PERFORMANCE, HANDLING

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

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

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

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

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

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

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

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

MAINTENANCE, ADS

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

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

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

As do all airplanes, the 120/140

Life can be pretty good with the Cessna 120-140 series—fall foliage via 140, top left, 120 on floats, middle left, and a 140 on skis, bottom left.

models have some weak spots. Here are some things to look for:

• Look for damage in the lower door posts, near the strut attach point. This critical structural member may be damaged by rough field operation, ground loops or corrosion.

• Corrosion in the carry-through spar can be a problem. The cabin skylight leaks water into this structure, and years of moisture will take a toll.

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

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

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

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

MODS, TYPE CLUBS

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

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

As for groups, the International Cessna 120-140 Association maintains a terrific Web site and support network. It can help with buying advice, parts and other support. Find them online at www.cessna120-140.org. Another group is the Cessna Pilots Association (CPA), which bills itself as the largest type club in the world. Either organization should serve the new 120/140 owner well. Find the CPA at www.cessna.org.

OWNER COMMENTS

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

Wheel and three-point landings can be done equally well.

Ours came with a metalized wing, which we dislike because it reduces useful load by 50 pounds. The original Goodyear brakes were maintenance intensive and moderately effective, but good on grass strips. The original straight stack exhaust, no muffler, on the airplane was just plain loud. The Eisemann magnetos gave a strong spark but were heavy for such a light aircraft. The airplane came to us with the horizontal stabilizer mod, which reinforced the horizontal stabilizer spar.

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

Tom Tann
Michel Litalien
Via email

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

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

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

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

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

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

Mark Zakula
Algonquin, Illinois

The Aviation Consumer

Oil Filters

(continued from page 21)

magnetic materials, Champion would not want this magnet to be used as the main inspection point for wear metal contamination," said Gallagher.

Moreover, Champion feels that the magnet acts to gather dangerous metal particles at the entrance of the bypass valve. Then, when the valve opens—such as during a cold start, these gathered particles can be released and travel downstream of the filter.

Champion also claims that metal build-up could put the filter into bypass, a point Tempest dismisses.

"The magnet attracts fine particles, but not at such a high rate as to overload it, at least in a normally running engine, between regular filter changes," said Tempest's Tim Henderson.

We talked with several mechanics who simply didn't have a particular brand loyalty to either manufacturer's filter. Most told us they put on whatever the customer wants or whatever is already on the engine. Not Brian Doyle, an experienced technician who manages Midnav Aviation Services at North Adams Airport in Massachusetts. He cares enough about his customers' engines to do a bit of oil filter research on his own. According to Doyle, he thinks the ring magnet in the Tempest might provide some owners with additional peace of mind, but prefers the Champion.

"I tore apart both filters and prefer the heavy-duty coil spring inside the Champion. Also, I've never seen any metal trapped on a Tempest ring magnet."

We asked Doyle whether his customers are concerned about the Champion's higher price.

"My sense is that if customers are sold on the perceived higher quality of the Champion, an extra five bucks is worth it to protect a $50,000 engine," said Doyle. Like all of the respected techs we spoke with, Doyle agrees that more frequent oil changes are important for engines that sit for longer periods of time.

CONCLUSION

We have no problem installing either a Champion or Tempest on our engine. We think both are high-quality filters. The last time we reviewed oil filters, we picked Champion as the winner, but this time around, Tempest convinced us that their design has a slight edge, because of the ring magnet and bypass valve design.

Based on our examination, the Tempest and Champion have similar filtering paper design and volume.

On the other hand, our discussions with Champion got us thinking about the trapped, dangerous metal re-entering the engine when the filter goes into bypass—which could be every time you start a cold engine without a preheat.

Last, while the five-dollar saving afforded by the cheaper Tempest may seem trivial to some, we're all about saving money wherever possible. To that end, we would put the money saved toward more frequent oil changes.

FEEDBACK WANTED

MAULE SERIES

For the May 2013 issue of *Aviation Consumer*, our Used Aircraft Guide will be on the Maule series, the tube-and-fabric, tailwheel (mostly) airplanes with a reputation for STOL performance and the ability to handle rough, remote airstrips. We want to know what it's like to own these planes, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your airplane to appear in the magazine, send us any photographs you'd care to share. We accept digital photos e-mailed to the address below. We welcome information on mods, support organizations or any other pertinent comments. Please send correspondence on the Maule series by April 1, 2013, to:

Aviation Consumer
e-mail at:
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