December 2015
Volume LXXX
Number 12

The consumer resource for pilots and aircraft owners

The Aviation Consumer®

Electronic Attitude Gyros:

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The Aviation Consumer

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REPRINTS: *Aviation Consumer* can provide you or your organization with reprints. Minimum order is 1000 copies. Contact Jennifer Jimolka, 203-857-3144

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

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

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

THE BAD OLD WARRANTY DAYS

When *Aviation Consumer* reported on new aircraft warranties in the late 1970s, we found that warranties for cars, refrigerators and Zippo lighters bettered what airplane manufacturers offered by a huge margin. At the time, an inexpensive car was around $5000 and an entry-level personal aircraft was around $50,000. Thankfully, warranty administration on today's new aircraft is much improved, but you'll pay for it. As we report in the pre-owned aircraft sales article on page 8 of this issue, it's now possible to get a short, but generous factory warranty even on a used aircraft. Ah, the beauty of quality control and inflated prices.

Back in 1977, the longest warranty most manufacturers could afford to offer on a new aircraft was six months with no hourly limit. There were a few market exceptions, including the newly introduced Meyers 200, which came with a one-year warranty. It's easy to understand the gripe an owner of a $300,000 aircraft had when left stranded because his new cabin-class twin broke down far from home base. Meanwhile, car makers like American Motors were picking up the hotel and bar tabs for owners waiting for repairs on a $5000 Pacer.

By comparison, the warranty on an average $5000 automobile is far superior to that of a $50,000 airplane.

While poring over Cirrus' extended "pre-flown" warranty for its certified pre-owned aircraft, Senior Editor Rick Durden reminded me how careful aircraft makers were (and still are) to not land themselves in court over written warranty issues. In the delicate environment of questionable warranty reimbursement, consistency is key. If an owner knew someone or some magic word, it wasn't unheard of for manufacturers to slide them additional coverage or extend coverage for a lapsed warranty. When that cat gets out of the bag, it's an ugly situation for both dealers and the manufacturer. I've witnessed this while working on the shop level and in a day of Internet-based owner groups, it's a slippery slope. One under-the-table exception can cost millions.

I watched as Cirrus stood its ground last year when the second owner of a first-gen SR22 dealt with damage to the internal composite structure around a fuel tank. This must have been a manufacturing or assembly defect, the owner argued, and expected Cirrus to pick up the tab some 13 years later. Cirrus basically told José, "no way," but when the owner wouldn't back down, Cirrus sent a representative to comb through the aircraft maintenance logs. I stood over his shoulder as the rep looked at every single maintenance entry, of which most—but not all—were accomplished by Cirrus service centers. If there were never any hands or tools inside of the subject wing area which could have cracked the composite structure, my sense was that Cirrus might step up and offer something for the $5000-plus repair invoice. But all bets were off when a log entry revealed a fuel sender swap early in the aircraft's life. It directly attaches to the area of the damaged structure. After tossing the log on the table, the Cirrus rep graciously offered to buy lunch.

Speaking of quality control, a member of the Cessna Advanced Aircraft Club (CAAC) reached out to me regarding a warranty dispute owners are having involving the fleet of Cessna Corvalis models. The cracking window paint issue on these aircraft is clearly cosmetic and not a structural one, but CAAC believed, based on communication from Cessna a few years ago, it would be corrected under warranty. That hasn't happened yet and CAAC says Cessna has ceased communications on the matter. Textron communications manager Nikki Rieman told us Textron Aviation is aware of customers experiencing issues with the paint around the windows on the Corvalis and related models and is working diligently to find the best solution to support the aircraft. In the bad old days of aircraft warranties, cosmetic complaints on an out-of-warranty aircraft might not get past a manufacturer's switchboard operator.—*Larry Anglisano*

ON THE SPOT

Here is some more real-world feedback on the Spot Gen3 satellite tracker you covered in the November 2015 issue of *Aviation Consumer*.

I have used the Spot3 locator for several years and find it to be extremely useful. It does its job well and rapidly acquires a GPS fix as long as it has a clear view of the sky. Surprisingly, many times it has acquired a fix while sitting in a hotel window sill. It may take a while, but it beats getting dressed and going outside to get an unobstructed view of the sky.

Also—and this is important—when I forget to send a Spot fix, a family member almost always worries and calls me to ask if things are OK. The absence of a Spot message is enough for them to become concerned. The Spot gives them the location, and in one click from the message received from Spot, our friends can explore our present location via Google Earth.

Tom Osborne
via email

I have owned four Spot satellite receivers. Two of them were the original design and since they didn't have a lanyard to attach the device to something, I lost one.

The second generation Spot had a lanyard and the keys were protected so that it was difficult to accidentally send messages. It was easy to tell what it is doing.

But I think the company outsmarted itself with the latest Spot Gen3. The two best features are its small size and the tether strap. Spot added other features that make the device very difficult to tell what it is doing. Because it has so many buttons, there are now button sequences that must be activated for certain modes. I verified this with one of their reps. Fortunately, I never had to activate any of the devices because of an emergency.

Dennis Wisnosky
via email

We have used all of the Spot devices in aircraft and on the ground and think the latest Gen3 has the best ergonomics of them all.

Lockheed Martin can track a Spot and initiate search and rescue if it stops moving. As you note, some functions are initially quirky, but nothing a quick read of the users manual can't solve, in our view. If that doesn't work, we also found Spot's technical support to be superb.

WILL GARMIN TALK?

Finally, a publication acknowledges that Garmin finally has some competition with an article outlining its well-rounded product line (November 2015 *Aviation Consumer*). My avionics installer—who wished not to be named—is trying to convince our flying club to install dual Garmin GPS navigators because we already have a GNS430W, which we wish to retain as a secondary backup. The same aircraft has an Avidyne traffic system so we don't have any problem mixing brands. But are we making a mistake mixing a new IFD540 GPS with the old GNS430W? In other words, are the systems compatible?

Anthony Lombardo
via email

The only useful compatibility you might want between the Avidyne IFD and your secondary Garmin GNS navigator is cross-fill. This is where active flight plans loaded in the Avidyne are automatically sent to the Garmin unit. Avidyne tells us Garmin has a proprietary crosstalk protocol, so it won't work.

INTERCOOLER OPS

Interesting article on intercoolers in your September 2015 issue. I bought a normally aspirated Cessna 210 and when the engine reached TBO, converted it to a T210 using a one-time STC and local FSDO approval with a DER letter. I added a Turboplus intercooler, which is available from Tom's Aviation in Long Beach, California.

Based on my JPI engine analyzer, the intercooler cools the induction air roughly 50 to 70 degrees between 8000 to 15,000 feet. One problem with intercoolers is that you have to pretty much throw the POH out the window when considering percent power and fuel flow. I've read somewhere that each 20-degree cooling is about one inch of manifold pressure, which is useful if you are operating rich of peak. I typically operate lean of peak, set the mixture full rich on takeoff and climbout, then set power for 30 inches and 2500 RPM, and lean fuel flow to 14.5 GPH, which is about 70 percent power. This keeps the CHTs below 380 degrees and the TIT below 1580 degrees. Am I doing this right?

Peter VerLee
via email

When it comes to engine operation with an aftermarket intercooler, that's a question best answered by the holder of the STC, Peter. You should also find precise operating data and limitations in the flight manual supplement that came with the intercooler installation. While you're at it, be sure a skilled mechanic has the fuel flow set up properly. If not, you run the risk of over-temping the engine.

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Digital Attitude Gyros: Primary Replacement

And you don't even need a secondary backup. Sandia and L-3 have models that serve double duty as mini-PFD systems, but lack autopilot interface.

by Larry Anglisano

In a recent policy statement, the FAA gave the regulatory green light to replace traditional vacuum-driven attitude instruments with electronically driven replacement indicators. This means you can remove the vacuum system from the aircraft, since the policy doesn't require a backup spinning gyro. In many cases, you won't need a backup at all.

AVIONICS MARKET SCAN

Coincidentally, the FAA's announcement was perfectly timed around the certification of new products, including the long-awaited Sandia SAI-340, L-3 Aviation's ESI-500 and the soon-to-be-certified BendixKing KI-300.

While some of these were originally intended for use as backup, manufacturers say the FAA's policy statement makes them legal for primary use. Let's take a look.

BENDIXKING

Except for the rate-based KAP140, most vintage and newer BendixKing autopilot systems require the KI256 or KI258 vacuum-driven attitude gyro. If you've ever been faced with repairing or overhauling one, you'll know this instrument isn't for low budgets. Even reinstallation labor costs are expensive, no thanks to a time-consuming calibration and alignment procedure.

BendixKing's AHRS-based KI300 next-generation electronic replacement promises to tame that dragon, since pitch, roll and other configuration settings are configured through software. But the greater benefit is the KI300's micro-electromechanical (MEMS) technology, which could have a longer interval between failures, compared to the KI256/258 spinning gyroscopes it replaces.

Weighing two pounds, the KI300 is designed to drop into existing KI200-series installations without having to modify the instrument panel. The instrument simply requires power and ground connection, and for KI200-series replacements, BendixKing offers an adapter harness which plugs into the existing autopilot wiring.

Speaking of autopilots, the KI300 is the only retrofit model equipped with autopilot output. This is the roll and pitch signals that feed BendixKing KFC and KAP-series attitude-based autopilots. BendixKing said it's working on an interface that can work with other brands of attitude-based systems.

AHRS-based autopilot drive has proven far better than the outputs from spinning gyros. As long as the autopilot computer and servos are healthy, we think it's an effective way of improving the performance of aging, analog systems.

The KI300's LCD display is programmable for various panel tilt configurations and is available with flight director command bar presentation, in addition to yaw rate sensing for driving the yaw damper circuitry in BendixKing autopilots.

The KI300 satisfies the FAA's secondary power source requirement (see the sidebar on page 7 for the legal tidbits) with its internal backup battery and accepts 9-32 VDC input. The base standalone KI300 without autopilot output is $4995, $5995 with autopilot output/flight director interface and $7995 with yaw rate sensor. BendixKing said the KI-300 is expected to be certified by February 2016.

L-3 GENESIS

The $5800 L-3 Aviation ESI-500 Genesis was originally intended as a backup display for EFIS systems. But L-3 says the FAA's policy statement makes it a player for use as a primary attitude instrument in Class 1 and Class 2 Part 23 aircraft.

Think of the Genesis as a small PFD, but with a rear chassis designed to fit a 3-inch instrument cutout. Equipped with a 3.5-inch diagonal active matrix color LCD display, it has airspeed tapes with speed aware-

BendixKing's KI300 electronic gyro, main photo, is the only primary instrument capable of driving attitude-based autopilots. The company hopes for certification by February 2016.

CHECKLIST

- Upkeep and reliability of electronic attitude indicators better spinning iron gyros.
- Other than BendixKing's KI300, none of the electronic replacements have autopilot pickoff.
- Retrofit PFD systems still require a backup due to STC certification and EFIS guidelines.

ness color bands, an altitude tape, plus vertical speed display. Major options include the $1333 synthetic vision software (with towers and terrain obstruction data) and on-screen heading data, through interface with the $1500 MAG-500 remote magnetometer.

The synthetic vision option requires either heading input from the MAG-500 magnetometer, GPS position from an external ARINC-429 GPS navigator and input from an outside air temperature sensor.

Since the ESI-500 Genesis has a generous I/O interface, including a serial and ARINC-429 databus, it can interface with an external navigator for displaying GPS and navigation data (including ILS), in addition to marker beacons. Airspeed, altitude and vertical speed functions rely on pitot and static input.

Backup power is provided by a self-contained battery pack containing three lithium ion cells, which are charged by the aircraft electrical system. The battery circuit has smart monitoring to ensure the ion cells aren't overcharged or overly depleted due to temperature conditions.

The Genesis uses minimum bezel controls. A Menu key opens the pilot-configurable menu items displayed on the bottom portion of the screen, while pushing and rotating the bezel knob moves through and makes changes to baro setting, synthetic vision, display brightness and course value (when the nav option is used), to name a few.

When ordered with all options (heading, nav and synthetic vision), the ESI-500 prices out at $9400, which L-3 says is introductory pricing valid through the end of 2015.

Aspen PFD installations (including ones with redundant displays) still require a backup attitude gyro to comply with the original STC.

KELLY/R.C. ALLEN

Kelly Manufacturing makes the R.C. Allen line of attitude gyros, including the electronic RCA2600-series electronic model, available in a 3-inch and 2-inch footprint.

Consider the 2600-series instrument a no-frills model compared to advanced models like the L-3 Genesis and Sandia SAI-340. The attitude presentation is on a color LCD display with 350 pixels per inch with a 15-frame-per-second refresh rate.

The center of the display features a familiar symbolic airplane with wings that reference a pitch dial.

The 2600-series instruments have simple bezel controls for display brightness and a Pitch Sync feature, which instantly synchronizes the onscreen airplane symbol to the horizon line when flying in a pitch-up or pitch-down attitude.

The software in the instrument handles calibration and alignment,

The Kelly RCA2600-3 satisfies the requirements for use as a primary attitude display when connected to the Kelly ESP emergency standby battery, photos at the right. The ESP battery can also power other systems.

Some electronic attitude indicators are miniature PFD systems. The L-3 Genesis, top, has an option for synthetic vision display, remote heading module and can even display navigation data—including GPS and ILS—from a compatible external navigator. Sandia's SAI-340, bottom, has airspeed, altitude and slip data.

while flagging an onscreen red X and "Exceed Bank Angle" if the processor can't deal with an excessive bank.

The 3-inch model can be used to replace the turn coordinator when equipped with an optional mechanical slip/skid indicator. It attaches directly to the bezel.

The 2600-series instruments can be used in aerobatic applications since they are designed to function in 360 degrees of pitch and roll.

For pitch attitude reference, there is 20 degrees pitch up on the pitch dial and 30 degrees of pitch down. For roll reference, there's a fixed roll pointer that references the roll dial about the roll axis. At the bottom of the display, just below the -30 degree pitch line, is a processor annunciator. This is a blinking dot that moves left and right, showing the internal processor is working.

For standby power, Kelly offers the $800 ESP emergency standby power module. It has a lithium-polymer battery, which can power the instrument for up to six hours. Unlike other electronic instruments, the 12.5-ounce ESP module is remote mounted (it measures 6.62 by 2.76 by 1.65 inches with connector), and Kelly provides a prewired harness and a battery status lamp for mounting on the aircraft instrument panel. This, of course, will increase installation effort.

The RCA2600-P version has pitot and static input, which is aimed at jet applications needing more precise attitude computations. This product is expected to morph into the next-generation RCA attitude indicator, which will have airspeed and altimetry functions.

Kelly's Jim Turner told us the unit is currently in development, as is an electronic directional gyro. The RCA2600-3 and 2-inch RCA2600-2 have a street price of around $2600 and doesn't include the battery or $150 inclinometer.

SANDIA SAI-340

Sandia Aerospace's SAI-340 has been stuck in certification for a couple of years, but was finally awarded a TSO last October. Sandia calls the instrument the Quatro because it has four-in-one functionality, including airspeed tape (with airspeed limitation markings), attitude, altitude tape and slip indicator.

The Quatro is designed to fit in a 3-inch instrument cutout, while pitot and static ports are built into the rear chassis. That chassis is shallow—less than 3 inches deep with the single rear connector attached, and the instrument weighs 0.8 pounds including mounting bracket and the internal lithium polymer battery. Battery endurance is advertised at three hours when the display is at maximum brightness and at 55 degrees Celsius.

The instrument has smart and intuitive battery monitoring, and the battery status is shown in the lower left corner of the screen. When operating on the internal battery, the colored battery icon will transition from green, to yellow, to red as the battery depletes. Charge levels (based on voltage received from the aircraft electrical bus) above 50 percent are shown in green, between 25 percent and 50 percent is shown in amber and levels below 25 percent are shown in red. The charge is also shown as a percentage of capacity.

At 3.5 inches diagonal, the Quatro's LCD display (with LED backlighting) size is the same as the L3 Genesis. But unlike the Genesis, the Quatro doesn't have a data-bus for communicating with other devices and it doesn't have synthetic vision.

Remember, the Quatro was originally developed as a backup instrument, but Sandia's Barry LeBlanc told us the TSO functions meet all of the standards for use as a standalone primary attitude indicator.

A single push/rotary knob is the only bezel control and it's used to set the baro correction, adjust the

ELECTRONIC ATTITUDE INSTRUMENTS COMPARED

MODEL	BASE PRICE	DISPLAY SIZE	COMMENTS
BENDIXKING KI300	$4995	3.0 inches	Available with autopilot pitch, roll and yaw outputs. Replacement for KI200-series gyros.
L3 ESI-500 GENESIS	$5800	3.5 inches	With synthetic vision, magnetometer and nav option, unit can serve as a small PFD.
KELLY/RC ALLEN 2600-3	$3100	2.5 inches	Available in a 2-inch version for small panels or for use as a standby. Uses a remote backup battery.
SANDIA SAI-340	$3595	3.5 inches	Has pitot and static input for airspeed and altitude display, plus a shallow space-saving chassis.

FAA: VACUUM SYSTEMS UNRELIABLE, COSTLY

Sometimes the clue bus arrives late to the airport, which is the case with the FAA's PS-ACE-23-08 policy statement for getting rid of vacuum attitude gyros, including the primitive system that drives them. Still, kudos to the FAA for finally offering take-it-to-the-shop policy on a situation most of us have known for years—vacuum systems are plain unreliable. Our guess is that a new generation of regulators hip to the superior reliability of solid-state, AHRS-driven gyro technology has at least something to do with it. Moreover, the FAA is long aware of the insidious nature of vacuum instrument failure, evident by the research it has done of NTSB reports littered with vacuum failure-related augers. But in its new policy, the FAA uses some interesting language to describe old-school gyros, while also recognizing the buying trend of AHRS-based instruments and the cost burden of maintaining old systems. Still, the policy statement for Part 23/CAR3 aircraft under 6000 pounds equipped with vacuum-driven attitude instruments isn't a free-for-all. Plus, aircraft equipped with traditional directional gyros still need a vacuum system, short of upgrading to a full-up PFD or electric HSI system.

PS-ACE-23-08 says it is acceptable to replace a single-function vacuum-driven attitude instruments with an electronically driven attitude indicator as long as it has an independent standby battery capable of meeting the intent of AC 23.1331, AC 23.1381 and AC 1353(h). These FAA Advisory Circulars offer guidance for the installation of instruments using a power source, in addition to the requirements for instrument backlighting. Additionally, the policy states that the final installation and instrument arrangement must allow for use of partial panel operating techniques should the electronic attitude indicator fail.

By the way, we're talking about minor alterations here—no field approvals—as long as the instrument has a TSO. This means installations can be signed off with a logbook entry if certain technicalities are met. This may include providing a new and dedicated circuit breaker for powering the instrument.

Additionally, the electronic attitude indicator must fit into the existing location of the vacuum-driven gyro, while not displacing the other originally certified instruments in a "basic T" panel arrangement. All of the models in our roundup satisfy that requirement.

The policy doesn't give the green light to ditch the backup attitude instrument (mechanical or electronic), which is a requirement to back up Aspen's Evolution-series and Garmin G500/600 retrofit PFD systems. Since the STC for these systems specifically require the presence of a standby attitude instrument, they need to remain in the panel and can be electronic when approved by the STC.

display backlighting and for manual alignment of the attitude display.

Roll data is shown in fixed pointer format—the pointer remains in a fixed location relative to the instrument housing and the roll scale rotates with the horizon. The background blue/brown horizon is configured such that some ground or sky reference always remains present on the screen.

The pitch ladder and heavy white horizon line will disappear from the background horizon in these cases. Slip data is shown in a format that mimics the mechanical inclinometer (white ball in a glass tube), and the left and right stops represent plus and minus 7 degrees of slip.

DEAL BREAKERS

As enthusiastic as we are to finally see the FAA recognize electronic attitude indicators worthy for primary, standalone replacements for iron gyros, the market may not be ready.

As mentioned, the BendixKing KI300 is the only attitude instrument in this roundup equipped to drive attitude-based autopilots—and even that is limited to BendixKing models.

That means the other instruments won't do what we think owners really want, and that's get rid of the finicky and costly spinning gyros that interface with Century, Piper and ARC/Cessna attitude-based autopilot systems.

Those buyers will look to the retrofit PFD market, including Aspen's Evolution PFD and Garmin's G500. Both offer autopilot gyro emulators based on digital AHRS input.

But for simpler applications, including aircraft without autopilots and even for those equipped with rate-based autopilots (which rely on the turn coordinator), we think the Sandia Quatro is the model to beat. With a brilliant display, plus airspeed and altitude functions and an all-inclusive street price of $3200, we think it's a solid value.

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Certified Pre-Owned: Good As New?

No, but factory certified pre-owned aircraft are generally the best on the market. You'll pay a premium for well-kept logs, cherry cosmetics and a warranty.

by Larry Anglisano

Cirrus, Mooney and Cessna offer factory certified pre-owned aircraft as alternatives to buying new models. This is attracting attention in a brisk and comparably priced refurbishment market.

It's an attention-getting and confidence-building strategy that's worked for years in the auto industry. To be sure, there's at least some sharp marketing involved here. When the manufacturer provides a certificate of approval for maintenance history, cosmetic condition and prescribes a thorough engine and airframe inspection process, dealers tack on a premium that's roughly 10 percent more than a non-certified used model, in many cases.

Let's take a closer look at the process, the warranty and the economics.

WHEELS-UP WARRANTY

That's generally the case with most used aircraft purchases when you buy the airplane as is, where is, hopefully after completing a thorough pre-purchase evaluation. While a pre-purchase eval seems like an obvious stage in the purchasing process, it doesn't always happen. The consequences can be severe.

We remember the sad story of a new pilot who bought a used Mooney over the Internet from an otherwise reputable broker, but ended up shelling out an additional $50,000 in unexpected engine and avionics repairs within weeks of flying the aircraft home. He sold it a loss and walked away from aviation.

That's the way it goes sometimes, and for the buyer left holding the account-draining repair invoices, an aftermarket repair warranty looks pretty good. More on those later.

Late-model aircraft may still have some factory warranty remaining. Aircraft dealers love these machines because the aircraft essentially sells itself. Expect to pay a premium for them, and for those with a factory pre-owned certificate of approval.

The good news is that many later-model aircraft are well cared for, both cosmetically and mechanically. But that makes the certified pre-owned purchasing decision questionable, in our view, since the short-term warranty that tags along represents most of the added cost. That might not be the case, however, for older models like first- and second-gen Cirruses, which could be approaching 15 years old.

If you own a late-model aircraft, you might utilize the upkeep guidelines of the following pre-owned certified programs as a reference for maintaining it. It could increase its value should you sell.

MOONEY CERTIFIED

Mooney's recent announcement of its factory-backed certified pre-owned aircraft program is a creative way to attract new buyers to the brand, if not reinforcing its renewed market presence. The company told us demand for its factory new $699,000 Acclaim Type S and $649,000 Ovation3 models is high, and the certified pre-owned program for used Ovation3 and Acclaim models can satisfy some of that demand.

Cirrus used to handle pre-owned aircraft reconditioning and resale alongside new production, main photo, but now partners with two dealers that manage used inventory.

CHECKLIST

- If cosmetics and factory-approved service history is important, pre-owned certified makes sense.
- Expensive aftermarket warranty coverage is questionable for newer aircraft.
- Certified pre-owned aircraft aren't refurbished and have a short-term limited warranty.

The 916-hour 2008 certified pre-owned Mooney M20TN Acclaim offered by Premier Aircraft, top, is listed for $499,999. **Aircraft Bluebook** *suggests an average retail price of $365,000. As the Cirrus fleet ages, Lone Mountain Aviation has completely refurbished select models, including the second-gen SR22 in the lower photo. It sold at a price premium, given the extensive cosmetic and mechanical rework.*

Mooney's program is executed on the dealer level, and was developed in partnership with Fort Lauderdale, Florida-based Premier Aircraft Sales. Premier is no stranger to new and used Mooney sales, service and advanced refurbishment work. It's known for the spinner-to-tail refurbishment, plus the Continental diesel engine conversion of pre-Garmin G1000 Cessna 172 models.

But the Mooney program focuses only on G1000 models built between 2004 and 2014—roughly 300 aircraft. Many of the Mooneys that meet the program's criteria are sourced from within the dealer network (many have been taken on trade). As we print, Premier currently has four used G1000 Mooney models for sale. There's a reason for not including vintage M20J aircraft, among other pre-G1000 Mooneys, and aftermarket avionics retrofits are partly to blame.

Mooney's Jared Absher told us the company excluded pre-G1000 models because there are just too many variables in aftermarket avionic configurations in more vintage aircraft. "It's tough to standardize and endorse those vastly different configured aircraft. When it comes to the G1000 in newer Mooneys, we know what we're dealing with," Absher said.

While there were only slight variations in the G1000 suites in the Mooney model line (which includes WAAS and non-WAAS aircraft), Mooney is dealing with the WAAS GPS and ADS-B issue that's been a source of frustration for G1000 owners. Absher said the company is close to a certified ADS-B Out upgrade solution through Garmin's GTX33ES ADS-B remote transponder, plus a G1000 software revision.

Absher stressed that the program isn't a total refurbishment process, but rather a way for buyers to source a used late-model Mooney that underwent a stringent inspection and cosmetic (paint and interior) repair process. The aircraft won't be in like-new condition, but perhaps cleaner and with more complete documentation than other used models not in the program.

One item Mooney is looking for is proof that the aircraft has been maintained by a Mooney service center throughout its life, theoretically proving the aircraft has been thoroughly maintained and inspected to factory standards. Airworthiness Directives, service bulletins, and Mooney maintenance manual items are addressed, plus all required and recommended inspections are current. The process ensures that the engine and prop comply with manufacturer overhaul recommendations, plus control rigging is tested and adjusted.

All told, the program includes a 27-point inspection and repair process, which results in a 30-day or 10-hour warranty. All aircraft in the program are issued a factory-signed certificate of authenticity verifying all work was accomplished.

Mooney's Absher was unapologetic about the program being—in part—a way to increase the value of used aircraft to build buyer interest in factory new models. Even with a potential $200,000 spread between the cost of a mid-time, certified pre-owned Acclaim and a new one, we suspect qualified buyers will do precisely what Mooney hopes—consider placing an order for the new one.

How the program will alter the market value of vintage models is unknown, but Absher thinks it might have at least some positive effects.

"If these late-model certified air

AVGUARD WARRANTY: ROLL THE DICE

An alternative to paying the price premium for a certified factory pre-owned aircraft is paying for a fixed insurance premium for aftermarket warranty coverage. Dating back to the 1980s (originally offered at a used Piper dealership), AvGuard's current AmTrust Financial Services-backed aftermarket extended warranty covers unscheduled maintenance for piston singles through mid-size jets and helicopters, based on a choice of 200, 500 or 750 annual flight hours. The program covers 447 makes/models manufactured between 1985 and 2015 and doesn't require an inspection.

An AvGuard transferable policy, purchased annually, doesn't cover scheduled maintenance and items like brakes, tires, paint, seats or interior accessories, to name a few. It does cover the engine, propeller, flight controls, electrical system, avionics and pressurization system, if equipped. Unlike a certified pre-owned warranty, repairs can be made at any shop certified shop.

If you operate your engine beyond TBO—and with proper inspection and maintenance we can't think of many reasons why you shouldn't—AvGuard's policy is void. While TBO is based on an engine manufacturer's recomendation on when to overhaul the engine, it is not required and engines can easily exceed that time.

Theoretically, say four out of the six cylinders on your engine (if under TBO) are toast. AvGuard says many owners will proceed with a full top-end overhaul and apply the payment the policy makes for the four cylinders to the cost of the overhaul. This might actually benefit AvGuard, since it reduces its liability for future repair claims. AvGuard keeps a file for each aircraft it insures, tracking maintenance, component warranty status and usage. Any modifications made to aircraft must be manufacturer or STC-approved.

Much like reporting an incident to an insurance company, the program requires the owner to report a mechanical failure via telephone or on its website to one of its claims adjusters, who according to AvGuard's Les Brent, "can just about troubleshoot the problem over the phone with the pilot and will have a really good idea of what needs to be looked at." When the aircraft gets to the shop, Brent described a process where AvGuard's adjusters work directly with the shop on approving the repair—or not. That's because if there isn't a hard failure, AvGuard won't cover it. Have a cylinder with declining compression? Just because failure is imminent doesn't mean

the policy will cover it. It has to fail. That's not necessarily a deal-breaker, in our view. Owners defer discrepancies all the time, often through the advice of a shop.

But it also means that discrepancies found during an annual inspection have to be approved by an adjuster. If an owner (and a shop, for that matter) takes a proactive approach to maintenance, we think this wait-and-see policy can lead to conflict. In our experience, similar conflict can occur with managed maintenance programs. As one shop manager once pointed out, how can someone sitting behind a desk thousands of miles away know for sure that an item can be deferred to the next annual without it failing? But, for an owner with limited time or knowledge (and with a cooperative shop), we think managed maintenance programs can work.

AvGuard's warranty coverage is available for avionics—both retrofit and OEM glass suites. Brent told us it incorporates avionics manufacturer extended warranty policies (Garmin and Avidyne) into the coverage.

We asked Avidyne—which requires buyers to sign an indemnity clause when signing up for its FlexCare extended warranty—if AvGuard is exempt from signing the clause and were told it doesn't even sell warranty coverage to AvGuard. Neither does Garmin; it told us the FliteLevel warranty is only sold through its approved dealer network. Regardless of how AvGuard pays for an avionics repair claim, we can't see buying one of its policies without avionics coverage given the flat-rate out-of-warranty costs of component swaps. These costs were one reason why AvGuard restructured its premiums. As a result, the cost of a yearly policy is eye-widening, as the pricing chart below proves. AvGuard's premiums can further skyrocket based on aircraft age and complexity.

Shops we spoke with having experience with AvGuard policies on aircraft they wrench had positive things to say. For buyers skeptical about aftermarket warranties in the first place (buying any extended warranty is a dice-roll, in our view), we think AvGuard's pricing will be a tough sell. AvGuard said it plans to offer tailored coverage to used aircraft dealers. Who knows, burying an AvGuard premium in the sell price might help sell more airplanes, as factory warranties do for pre-owned certified models.

AFTERMARKET WARRANTY	ANNUAL PREMIUM
2001 CIRRUS SR22	$9728.13 *
2006 CESSNA 172	$8492.19 *
1985 BEECH BARON 58P	$68,831.88 *
1990 BEECH BONANZA A36	$17,484.00*
GARMIN FLITELEVEL— G1000 (* 3 YEARS)	*$7380.00
AVIDYNE FLEXCARE FOR DUAL ENTEGRA	$1000.00

* INCLUDES COVERAGE FOR OEM OR AFTERMARKET AVIONICS

craft are demanding a higher value in the market, I believe there might be a small trickle-down effect for older models, too" he said.

CIRRUS PRE-OWNED

Cirrus' factory certified pre-owned department started in 2006 when the company bought trade-in aircraft on its own and resold them after performing a stringent inspection and reconditioning process. This helped the company sell new airplanes, of course, given the number of repeat customers looking to step up to later-generation models. Cirrus even offered financing incentives similar to what was offered on a new aircraft, while offering a factory warranty. Buying a used Cirrus was almost the same process as buying a new one. Most buyers even skipped a prebuy inspection, given their confidence in the quality of the aircraft and warranty.

Cirrus eventually divested itself of owning any used inventory, partnering with Ohio-based Lone Mountain Aircraft Sales and TAS Aircraft Sales in Portland, Oregon, to carry, manage and resell the used inventory.

Lone Mountain's Mark Rogers made it clear that not all used Cirrus models make the cut for factory certified pre-owned status, which carry a six month, 100-flight-hour limited factory-backed warranty.

We read the warranty and found it to be concise, generally well-written and inclusive of what we might expect. It covers major systems including the engine, starter, alternators and avionics, but not the paint, light bulbs, brake linings, filters, hoses and tires. Planes that aren't worthy of certified pre-owned status are sold as is.

On the other hand, Rogers noted that many Cirrus models are still under the factory spinner-to-tail extended warranty—a popular option that was and is still offered by Cirrus at the time of sale. This could potentially extend coverage out to five years, including the original two-year coverage. As we describe in the sidebar on page 6, it's possible to purchase an aftermarket warranty, but Rogers noted that many price-conscious buyers simply self-insure.

To be eligible for certified pre-owned status (and a Cirrus Pre-Flown warranty), the aircraft must have no damage history, it must not have any structural repairs, it must have been maintained within the Cirrus service network for all of its life (with maintenance performed exactly per the maintenance manual), the maintenance logbooks must be complete and in orderly condition and oil changes must have been completed per recommended intervals. Aircraft that were ever in the experimental category (even if it was temporary) are not eligible.

Cessna's pre-owned certified program for piston models could be grounded. A pre-purchase inspection on later models should include ensuring mods and service bulletins are current on the G1000 avionics.

Lone Mountain isn't necessarily concerned with minor cosmetic flaws, including scuffs, scratches and normal interior component repair. This will be addressed as part of the certified pre-owned resale process.

"If it's necessary, we'll replace the carpeting, resurface the leather seats and armrests and generally bring the aircraft to a cosmetic standard that is above average," Rogers told us.

In addition to a cosmetic makeover, the process includes an extensive annual inspection (a $20,000-$30,000 annual, Rogers told us) while also addressing any mechanical issues necessary to meet or exceed Cirrus maintenance manual-recommended and time interval-driven standards. This might include replacing the magnetos and flexible hoses, for example, and even replacing the engine and or overhauling the propeller if the systems are at or approaching TBO.

But for older aircraft that require sizable amounts of rework just to meet certified pre-owned standards, Lone Mountain has been alternately refurbishing them, which, according to Rogers, comfortably fit the qualification of the certified pre-owned program. The refurb could include a complete strip-and-paint, new interior, a factory rebuilt engine, overhaul Hartzel propeller, plus fresh logbooks.

MEANWHILE, AT CESSNA

During our research, we spotted a section on Cessna's website advertising its factory certified pre-owned program for late-model 172, 182 and 206 models. It farms out the program to six designated Cessna dealers in the U.S.

Air Orlando in Orlando, Florida, is one of them. Company principle Mike Long told us he was instrumental in developing the program in response to the demand for such a program, and sold several pre-owned aircraft delivered with Cessna factory certified certificates in their logbooks.

Long said the aircraft selection process of model year 2007 and newer aircraft is based on cosmetic items that would impede saleability, while performing a detailed mechanical and logbook inspection ensures that any questionable maintenance and damage issue is addressed.

After reviewing a checklist of items completed on the aircraft, Cessna signs off on the aircraft by providing a pre-owned certificate.

"We felt that as time went by, a certified pre-owned aircraft with a factory certificate would enhance its value, thereby increasing its trade value against the price of a new Cessna," Long said. He also said it's realistic to expect the aircraft to have a 5-percent price delta over one not in the program.

Since these later-model aircraft all have Garmin G1000 avionics, included is a one-year Garmin FliteLevel extended warranty, purchased by the selling dealer. For aircraft out of Cessna's two-year warranty, the aircraft were sold with six-month AvGuard extended warranty policies.

As of this coming January, Cessna will sell its piston line direct, eliminating the dealer network. It's unclear whether the pre-owned program will continue.

THE WILD WEST

As one aircraft sales professional put it: "When it comes to the used aircraft market, it's the proverbial Wild West out there. Where you buy is just as important as what you buy," he told us. We agree. The dealer you want to buy from might be flexible to do buyers right on items that fail shortly after the sale, even when it has no obligation to do so.

Used aircraft dealerships that sell the most aircraft and that are in business for the long term do so by keeping buyers happy. Van Bortel Aircraft in Arlington, Texas, currently offers a 100 percent, 60-day/60-hour (and 85 percent, one-year/120-hour) money back guarantee on every pre-owned Cessna it sells. That's impressive.

In our view, working with flexible dealers like them to help find the cleanest, best-maintained used aircraft you can afford is an alternative to paying a price delta for a certified pre-owned model with a short-term warranty you might not use.

Exhaust Systems: Inspection is Critical

When exhaust systems wear out, they create a serious safety of flight risk. Replacement systems from Power Flow claim to boost performance.

by Rick Durden

For most owners, the exhaust system is an out-of-sight, out-of-mind portion of the airplane. It's certainly not a sexy part of any aircraft—even the FAA's description of the exhaust system in its Airframe and Powerplant Mechanics Powerplant Handbook is a little off-putting: "…a scavenging system that collects and disposes of the high-temperature, noxious gases as they are discharged by the engine." Nevertheless, all exhaust systems deserve a great deal of respect and your attention and consideration because they live in a horrible environment of intense heat, flame, corrosive gases and vibration. Plus, if any component fails, the risks are nothing short of serious: carbon monoxide poisoning of the aircraft occupants, partial or total engine power loss and fire.

Despite being made of materials designed to withstand the nasty process of ducting the products of combustion overboard, exhaust systems will eventually wear out and need to be repaired, overhauled or replaced. When that time comes, what are your options and what is it going to cost? We'll go through a brief discussion of the makeup of exhaust systems, how they are inspected, what's most likely to go wrong and what is available when your exhaust system has done its job and is ready for retirement.

The good news is that there are reputable specialty repair facilities and aftermarket suppliers of new and overhauled exhaust systems for virtually all general aviation airplanes and there are two companies that offer exhaust systems for some airplanes that claim—honestly, we think—to increase engine power output and aircraft performance.

CARE AND FEEDING

According to shops and owners we spoke with, a new exhaust system may or may not make it to the engine's TBO. As Scott Utz, principal of Arapahoe Aero on Denver's Centennial Airport, told us, "The system not only has to withstand all that heat and vibration, it has to be light enough to fly." Normally made of stainless steel or the nickel-chromium alloy, Inconel, an exhaust system wears from the inside out, which makes an evaluation of its condition challenging until signs of wear show up in the form of cracks, holes bulges or ripples.

Mike Busch, proprietor of Savvy Aircraft Maintenance Management, which manages a large number of turbocharged general aviation airplanes, told us that his company most often sees exhaust systems first develop problems on the outside radius of bends in the system—something that isn't surprising when you think of what's involved in getting 1600-degree gases to change direction. Busch told us that every system tends to have a component that shows wear faster than the rest of the system and a shop that is knowledgeable about that type of airplane will inspect accordingly.

Utz said that the manner in which the pilot operates the engine affects exhaust system longevity—turbocharged engines run at higher TITs tend to have exhaust systems that wear out more quickly. As with cylinders, the more heat, the shorter the life. He also pointed out that cal-

Cessna 150 exhaust pipes that each developed holes in the outside radius of a bend, right. This turbocharged twin Cessna exhaust slip joint failed internally and seized, below right.

endar time on the system is important—he sees exhaust systems last through TBO on airplanes that are flown frequently enough that they hit TBO in 10 years or less, but less often on airplanes that are not flown regularly. He noted that exhaust systems on turbocharged airplanes require more maintenance than on normally aspirated engines due to the heat generated by turbocharged engines.

WHAT CAN GO WRONG

As exhaust systems wear, the components become thinner and become susceptible to cracking from vibration, or bulging—and blowing out—from the pressure. If an internal component in, for example, the muffler, cracks and breaks off, there's a chance it can lodge where it restricts the flow of the gases through the exhaust. That increases exhaust back pressure on the engine, so each cylinder cannot scavenge the combustion by-products out through the exhaust valve as effectively—reducing the power output. The power loss may be so significant that the airplane cannot hold altitude or that the engine will not continue to run.

An opening in the exhaust system in the heat exchanger for cabin heating means that exhaust gases are going to be introduced into the cabin. Pilot incapacitation due to CO poisoning is the cause of a few accidents every year.

If an exhaust system component breaks off or opens up, that means the blow torch of exhaust gases is being released inside the cowling. There's not a lot of empty space inside the cowling, so the odds are good that the blow torch is going to be pointed at something important—perhaps a fuel or oil line or an engine mount. It doesn't take long for that blow torch to open up a flammable fluid line and start a fire.

We strongly recommend that if your mechanic tells you that there is an issue with the exhaust system, that you take it seriously and have it repaired before your next flight. In more than one of its publications, the FAA states unequivocally, "You should regard any exhaust system component failure as a severe hazard." We agree.

One of the common symptoms of wear in an exhaust system is the seizing up of slip joints. Slip joints are as they sound—one bit of exhaust duct slips inside another so that they can slide back and forth as needed to compensate for expansion and contraction as well as for movement of the engine on its mounts. Over time, those joints wear out and seize. Once the joint will no longer move, loads are passed to others areas of the exhaust system and cracks develop, usually adjacent to a weld.

FIXES

Okay, your mechanic just said that components on your exhaust system have problems, notably a crack on one and a bulge on another. What are your options?

It's not uncommon for mechanics to do field weld repairs on exhaust systems, especially on normally aspirated engines. Because the quality of welds we've seen has varied dramatically, we are not big fans of weld repairs of exhaust systems unless carried out by shops that specialize or mechanics who know precisely what they're doing. We note that weld repairs are prohibited on some turbocharged engine exhaust systems, notably twin Cessnas, because of a history of catastrophic accidents.

It is possible to replace one or more components of your exhaust system, although putting a new or overhauled part into an older system often means challenges with alignment of the system—and may cause other parts to crack.

POWER FLOW SYSTEMS

After years of developing and manufacturing speed mods for Piper aircraft, Robin Thomas started Power Flow Systems (www.powerflowsystems.com) with the intent of using automotive technology to design "tuned" exhaust systems for aircraft. To accomplish this, Power Flow says it customizes the exhaust tube for each cylinder so its length—from cylinder to the collector where the tubes join—causes the low pressure traveling down the tube behind an "exhaust puff" to reach the collector in time to suck out the exhaust from the next cylinder.

In 1999, Power Flow received its first STC for an exhaust system for Cessna 172s using the four-cylinder Lycoming O-320 engine. The system involved a goofy-looking pipe assembly that extended below the fuselage and was supported by a rod. Eventually, Power Flow developed systems that didn't have so much hanging outside of the airplane. The early system for a 172 is shown above left, the current system is above, right.

Depending on the type of airplane, Power Flow claims measurable power increases with its exhaust system—23.8 HP on a 160-HP Lycoming O-320-A1A engine in a Cessna 172. The power increase translates into an increased rate of climb and cruise speed. It also means greater fuel consumption—as is expected with more power. However, as Power Flow points out, if the pilot reduces power to cruise at the same speed as before the mod, fuel consumption decreases. Depending on the installation, the fuel saving is from one to three GPH.

In late 2008, *Aviation Consumer* surveyed Power Flow customers and found that the majority were satisfied with the system and reported performance gains consistent with Power Flow's claims.

Power Flow offers a 60-day trial period for its system—if you don't like it in that time, you can return it for a full refund. You're only out postage and the cost of install and removal. We think that's a good deal. Beyond 60 days, the warranty is one year or 500 hours of operation.

Until recently, a Power Flow exhaust was only available for four-cylinder Lycoming-powered airplanes; however, the company is in the process of developing a system for six-cylinder, IO-520-equipped Bonanzas.

Prices for the systems vary by airplane and options—and there are discounts if you are willing to wait a few weeks or months for your system—but figure on $4000 to $5500 and five to 10 hours for the installation.

If it's time to replace the exhaust system on your airplane, and there's a Power Flow system available, we think it's worth serious consideration.

When systems show signs of distress, shops tell us that their practice is to pull the system and send it out to a specialized shop asking the shop to "evaluate and advise." The major players in the exhaust system repair/replacement field are Knisley Welding, Inc., Aerospace Welding Minneapolis (AWI), Heliarc Welding Service, Inc. (turbocharged Cessnas) and Acorn Welding (Canada)—the shops we spoke with recommended all of them. All of the specialty houses can do repairs and most offer new or overhauled components and systems. Overhauled means that some portion of the original component was reused. In some cases, the specialty houses have developed and received approval for modifications to original equipment systems that increase life or reduce heat on engine accessories by rerouting the system.

Because the system wears from the inside, the specialized shops have the equipment to measure the thickness of components and can give recommendations on whether they can be repaired or must be replaced.

Because turnaround time can matter, we recommend calling the specialty shops before sending out an exhaust system to assure that the one you use has replacement parts on hand in the event your system can't be repaired.

Cost of replacement systems vary depending on whether new or overhauled parts are used and the

LEADING EDGE EXHAUST SYSTEMS

In 1995, following 10 years of running a company that performed aircraft exhaust system repairs, Dane Wagner opened Leading Edge Exhaust Systems (LEES) (www.wemakeyoufly.com), in Anchorage, Alaska. He was determined to build aircraft exhaust systems that were not only of higher quality and more robust than OEM equipment but that would allow the engine to develop more power. Having experience with the needs of the Alaska bush operators, he targeted their airplanes of choice, the Cessna 180 and 200 series and the Piper PA12, 18 and 20/22. The Cessna 182 system is shown in the inset photograph.

Prior to and during his aviation career, Wagner had been involved in automotive racing, including the Indianapolis 500 and made use of technology for exhaust system efficiencies developed in the automotive world in the design of LEES exhausts.

Wagner worked to incorporate laminar flow technology into the systems and chose not to use the stamped out and welded together half-sections common in OEM exhausts as he said they create flow turbulence and back pressure on the engine. LEES exhausts use separate, equal-length primary tubes that are mandrel bent—helping to balance the back pressure on the cylinders and create a low pressure at each exhaust port at the time it opens to facilitate scavenging of the products of combustion.

According to Wagner, the design also can enhance filling the combustion chamber with the incoming fuel/air mixture, improving volumetric efficiency and horsepower.

Leading Edge states that customers can expect to see a horsepower gain of approximately 10 percent using its pipes with a reduced brake specific fuel consumption (BFSC) and increased torque. It also states that its testing debunks the myth that removing muffler baffles increases engine horsepower—when it removed its patented baffles from its muffler, the dyno showed a loss of five HP and 10 pound feet of torque.

LEES primary exhaust tubes are made of 321 stainless steel that is 0.049 inches thick, some 40 percent thicker than most OEM systems. Leading Edge says that its beefier systems should last at least through engine TBO and offers a one-year, unlimited-hour warranty on most of systems, although for the PA-12, 180-HP short mount system, it's 10 years or 1000 hours. For the exhaust collector for the 200-series Cessnas it offers what we consider to be an amazing warranty—20 years or 2000 hours of operation, and the warranty is transferrable. The company asserts it has customers who have put 5000 hours on its collectors.

Prices for Cessna 200-series exhaust collectors start at $2750; for complete exhaust systems for its Piper and Cessna lines, prices range from $4400 to $6500, depending on the specific system and options. According to its website, Leading Edge does not stock complete systems—yours will be built for your specific airplane once Leading Edge receives your order and deposit.

size and complexity of the system. As reference, we were told to figure on $6000 for a new replacement system for a Piper Cherokee 180, installed.

MORE PERFORMANCE

Will a replacement exhaust system boost my engine performance? In general, no. While a new system should mean less back pressure on the engine than one that is slightly clogged with deposits built up over the years, the difference is probably not going to be noticeable. However, there are two companies, Power Flow Systems and Leading Edge Exhaust Systems (see sidebars), that have specifically developed and received approval for new exhaust systems that are designed to increase engine horsepower by reducing back pressure. The companies use techniques long in use in auto racing and, because the original aircraft manufacturers were generally just interested in safely finding a way to get the exhaust outside the airplane within the confines of the cowling, we are not surprised that the Power Flow and Leading Edge mods do work.

CONCLUSION

Aircraft exhaust systems balance the demands of weight versus longevity in an environment of horrendous heat and nasty vibration while generally being ignored by the aircraft owner. We strongly recommend that you eyeball the visible portions of your exhaust system for cracks and areas of gray soot on each preflight and make sure it is inspected carefully at each annual—and that you take seriously any signs of distress.

The good news is that no matter what you fly, there is probably a company that specializes in repair and replacement of the exhaust system on your airplane. And, if it's time for replacement—for about the same price as replacing the system you now have—you may be able to buy a system that will increase power output and aircraft performance.

MARKET ANALYSIS

Nextant's King Air: Faster, Higher, Cheaper

At least that's what the company claims for its ambitious King Air C90 remanufacture project. Its success with the Beechjet 400A definitely proved the concept is sound.

by Paul Bertorelli

Modifying airplanes that the original manufacturer got almost right has been a constant in general aviation. But lately, we call it something different: remanufacturing. And if any company is the Alpha dog of this process, it's Cleveland-based Nextant Aerospace, which has had impressive success remanufacturing Beechjet 400As. Now it's poised to repeat the trick with the popular King Air C90 series.

It's no accident that Nextant has concentrated on Beechcraft products. The company is looking for durable, over-engineered airframes manufactured in relatively large populations. Both the 400A and certainly the King Air qualify, even if Nextant is picky about what airframes it will rework.

> *"The aerodynamics have to be conducive to improving upon it; you can't simply take an old outdated airframe and make it new again."*

When pushed into Nextant's hangars at Cuyahoga County Airport, hard by Lake Erie, the airplanes are decade-old hydromechanical stalwarts with steam gauges. About 140 days later, they emerge as nose-to-tail remans with the latest digital technology that even bests what the factory might offer. Given the prices, the economics are compelling enough that the industry is feeling Nextant's influence. We recently visited the company's works to get a feel for the emerging King Air project.

THEY FLY THESE THINGS

Nextant is nestled amongst a group of companies under a parent called Directional Aviation, a closely held company managed by CEO Kenn Ricci. All of the operating units—there are nine—are aviation related and juxtaposed to create what might be ideal synergy for remanufacturing airplanes. Directional's portfolio includes two fractionals—FlexJet and Flight Options—two charter companies, an aircraft sales outlet and three maintenance organizations. This mix of companies evidently led quite naturally into the Beechjet 400A project. "We operate 90 Beechjet 400As between FlexJet and Flight Options. So we knew what these airplanes are capable of and what it requires to maintain them," says Kent Stauffer, Nextant's VP of operations and customer support. The 400A has a reputation for being fast and robustly built and readily maintainable into the future, despite being out of production for more than a decade, if not longer. But it has warts, too.

The Pratt & Whitney JT15D-5 engines are considered old technology and even the latest versions of the airplane have analog gauges and dated avionics. Nextant sales and marketing VP Jay Heublein describes the 400A's original engine mount pylon as "a mess" that caused vibration and cracking in the horizontal stab and had poor thrust delivery and aerodynamics.

Much of Nextant's developmental effort focused on reengineering the engine pylon and fitting more efficient, high-bypass Williams FJ44 engines. Moreover, the airplanes are stripped to bare metal, rewired and replumbed, repainted and upholstered and given new Collins Pro Line 21 avionics. They emerge from the rebuild as near-new fully digital airplanes that merit the ultimate recognition: An *Aircraft Bluebook* value line that marks them as a new model year.

If anyone doubted the business sense of Nextant's template, the numbers should allay them. When we visited last October, the company was about to deliver airframe number 60 and the King Air project, called the G90XT, was ramping up.

WHY KING AIRS?

While other companies have tended to gussy up older airframes with paint and avionics, Nextant pursues a cannier philosophy. "In our space, what we're looking to do is find

airframes that are over engineered or have the capability to apply design improvements that are still sustainable in the future," says Nextant's Stauffer. "For example, the aerodynamics of the airframe have to be conducive to improving upon it; you can't simply take an old outdated airframe and make it new again," he adds.

Nextant found this in the Beechjet 400A with the aforementioned reengining and pylon redesign, something largely made possible by computer-aided design analysis that didn't exist when the airplanes were originally designed and that Beech lacked the resources to apply as the model matured. The King Air C90 series meets the same design brief.

Despite being a 50-year-old design, it's still in production with about 20 to 50 units sold each year. (The larger 350 is the King Air current best seller.) Nextant—and King Air owners—like the fact that the model has a reputation for rugged maintainability and over engineering at every turn. That explains, says Heublein, why there are more than 1600 examples in the field that Nextant can mine for remanufacturing. As a test case to prove the concept, the C90 that Nextant used as its test bed is the oldest, highest-time King Air the company could find that it would consider for remanufacture. With four years of 400A rework behind it, Nextant had a clear picture of how to upgrade the C90.

"When we look at airplane design, everything has to buy its way onto the airplane in a couple of categories," says Heublein. "One is, will it significantly impact the overall safety of the operation? And it has to significantly affect the operating cost to the positive. It's got to increase dispatch reliability or decrease maintenance costs. If it doesn't do those things, we're not necessarily going to bring that technology onto the airplane," he adds.

Specifically on the G90XT, Nextant's design plan translated into new engines and reworked nacelles, new avionics, pressurization and environmental systems and, as with the 400XTi, a complete redo of wiring, plumbing and paint. The result, Nextant predicts, is an airplane that will climb faster, cruise higher and faster and carry a little more than new

Nextant installs Garmin's G1000 in the G90XT, with an ESP-equipped GFC 700 autopilot. With limited electronic engine control, the aircraft will have single-lever power, right. The prop levers are fail-safe backups. Nextant's 400 XTi, below, has premium interiors with improved acoustic insulation. The G90XT will get the same.

C90s emerging from the factory in Wichita, all for a lot less money than a new airplane costs.

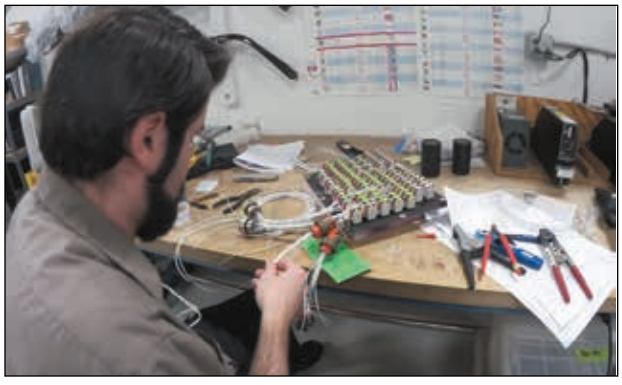
The big-ticket item is reengining, replacing the venerable Pratt & Whitney PT6A-135 with the GE H75, a powerplant that both GE and Nextant claim is more thermally robust, more efficient and less maintenance hungry than the Pratt. (See the sidebar for details on the engine.)

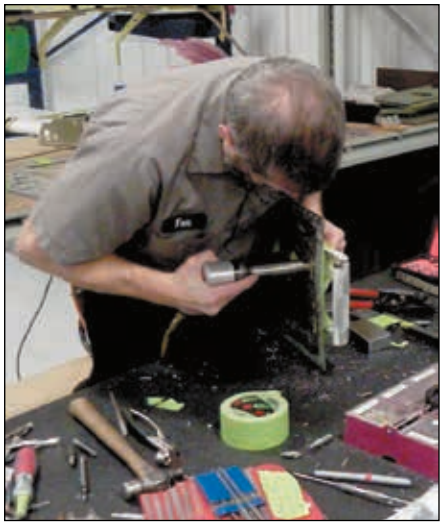
DOWN TO THE NUBBINS

When we were walking the production floor with Kent Stauffer, he said that during its remanufacture process, the airplane will be revealed in more intimate detail than at any time since it was built. That might be an understatement. As it did for the 400As, the King Air remans will be completed in four steps using Nextant's cellular approach to manufacturing. The airplanes stay put in the hangar, but work teams cycle from airframe to airframe, completing each stage.

Nextant calls the first step deletion, in which all of the old equipment and wiring is removed, with about 90 percent of it replaced. The aircraft are given an invasive inspection in search of damage or corrosion which is repaired using either OEM parts or Nextant's own PMA components. (It has more than 2000 PMAs and its own Beechcraft parts network.)

In both the King Air and 400A, we saw interiors stripped down to the inner hull with fresh harnesses in





Nextant's test article, top, is the oldest and highest-time King Air the company thought worthy of reman. The company has extensive wiring and metal shops at its Cuyahoga County headquarters hangar, center photos. Owners complain about poor-performing air conditioning so Nextant installs new, high-capacity electric Freon units, bottom photo.

place, all prepared in Nextant's wire shop. Nextant also has a metal and machine shop and, on another site, an interior shop.

"In-house or in the group, we have a company that does everything except paint," says Stauffer, and even that is about to come in-house, making Nextant one of the most vertical companies we've seen. Stauffer said keeping the work inside improves scheduling, controls costs and maintains quality. If Nextant reaches the same volume in the G90XT as it has with the 400XTi, production control may be more critical than ever and we suspect there will be some physical expansion. The hangars were nearly full when we visited.

In addition to the engine change and nacelle modifications, the G90XT gets a full avionics remake with a Garmin G1000 and GFC 700 autopilot. It also gets new environmental equipment. "One of the biggest complaints we hear from King Air owners is about the air conditioning," says Stauffer. "The two-zone Freon system we install will cool a heat-soaked cabin to 70 degrees in two minutes," he adds. Nextant claims its environmental system, including digital pressurization control, bests the factory system being installed on new King Airs.

They make a similar claim about their version of the Garmin G1000. The fuel system is fully integrated into the G1000. "No one had ever done that before. That gives us an advantage because even the new airplanes have 1960s technology for fuel management," says Heublein.

PERFORMANCE, PRICE

When we visited, the G90XT had completed certification testing, but final approval was still at least a week away, so we weren't able to fly the aircraft. Nextant hasn't released final performance data, but Heublein says initial data shows that even though the engines are a bit heavier, as is the air conditioning, so much weight is removed from the old aircraft in avionics that the airplane should pick up a slight payload bump. The weight removal also helps the airplane's tendency toward a forward CG.

The larger gains, according to Heublein, will be in flight performance. At 550 HP, the H75 is substantially derated mainly because of airframe limits. Because of its surplus thermodynamic margin, the G90XT will be capable, according to Nextant, of climbing faster and cruising both higher and faster where the PT6A tends to be temperature limited, especially on ISA-plus days. It also has a single-lever power control thanks to the limited-authority engine control GE developed. That means the pilot doesn't have to worry about temperatures during starting or climb, but merely advances the throttle for more power and yanks it back for less. Two condition levers are retained (see

photo on previous page) as backup for the electronic controls. In normal operations, they shouldn't be needed.

Heublein thinks the engines' non-temperature-limited performance will translate to 15- to 20-knot higher cruise speeds at altitude, 20 percent faster climb and 10 to 12 percent reduction in fuel burn. If this data proves true, those are killer numbers, in our view. We'll find out when we're able to fly the airplane.

Nextant is bringing in its 400XTi at a little more than half the price of the closest competition, which it considers the Embraer Phenom 300 or the Citation CJ3. Heublein told us the typical 400XTi invoices for a just over $5 million, while the new jets in the same market space sell for between $8.3 million and $9.3 million.

On the King Air side, Nextant says the G90XT will sell for between $2.3 and $2.4 million if the customer supplies the airframe and between $2.8 to $2.9 million if Nextant sources the airframe. According to Textron's price list, a new King Air G90GTx retails for about $3.9 million, so Nextant's G90XT represents a savings of $1 million to $1.6 million against a new model. That's a big number, to be sure, but not half price. This makes us wonder if Nextant's business on this project will tilt strongly toward owners who already own King Airs and would like to upgrade but can't see the point of buying new just for the same performance. Heublein and company are counting on it.

"That was the thesis for the company in the first place. We absolutely think the largest percentage of the market is going to think the way we think. This represents a great value proposition. I get that the metal isn't perfect. But we looked at it this way, even if we lost 25 percent of buyers because they're saying 'I want new metal,' the market is still enormous and the business case is, too," Hueblein says. He was proven correct in the Beechjet market. We'll see if the same is true for King Airs.

CONTACT...

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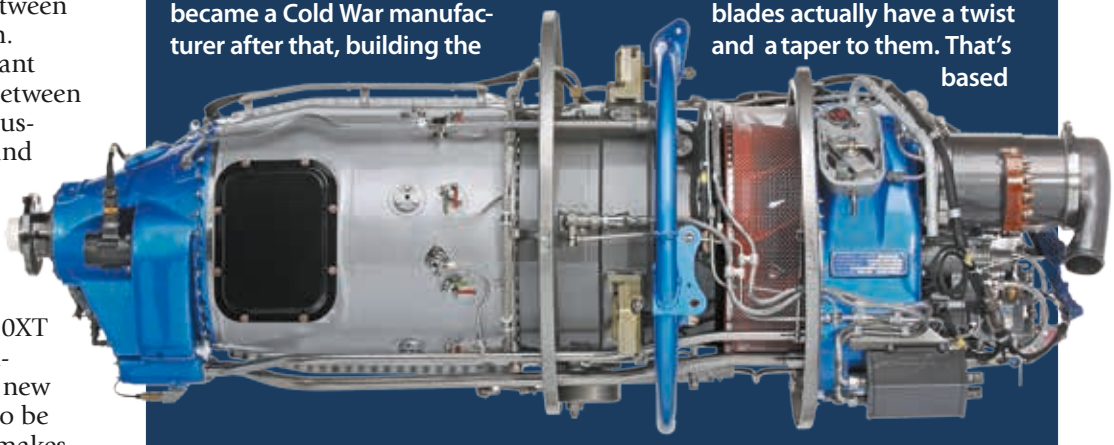
THE PT6 GETS SOME COMPETITON

If Pratt & Whitney doesn't quite own the low- and mid-power turboprop market, it at least has a long-term lease at rent-controlled prices. GE Aviation plans to challenge that primacy and the instrument of their run at PW will be the H-series engines of the sort Nextant is using.

GE is the giant in transport-category turbofan engines and in a tiny little Czech Republic company, Walter Aircraft Engines, it found a contender. Walter began life in the 1920s manufacturing engines for BMW, supported the German war effort during World War II and became a Cold War manufacturer after that, building the



famed knockoff of the Rolls-Royce Nene that powered the MiG-15. During the 1960s and 1970s, it branched into turboprops, developing a free-turbine design similar to the PT6 called the M601. This engine found application in Eastern Bloc designs, including the LET 410 twin. After the Soviet Union collapsed, Walter subsisted on aftermarket support. In 2007, GE bought Walter and invested heavily in improving the M601 into what are now the H-series engines.

Like the PT6, the H engines are free turbines, with a gas generator section directing energetic gas toward a power turbine that connects to the prop through a gearbox, but not to the compressor section of the engine. Utilizing expertise it developed in its larger turbofans, GE reworked and recertified the M601, according to GE's Matthew Gerus and Zdenek Soukal, who works in GE's plant in the Czech Republic.

"When GE was looking at the engine initially, what they saw was a very robust, durable, low-maintenance engine. But the performance just wasn't there to be competitive. So GE worked with Walter to infuse it with more modern technology proven on GE others engines," says marketing manager Gerus.

"We didn't change the stage count, we didn't change the outer cases. A lot of what we did was in the existing flow path. We improved the aerodynamics of the blades. Instead of being a 2D airfoil, the blades actually have a twist and a taper to them. That's based on our experience with our large commercial engines," Gerus adds.

There are currently three models of the H series, the 75, 80 and 85, each with a different power range. Nextant is using the H75, a 750-HP engine derated to 550 HP, just as the PT6A-135 it replaces is similarly derated. Nextant is also a launch customer for what GE says is the first electronic control for a small turboprop engine. It consists of an electronic controller, a fuel management unit and an electronic prop governor. Taken together, these allow single-lever operation.

The H-series engines have a 4000-hour TBO and no hot section inspection, primarily because they use a fuel slinger design that has no nozzles and uses a spray system instead. Lack of nozzles reduces maintenance and obviates the need for hot-section inspections because the spray doesn't cause hot spots.

LED Flashlights: Maglite, S&W Standouts

For a rugged light with simple ergonomics, the classic Maglite is tough to beat. For advanced features at a decent price, we like Smith&Wesson.

by Larry Anglisano

Unless you fly a lot at night, the handful of lights you have stashed in the flight bag, glove box and map pockets are used infrequently. That makes selecting a model with decent quality important. In our experience, some models that sit for long periods while subjected to heat, cold and humidity don't work that one time they're needed.

That's not to say inexpensive models sourced from a local hardware store won't do the job, and we realize you have a favorite flashlight we didn't include here. We scanned the market and consulted with high-volume mail order retailers, including Sporty's, to get a feel for the best sellers with the fewest returns. We also talked with mechanics (not a gentle crowd) to see which lights survive life outside the cockpit.

We selected eight diverse models priced well under $100 for comparison and shared them with local pilots. We made selections based on specific usage, including emergency, preflight and for general use inside of a dark cabin. We'll continue to use them for a year to see how they hold up. For now, here's a look at them.

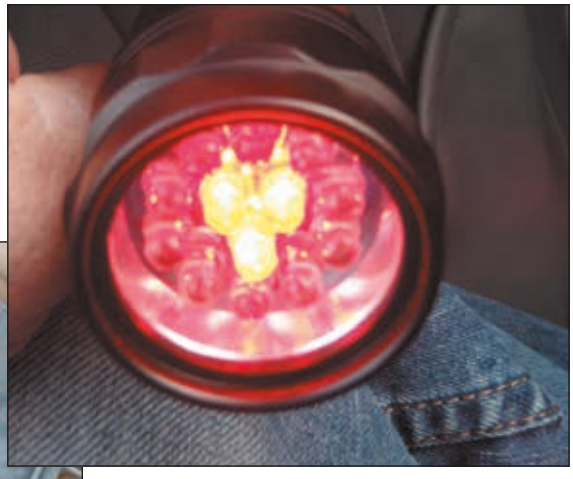
SIZE MATTERS

As you'll see in the sidebar on page 21, the illumination power of LED technology allows for a more conveniently sized flashlight. With the exception of the full-size Maglite, we looked for models under seven inches long because they are just easier to deal with in the cockpit. But we also found that penlights—unless tethered—might be too small. We had one roll between the seat and center console in a Cirrus one night and there was no way we were retrieving it without climbing in the back seat.

The other size consideration relates to battery type. Obviously, a light requiring larger D or even C cell batteries are going to have some girth. While the trade-off to pricier lithium cells is endurance, we prefer AAA or AA cells. Then there is the convenience factor of loading fresh batteries on the fly. One otherwise good light—the Coast PX20—didn't make our cut because it requires removing a cylinder-like battery carrier to load three AAA cells. We fumbled

CHECKLIST

- LED technology lends to a smaller footprint and low power consumption.
- Models with switchable red and white lamp color circuits are well-suited for cockpit use.
- Some models are simply too bright for cockpit use. Save them for preflighting and for working.



We think incandescent flashlights are a non-starter, so we ruled them out when selecting the models for our roundup. The full-sized Maglite dwarfs the others, left photo, but we like it for preflighting. We prefer models equipped with both white and red LEDs, top.

horribly with it in the dark. As a result, we favor a simple do-it-by-feel, drop-'em-in design.

TACTICAL BUILD

Firearms icon Smith&Wesson also makes flashlights, including the Captain's model, which is made exclusively for and redesigned by Sporty's to be pilot friendly (the original has blue lighting, but Sporty's thinks it is too bright for cockpit use).

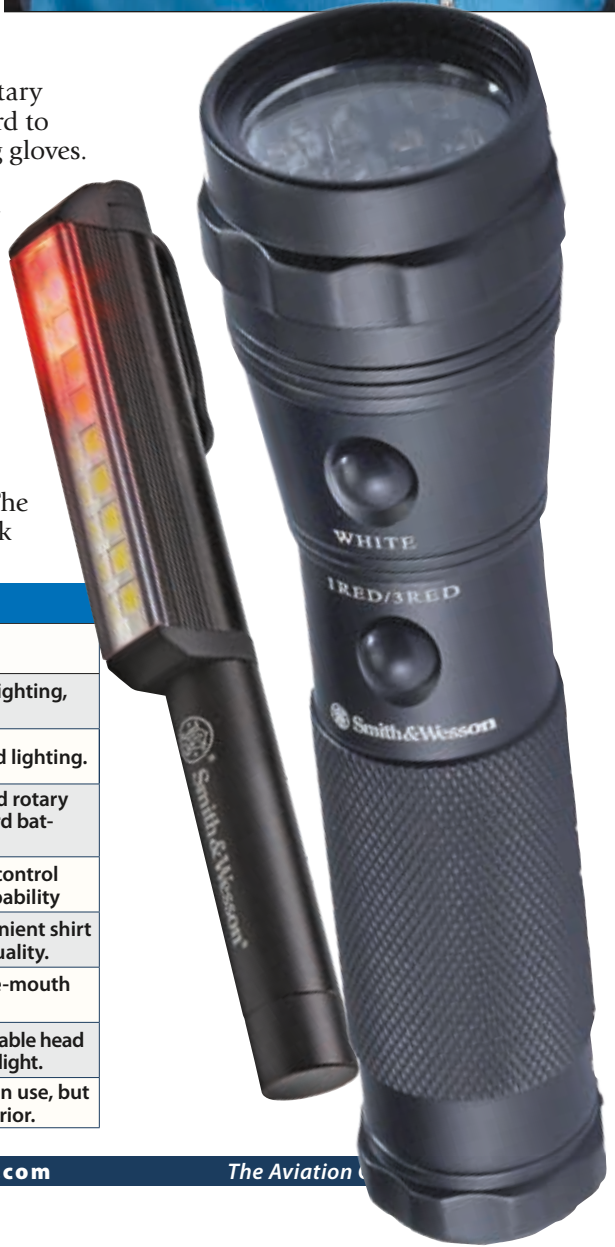
Carrying a lifetime warranty, the light is constructed of anodized aluminum and has independent switches for its dual-mode three LEDs and single-mode 10 white LEDs. What we like most is its intuitive and simple mode buttons, which can be operated by feel. We also like that you can operate the light on one single LED to preserve night vision. Powered by three AAA cells, we think it's priced just right at $39.95 with an included belt holster, which accommodates spare batteries.

An airborne law enforcement pilot turned us on to the Streamlight Night Com. Eagleville, Pennsylvania-based Streamlight specializes in tactical lighting products, including gun-mounted models. The Night Com LED operates on two 123-series lithium cells, which can last up to 28 hours. We were initially fond of the Night Com for its high-quality feel (it has an anodized aluminum construction), which is a lot like the S&W Captain's light, but in a smaller footprint. We also like that it has a "safety" mode, to guard against inadvertent power-up (it uses a rubber push-button tailcap on/off switch, which could inadvertently activate).

We geeked out and tried three hands-free LED lights, top photo, including the Flight Outfitters Pilot's Headlamp, the Terralux Lightstar 80 with a rubber bite grip and Smith&Wesson clip-on work light. Our overall top pick for a handheld flashlight in the group is the Smith&Wesson Captain's light, lower right, but we're unimpressed with the company's pen-style worklight, lower left.

But we found the small rotary mode switch slightly awkward to use, especially while wearing gloves. The switch does have raised thumb guides for easier rotation, but we would prefer dedicated buttons like the S&W's. At $59.95, the Night Com is pricier than the S&W, too.

It has four positions: Safety, NV LED for red night vision, Hi LED (which is red) and Light, which is 105 lumens of white LED light. The Night Com has Mil-Spec dark



SELECT LED FLASHLIGHTS COMPARED

MODEL	STREET PRICE	LENGTH	BATTERIES	COMMENTS
MAGLITE FULL-SIZE LED	$48	10 inches	4 D cells	Large body good for preflighting, buy bulky for cabin use.
MAGLITE MINI	$25	6.00 inches	2 AAA cells	Proven reliability, lacks red lighting.
STREAMLIGHT NIGHT COM	$60	5.25 inches	2 lithium cells	Durable housing, awkward rotary mode switch, non-standard batteries.
SMITH&WESSON CAPTAIN'S LIGHT	$40	5.50 inches	3 AAA cells	High build quality, smart control set, excellent low light capability
SMITH & WESSON HANDS FREE	$25	6.25 inches	3 AAA cells	Narrow light beam, convenient shirt clip, questionable build quality.
TERRALUX LIGHTSTAR 80	$30	5.50 inches	2 AAA cells	Rubber bite grip for in-the-mouth use, no red lighting.
PILOT'S HEADLAMP	$30	2.50 x 2.00 x 1.50 inches	3 AAA cells	Good ergonomics, comfortable head strap, effective emergency light.
SPORTY'S 100 LED	$38	7.00 inches	4 AAA cells	Too bright for normal cabin use, but great for preflighting exterior.

SIMPLE LED ADVANTAGES

Like in other lighting applications, LED flashlights came to market somewhat unannounced and in some ways, without appreciation. Frankly, we didn't give the LED-equipped flashlight a second thought until we used the bunch for this review, where we quickly recognized a handful of benefits compared to their nearly extinct incandescent predecessors.

For one, LED lamps have a long life expectancy. They won't last forever, but they'll surely outlast an incandescent lamp. Additionally, LED technology allows for multiple lamp colors to be incorporated in a single flashlight. As we discovered, models with integral red and white LED lighting are far more convenient than the plastic colored lenses we used to fit over yellow incandescent lamps. While red is arguably best for preserving night vision, many of the pilots who tried our samples preferred their white LED lighting. It's nice to have an option at the push of a button.

Another advantage is reduced power draw, which translates to increased battery endurance, although this is highly dependant on the number of LEDs the batteries have to power. But, having the capability to switch off some of the LEDs serves two purposes—saving power and dialing back the brightness—which is imperative in maintaining night vision.

As proven with LED landing and taxi lights, flashlights with LEDs can survive more abuse, including vibration and drops. Drop an incandescent flashlight to the pavement from the cowling and you could be replacing the lamp in all but the most rugged models. That's one area we'll be looking at during our long-term evaluation. We won't be gentle.

Last, LEDs are ideal for use in cold temperatures. Preflighting in single digit temps? All of the LEDs in Sporty's 100 LED flashlight, shown above, will fire immediately. But if you're looking for some heat to warm your fingers, you won't find much in an LED lamp. They simply run much cooler than incandescent.

adaption, outputting less than 0.05 lumens in its night-vision mode.

We collected two LED Maglite flashlights, the $48 168-lumen full-sized D-cell and the 87 lumen AAA-cell Mini. We had great luck with incandescent Maglite models and an old Mini equipped with a red lens has lived in the flightbag for as long as we can remember (the Mini was introduced 25 years ago).

At 10 inches long, we think the full-size Mag can be bulky for stowing in smaller cockpits, but is nearly ideal for preflighting and working under the cowling. Ever lose a flashlight in the cowling? We did, requiring its complete removal to retrieve the light while passengers cooled their heels in the terminal. Consider size when selecting a model for preflight chores.

The Maglites are perhaps the most utilitarian models in the group, but in our view that's a good thing. Both are drop- and water-resistant, have adjustable heads for spot and floodlight and the larger models have a basic, self-cleaning momentary switch.

If these lights are used less than once per month, Maglite suggests removing the batteries (not a bad idea for any model), plus lubricate all threads and the rubber O-rings with petroleum jelly twice per year.

HANDS-FREE

An electrical failure at night will take down the panel lighting and have you reaching for a flashlight. Unless you have a copilot or back-seater to hold it, your mouth will have to do. With this in mind, we included a few lights capable of hands-free operation. The $29.95 Flight Outfitters Pilot's Headlamp model is the easiest. There are several things we like.

We were drawn to the Streamlight Night Com, left, for its solid build quality and convenient size. We like its "safety" mode to guard against draining the lithium batteries, but found the rotary switch awkward.

First, the headstrap is made of a comfortable elastic material much like you find on ski goggles. It's thin enough to not interfere with a headset or eyeglasses. The light assembly has a vertical pivoting adjustment to compensate for seat height when illuminating instruments or a checklist, for example, while a multi-position focusing function allows the user to accurately adjust the size of the light beam from floodlight to spotlight.

The light has both 80-lumen white and two-lumen red LEDs, each having a high and low output function. We also like the separate push-button controls for the white and red lighting modes. This eliminates having to scroll through different light settings to find which one you want. The device is water resistant (useful for water ditching) and operates on three AAA batteries.

While initially optimistic, we were ultimately disappointed with the $24.95 Smith&Wesson work light—a 6.25-inch-long aluminum wand with a pen-like shirt clip and built-in magnet. Unfortunately, the magnet

is attached to the 1.5-inch shirt clip and doesn't hold the light's weight in a horizontal position. If it did, you could attach it to metal structure on the underside of the glareshield and use it to illuminate instruments. Instead, it works best when clipped to a shirt, or for use as a reading light.

It has two red LEDs and seven white LEDs arranged in a narrow strip. Clicking the power button once illuminates one red LED, twice for both red LEDs and holding the button energizes the white LEDs. Our unit failed under vibration and we couldn't source a replacement before going to press. We'll continue to use the replacement in our long-term evaluation.

A penlight we did like was the $29.95 Terralux Lightstar 80. Measuring 5.5 inches long, it outputs 80 lumens and has a five-hour endurance with two AA batteries. Equipped with a rubber bite grip attached to the tail, it can serve double duty as a hands-free light without fear of busting a tooth when held in the mouth. Our only beef is that it lacks an integrated red LED.

ONE SIZE WON'T FIT ALL

Our thanks to Sporty's for providing some of the samples for our evaluation. Unlike others, it actually uses the flashlights it sells. We think you should make a selection based on the task and should have at least two available (and for passenger use).

We think the best overall flashlight in this group is the Smith& Wesson Captain's light. It has simple controls, effective output in all lighting modes, it's not too big or too small and just feels good in the hand.

For working in and around the cowling during preflighting chores (and for maintenance tasks), we prefer the 10-inch LED Maglite. Our old incandescent model has stood the test of time and every mechanic we talked to owns one. For preflighting the fuselage, Sporty's 100 LED mega light is certainly bright enough and nicely designed, in our view.

For $30, the hands-free Pilot's Headlamp is the belt and suspender and can also serve for preflighting.

We'll see how well these lights survive our abuse over the long term and report on the results. In the interim, if you have a favorite model, tell us about it.

Cylinder Follow-Up: Continental's New NiC3

Continental scrapped the Nickel+Carbide-coated Titan cylinder line when it bought ECi, but now introduces a Nickel Silicon Carbide option for its own cylinders.

by Larry Anglisano

In the November 2015 issue of *Aviation Consumer*, we reported on Continental Motors' acquisition of competitor and aftermarket supplier ECi, a buy which eliminated the aftermarket Titan cylinder line.

While Continental admitted that it wouldn't retain many of ECi's products, it also said it was considering a corrosion treatment for its existing line of factory cylinders, and now follows through with the NiC3 line.

Continental's Emmanuel Davidson told us the new NiC3 cylinders are aimed at owners concerned about corrosion in engines that sit for even short periods of time. This may include aircraft based in maritime locations and those parked outside in severe climates.

Continental's NiC3 cylinders are Nickel Silicon Carbide-coated (creating a hardened barrier inside the cylinder wall) and are available now for all of the cylinders Continental produces. This includes cylinders for a wide range of Continental engines, on the PMA cylinder line for Lycoming engines and also the Titan line of experimental and ASTM-certified engines, which the company acquired from ECi.

The NiC3 line are not newly designed cylinders. Continental is simply coating its existing ones. Incidentally, only 52 percent of the respondents in our cylinder survey were happy or satisfied with their Continental cylinders.

The trademarked NiC3 treatment will carry a price premium over non-coated cylinders, of course. Continental's Davidson told us to expect an approximate premium of $175 per cylinder, above the retail price of a non-coated Continental, Titan or PMA cylinders.

Worth noting is that 73 percent of ECi cylinder owners in our survey were either happy or satisfied with them. Some of that had to do with ECi's proprietary Nickel+Carbide anti-corrosion treatment.

Continental is providing an additional warranty for NiC3 cylinders, which covers the cylinder barrel for abnormal wear and corrosion for five years. Contact www.continentalmotors.aero.

The NiC3 option is only available on factory new cylinders produced by Continental, right.

Cessna 150/152:

An old friend to many, the venerable Cessna 150/152-series still serves as a durable trainer and miserly cross-country traveler.

As we reported in the August 2015 issue of *Aviation Consumer*, the maturing support network for LSA models is building at least some confidence in their dispatch reliability. But for owners and flight schools looking for a simple and reliable trainer that's easily supported on most every maintenance floor, it's still tough to beat the familiar Cessna 150/152 series.

That's why old 150s are still flying side-by-side on the rental line with ultra-modern light sport designs and the older airplanes, despite decades of abuse, still hold up better than some newer LSA models and often require less maintenance. The harsh lesson here is that despite advances in materials and computer-aided design, the 1950s engineers who designed the 150 knew their way around structure and half a century later, what they built still remains serviceable for the foreseeable future. The airplane that trained thousands of pilots (us included) endures.

MODEL HISTORY

Cessna was a latecomer to the post-war pilot boom. With its iconic yellow Cub, Piper owned the market during the 1940s, but that was all to change when Cessna created the 120 and later the 140, which stayed in the model line until the early 1950s. Although only hardcore Cessna aficionados know it, the Cessna 172 actually predates the Cessna 150, which first appeared in 1959.

Unlike the 140, the 150 was created solely with the training market in mind to tap into what was then a booming market. Would-be buyers had disposable income, the economy was strong and the post-war flying frenzy was still a real trend. The world needed a practical, cheap and no-frills trainer that wasn't made of cloth.

Ever practical, Cessna provided. By modern standards, the first 150s look a bit frumpy, with their squared-off tails and a turtledeck-style fuselage, with no rear window.

But it was not to stay that way for long. In 1961, the first of many changes in the model began, starting with moving the gear struts aft two inches, curing the airplane's tail heaviness. Ten years later, tubular gear legs with a wider track were added.

In 1964, the rear window appeared and, of course, it needed a snappy marketing moniker, thus was born "Omni Vision." The stodgy straight tail went away in 1964, replaced by the swept-back tail, giving the airplane a more rakish look.

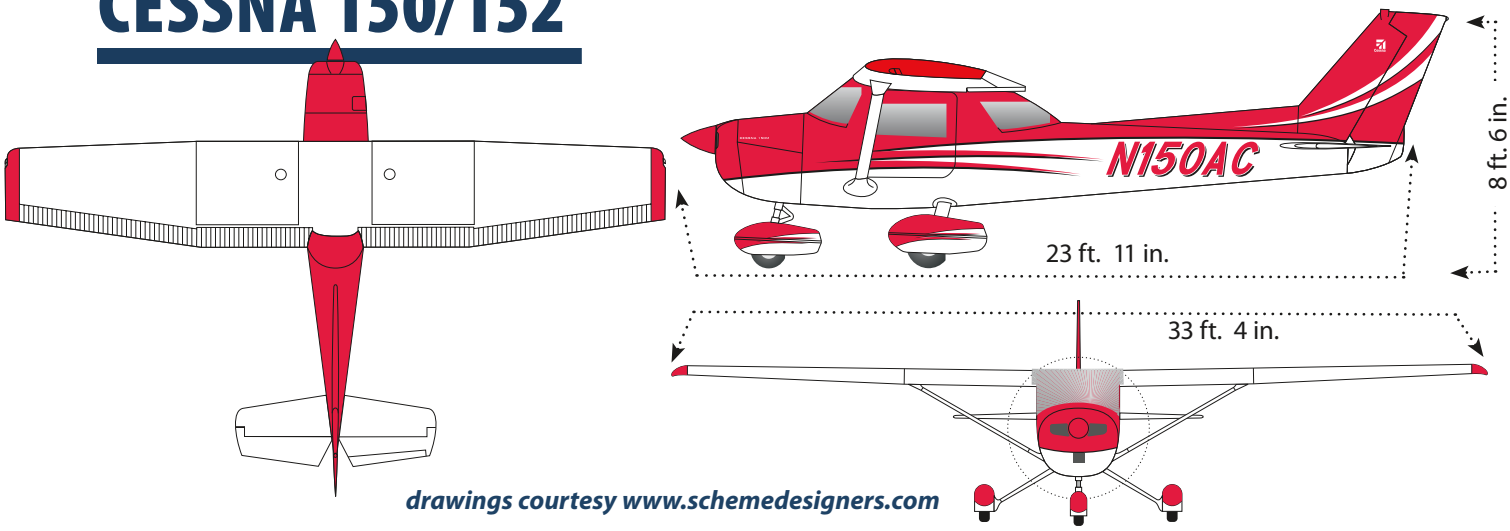
The overall dimensions of the airplane haven't changed much, but its max gross weight has. The 150 began life as a 1500-pound airplane, but by 1978, the gross weight had been bumped up to 1670 pounds for the 152. For a two-place airplane, that's a big hike but, as is usually the case, there wasn't much payload gain due to rising empty weight.

Anyone who learned to fly in a 150 will remember the cockpit as cramped

With such a low cruising speed, a 30- to 40-knot headwind can make some trips a lesson in patience.

Aviat Aircraft's 152 refurb project, main photo, boosts the airplane's price north of $80,000.

CESSNA 150/152

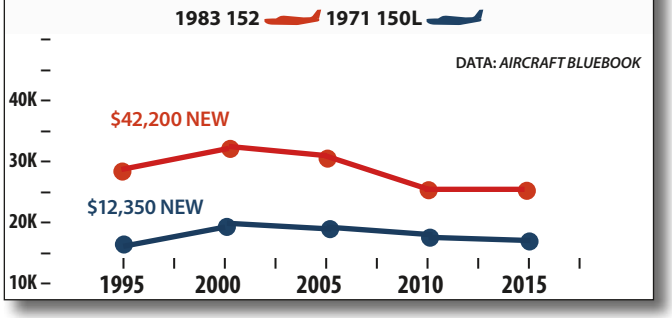


drawings courtesy www.schemedesigners.com

SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1959-1961 CESSNA 150, A	100-HP CONT O-200-A	1800	$20,000	26/38	554	105 KTS	±$12,700
1962-1964 150 B,C,D	100-HP CONT O-200-A	1800	$20,000	26/38	554	105 KTS	±$13,500
1965-1967 150, E,F,G	100-HP CONT O-200-A	1800	$20,000	26/38	554	105 KTS	±$14,500
1968-1973 150, H,J,K,L	100-HP CONT O-200-A	1800	$20,000	26/38	554	105 KTS	±$16,000
1970-1974 A150K,L AEROBAT	100-HP CONT O-200-A	1800	$20,000	26/38	554	105 KTS	±$21,000
1975-1977 150 M	100-HP CONT O-200-A	1800	$20,000	26/38	554	105 KTS	±$20,000
1975-1977 150 M AEROBAT	100-HP CONT O-200-A	1800	$20,000	26/38	554	105 KTS	±$25,000
1978-1984 152 II	110-HP LYC O-235-L2C	2400	$21,000	26/38	568	107 KTS	±$25,000
1978-1982 A152 AEROBAT	110-HP LYC O-235-L2C	2400	$21,000	26/38	568	107 KTS	±$30,000
1984-1986 152 B	108-HP LYC O-235-N2C	2400	$21,000	26/38	568	106 KTS	±$26,500
1983-1986 A152 AEROBAT	108-HP LYC O-235-N2C	2400	$21,000	26/38	568	106 KTS	±$32,000

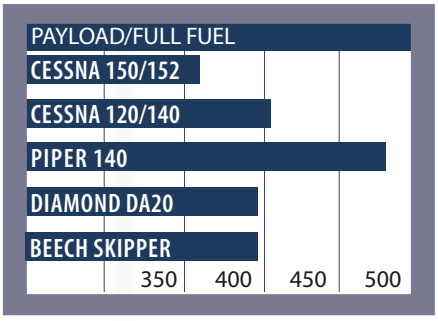
RESALE VALUES

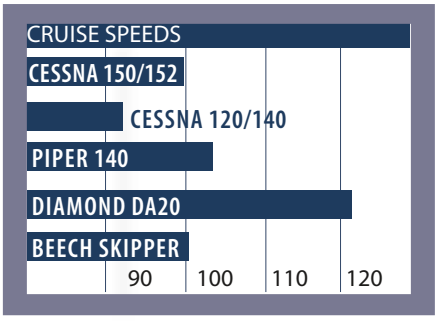


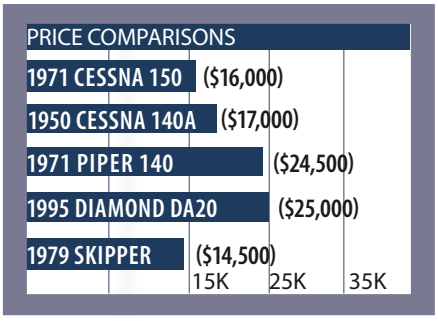
SELECT RECENT ADs

AD 11-10-09	SEAT RAIL INSPECTION
AD 09-10-09	RUDDER STOP/PLACARD
AD 00-06-01	FUEL STRAINER
AD 96-12-23	WING STALL FENCE
AD 88-15-06	BATTERY LOCATION

SELECT LATE-MODEL COMPARISONS







It's no Pitts, but an A150 like Brian Anderson's Aerobat, top photo, makes for good, inexpensive upset training. Fred Larson's 1969 150J has the modern six-pack panel layout that works for instrument training, middle. Shoulder harnesses and seat reupholstery lend to safety and comfort, bottom.

and narrow and that never changed. But Cessna did bow the doors out slightly and trimmed the center console to provide more legroom.

The baggage compartment was also enlarged several times and one option included a rear child seat. The baggage area could accommodate up to 120 pounds of kids and/or bags, so it was suitable for a toddler and a day bag, but little else. But for a small airplane, the baggage area is rather generous and easily accessible for an instructor fishing for a chart or a hood.

In 1975, a larger fin and rudder were added and before that, electric flaps were installed. Previously, the flaps had been manually operated and some pilots complained that electrics were a step backward. We agree.

ENGINE CHANGES

The Cessna 150 first appeared with a 100-HP Continental O-200, a reliable and easy-to-maintain engine that matched the airframe nicely. When 80/87 gas began to fade from the market in 1978, displaced by 100LL, Cessna switched to the 110-HP Lycoming O-235 that provided more power and boosted the TBO from 1800 hours to 2000 hours and eventually 2400 hours.

As the 150 morphed into the 152, there were other changes, including a 28-volt electrical system, a one-piece cowling, a McCauley gull-wing prop, an oil cooler and redesigned fuel tanks. Sum total of changes? About 40 pounds more useful load than the original Cessna 150 had, but fully 60 pounds less than a 1948 Cessna 140 could heft. The airplane's performance was about equal to the 150 it replaced, but the engine was susceptible to severe lead fouling when burning 100LL and the 28-volt electrical system was a nuisance.

Also, the 152 turned out to have some significant warts. Early models were hard to start because of weak spark and lack of a priming plunger. Cessna added impulse coupling on both magnetos to improve this, plus direct priming for each cylinder. Mechanics complained about having to remove the prop to decowl the engine so Cessna added a split cowl. In 1981, the Lyc got a spin-on oil filter as standard, rather than the old rock screen. In 1983, Cessna and Lycoming tackled the lead fouling issue by replacing the O-235-L2C engine with the N2C variant, which the model had until it was discontinued in 1985.

Except for troublesome starter drives, the Continental O-200 used in the Cessna 150 was a reliable and robust engine that could be counted to make the 1800-hour TBO, if not beyond. The Lycoming O-235L2C was supposed to achieve three goals: Solve the O-200's lead problem, boost power a bit to increase the payload and offset the 15 percent gain in empty weight and last, reduce noise. The higher compression O-235 Lyc delivered its 110 HP at 2550 RPM rather than the O-200's 2750 RPM.

Did Cessna hit the mark? Not re-

ally, say operators familiar with both airplanes. In its favor, the Lyc had no starter problems, but if the engine/prop was quieter, you'd hardly notice. Owners complained about high parts prices for the O-235—including pistons and valves, the latter being sodium filled for improved cooling.

And the lead problem? Still there, say owners. The O-235 accumulated lead deposits in every nook and cranny and lead fouling of plugs became such a problem that Champion developed a special extended-electrode spark plug for this engine, the REM37BY. Mechanics say even with careful leaning, the plugs must be removed and cleaned as often as every 25 hours. In Service Instruction 1418, Lycoming explains a procedure whereby cylinders can be blast-cleaned with walnut shells without removal for top-end overhaul. Prior to this, operators found that early tops were needed due to lead fouling.

One positive aspect of the Lycoming engine is its TBO—a whopping 2400 hours. If you can keep the thing from choking with lead, it may actually reach that impressive limit. Some owners use TCP additive to help control lead. Also, thanks to intense competition in the engine overhaul field, overhaul prices remain affordable, on the order of $15,000 to $20,000.

Unique to the mass-market trainer, Cessna offered two additional versions of both the 150 and 152—the Aerobat and a seaplane conversion, which appeared in 1968. There are still a few of these models running around, some even used on the water. The seaplane was, by most accounts, a decent little water taxi, although no one would mistake it for a Beaver. It couldn't haul much and with limited power, it took a while to unstick from the water.

The Aerobat version—which first appeared in the 150 in 1970—made a much bigger splash, although not in the water. In those days, aerobatic training was all but impossible so when the Cessna Aerobats, with their flashy checkerboard paint, showed up on the rental line, many renters responded enthusiastically. Some 5 percent of the 150/152 fleet is acrobatically capable, after a fashion.

We're not talking Extra 300 or even Pitts-type performance, of course. Aerobatic purists sniff at the Aerobat because it has control wheels, not a stick. Any maneuvers that require climbing back to altitude will require a plodding climb to get back in the perch. Still, the Aerobat was and is an affordable gateway into the world of aerobatics and at the very least, upset training. The Aerobat commanded a price premium when new—about $1500 to $2000—but on the used market, the Aerobats bring as much as $10,000 or more, or nearly 50 percent higher average retail.

Pull the cowling and you have easy access to the 150's Continental O-200 engine, top. Tail-wheel-converted 150s, bottom, fetch a price premium of nearly $20,000.

PERFORMANCE, HANDLING

The trainer market has evolved considerably since the 150 first appeared and although modern trainers such as the Diamond DA20 and a passel of LSA designs have improved the breed, technologically, at least, the 150/152 still has better than credible performance and handling traits. Interestingly, some flight schools report that although many students take intro rides in a sexy LSA with a glass panel, they transition to a 152 or 172.

Why? Probably because the 152's higher weight gives it a somewhat stabler feel than a hyper light LSA and pricewise, 152s remain competitive to buy and operate, so the hourly rental is less. Furthermore, some instructors say it's easier to solo a student in a 150/152 because LSAs tend to be twitchy, especially in pitch.

But the Katana cruises faster than the 152 and uses more fuel. It's a better climber than the Katana A1, with its 80-HP Rotax engine, but the C1 Katana, with its Continental IO-240, outdoes both the 152 and the A1 Katana, not to mention many LSAs.

Top speed for the 152 is given as 109 knots, same as the Tomahawk and two knots faster than the plodding Skipper. In the real world, owners say they go slower. Much slower. The airplane seems happiest at 90 to 95 knots, a realistic speed in our view.

Handling is what it is, which is predictable, with relatively light control forces and no nasty stall habits. The Cessna 150/152's slow flight characteristics are so utterly benign that they nearly qualify as STOL airplanes. The large flaps—even when limited to 30 degrees—are quite effective, although they do generate quite a nose-down

Don't think you can travel long distances in a 150? Graeme Smith recently flew his 1970 K-model on three cross-country trips totaling nearly 7000 miles. That's its busy cabin, top, and him on the Alton Bay ice airport in New Hampshire, bottom.

trim moment. This is easily handled, although the control forces escalate somewhat. Students have to be taught to watch for abrupt noseups when applying full power for a go-around, training that prepares them nicely to transition into the Cessna 172, which has the same characteristic.

Landing a 150/152 is easy enough to teach and learn, to a point. And that point is often exceeded, since runway fender benders are the most common type of accident suffered by the 150/152 series and other trainers, for that matter. The model is an excellent crosswind trainer, since it has an effective rudder.

The airplane is comfortable with an approach speed of 60 knots or slower, but it will easily tolerate higher speeds, because those draggy flaps bleed off excess airspeed in a heartbeat. Land it fast and it will bounce. (Any pre-buy should include a specific check of the logs for landing damage that included nosewheel work or firewall damage.)

Operators tell us the 152's runway performance is good, especially if the airplane is light. It's not as good when heavy on a hot day. With a portly CFI and student aboard, more than a few 152s have trimmed the trees off the end of runways.

Speaking of payload, the 150/152 essentially carries what other popular trainers do. At 528 pounds useful, it carries a bit more than the Katana but a bit less than the Skipper and Tomahawk. Before the model got fat, some E/F/G 150s topped 600 pounds in load-carrying capability.

Where the 152 shines, however, is on load flexibility. With a fuel capacity of 39 gallons for the long-range tanks, it has better range with a single pilot than either the Tomahawk or the Skipper. Does this really matter? Maybe. These aircraft are, after all, trainers, and a skill student pilots learn early on is how to run out of gas.

CABIN, ERGONOMICS

Cabin comfort is not much of a consideration in two-place trainers. Lessons are short and there's no point in pretending there's enough room in the airplane for plush seats. The 150/152 is so narrow that even pilots of moderate size will bump shoulders. Two big guys will be miserable. Although the seat height is quite low, the legroom is excellent.

In 1979, thicker seat padding became standard, but it helps only a little. Many owners have had the seats repadded or carry a pillow or two to make them more tolerable. Noise level is quite high, due to the proximity of the cabin to the engine compartment, but the advent of noise-canceling headsets and intercoms has rendered this moot.

Ventilation in the 150/152 is via the standard Cessna pull vents in the wing roots, plus in most models the windows open for taxi and can also be opened in flight. During the winter, this can be a mixed blessing and some operators tape off the root vents to reduce drafts. If the heater is well-maintained, it will get the job done.

MAINTENANCE

Owners who use the 150/152 for personal use—and many do—can count on literally years of service from the engine, if they're operated enough to keep corrosion at bay and leaned to avoid lead buildup. In general, these are simple airframes that don't require much maintenance. However, any that have been used extensively as trainers—as most have—should be inspected carefully for hard landing damage, especially in the nosegear/firewall bulkhead area. Wrote owner Ed Park of Aliso Viejo, California, "Unless the guy that you bought the airplane from spent a bunch of time and money fixing up that 20-year-old airplane and fixing/replacing/repairing a lot of things, you can expect that you will be that person if you are conscientious about your maintenance."

The 150/152 series has what we would call an average list of ADs, none of which are particularly onerous or expensive. The major safety-re-

lated item is the seat track AD, which prevents the seat from unlocking and sliding rearward. Most aircraft should have had this done long ago.

Owners report that annuals are thrifty—in the $800 to $1200 range, depending on parts needed.

MODS, OWNER GROUPS

The 150 can be given a power boost and even turned into a taildragger, as quite a few have been. The only current 150 taildragger conversion we could find is through Lowe Aviation, at taildraggerconversion.com, 270-929-3776. The STC applies to 1959-1963 Cessna 150s. These are the straight back/straight tail 150s that were manufactured using tooling and parts from Cessna 140A fuselages. This conversion uses Cessna 120/140/140A main gear and tailwheel gear. We couldn't verify the existence of other conversions (Texas Taildragger or Bush) that use the original Cessna 150/152 landing gear moved forward on the fuselage.

Horton, Inc. (www.Hortonstolaircraft.com, 800-835-2051) sells STOL kits for the 150/152. Met-Co-Aire sells wingtips for the 150 series, reach them at 714-870-4610 or www.metcoaire.com. O&N sells aux fuel tanks for the 150/152. Visit www.onaircraft.com or 570-945-3769.

Air Mods N.W., sells an engine conversion for 152s that includes a new prop that boosts climb and takeoff performance by allowing the Lycoming O-235 to spin up to 2800 RPM. It also has a higher compression ratio so supposedly, this decreases lead fouling. See www.airmodsnw.com.

Two organizations of note are the Cessna Pilots Association and the Cessna 150-152 Club. CPA's Santa Maria, California, HQ is the fount of all things Cessna and members rave about its technical services. Visit CPA at www.cessna.org.

The Cessna 150-152 Club has a monthly newsletter that's an excellent clearing house for information, parts, mods, maintenance and service tips. Contact the club at 541-772-8601 or www.cessna150-152club.com. For a detailed book on flying and operating Cessna 150s, contact Arman Publishing at www.Cessna150book.com.

OWNER FEEDBACK

We have owned our 1968 Cessna 150H for over nine years now. We like the 150 because it is relatively inexpensive to own and operate—perhaps one of the least expensive airplanes a person can own. Insurance this year was about $450 and the annual inspection was $710, which included replacing a few things.

Its fuel burn is less than 6 GPH, but we still flight plan for a solid 6 GPH. The airplane is all metal, so it can be tied down outdoors instead of renting a hangar, although it is important to have a canopy cover and a good coat of wax to protect the paint. You can buy a good Cessna 150 for the price of a good used car.

In my opinion, the number one reason to own one is because it's so fun to fly. Control response—although not like a Pitts—is light and responsive. With 40 degrees of flaps, it will descend like a helicopter.

If you need to go somewhere, these are not the fastest airplanes, but still beats driving by about half on most trips. As many Cessna 150 owners have demonstrated (and demonstrate every year at the Cessna 150/152 Fly-in in Clinton, Indiana), these airplanes can be reliable, long-distance transportation. Many people I know fly IFR in their 150s on a regular basis.

Pilots are mission-oriented individuals, and one of the first pieces of advice a prospective owner receives is to define their mission, then start looking at airplanes that will fulfill that mission. If your mission is to have fun flying on a budget, a Cessna 150/152 can hardly be beat.

Stacey Morris
via email

I purchased a 1973 A150L to teach my daughters to fly, versus paying for lessons at the FBO. No one wanted to rent me an airplane to instruct in. At 155 pounds and five feet, eight inches tall, I'm the giant of the family. We just fit in a 150 well. The plane will be used for training and taking friends for short joy rides.

It is IFR certified with a Garmin GNS430W, so I can't do most of the commercial and instrument work with this 150. I just renewed my insurance policy with Old Republic Insurance. The premium is $627 for $35,000 in hull coverage and $1,000,000 liability. This also includes the insurance cost to instruct my two teenage daughters. Try getting those rates with a two-seat car!

Only 734 150 Aerobats were built out of 22,000-plus 150s, and only 264 150 Aerobats are still registered in the United States. A great trainer should be easy to fly, but a challenge to fly really well. It should be capable of mild aerobatics for unusual attitude training. I've seen high-time, skilled pilots botch unusual attitude recovery because they've never been upside down. Some ground instruction and 1.5 hours of unusual attitude training in an aerobatic aircraft can make them better pilots than I am. Since I don't want my own daughters to botch an actual unusual attitude, the A150 is just the ticket for instruction. Plus, it's just so much fun to fly for a miserly 5 GPH fuel burn.

Tim Boese
via email

I've owned my 1978 Cessna 152 for almost six years now. I live in upstate New York and have family and friends spread out over the Northeast. With many holidays and vacations spent stuck in traffic for hours, flying to destinations seemed like a great idea and much more fun. Renting airplanes for long weekends was problematic, so I looked into ownership. Since I don't have kids, a two-seater could fit most of my missions while keeping costs at a minimum—perhaps as minimum as flying gets. The 150/152 seemed like a good choice, as I was familiar with it from flight training, plus with so many produced over the years, parts and model-experienced mechanics are relatively easy to find.

My mid-time 152 came with the Sparrowhawk modification, a propeller change and different pistons that ups the horsepower from roughly 110 HP to 125 HP. I'm not sure if this does much to improve the cruise speed because it's still nowhere near book numbers, but the climb rate and fuel economy I see are better than book, so it may be a worthwhile mod to consider. The prop upgrade also eliminates the AD.

The avionics in the plane were dated, although there was a Loran installed that I appreciated for a few months before the Loran network

CESSNA 150/152 WRECKS: LANDINGS

As would be expected in an airplane widely used as a trainer, our review of the 100 most recent accidents involving the Cessna 150/152 series found that 38 were landing-related. A breakdown of those numbers revealed some interesting details: There were two pilots who couldn't get stopped on the available runway—quite a feat for an airplane with massive flaps and a slow approach speed.

There were 17 runway loss of control (RLOC) accidents—a number we think is low for a trainer. To us, that indicates excellent control authority and ground handling in crosswinds. We note that at least three of those accidents were in tailwheel-converted machines. We've observed that the handling qualities of the various conversions (and how well they are carried out) can vary widely.

Four pilots cracked up on a go-around, another number we consider to be low, as go-arounds are a staple of student training. The low number indicates to us that the airplane handles the maneuver well despite its modest power.

We raised our eyebrows at the 15 accidents in the botched flare/landing category. All of those involved a bounced landing and then PIO or porpoising and, usually, breaking off the nose gear—13 of them were in 152s. Because the airframes of the 150 and 152 are nearly identical, we're curious about this data point.

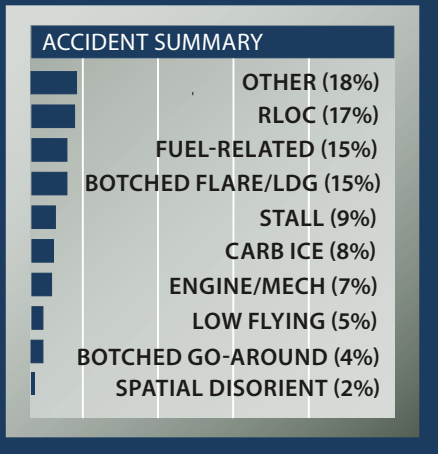
There were surprisingly few engine/mechanical events. Of the seven, one pilot got distracted while doing his own oil change and forgot to put in any oil. His next flight was fairly short. Oil exhaustion brought down a 152, although the pilots swore up and down they'd checked the oil prior to flight. Two engines quit not long after maintenance because the mechanics did something wrong. The cause of the other three stoppages could not be determined.

The 150 and to a slightly lesser extent, the 152, have a reputation for issues with carburetor ice. It was credited for eight forced landings, with damage, and may have been behind the three unexplained power losses in the engine/mechanical category. Having had a forced landing due to carb ice in a Cessna 150 ourselves, without damage, we can't help but suspect the eight events are not all of the times 150s and 152s have landed other than where desired due to carb ice. We caution attention to the matter.

Fifteen accidents were fuel-related, with four due to water or debris in the fuel. The remainder involved pilots who simply ran the fuel system dry—many after taking off with partial fuel and trying to travel a considerable distance. A few of them had landed and chose not to refuel before launching again and running out short of their destinations.

We were troubled by the behavior of the pilot who tried to climb his 150 to 17,500 feet (making it to 16,000) and who remained at over 12,500 feet for 2:40 of the 4:52 he was in flight before running out of fuel, at night. He survived landing in trees. After being rescued by police, he blew 0.16 on the Breathalyzer.

New technology was a factor in the night crash of two friends flying VFR in a 150 while taking flash-stills of themselves with their cell phone cameras. While maneuvering at low altitude in IMC and destroying their night vision with flash photography, the pilot became spatially disoriented, stalled the airplane and spun in.



was shut down. I eventually replaced the Loran and aging ADF with used avionics, including a Garmin GPS-155XL and a glideslope system. This provides good IFR capability, including GPS approaches. I also had Knots 2U flap gap seals installed. This improved handling near the stall speed and contributed modestly to the improved climb rate.

As currently configured, full fuel (24.5 gallons usable) gives a maximum ramp weight of about 360 pounds, which works out OK for myself, my girlfriend and some luggage. The 152 offers a little more shoulder room than the 150, but the cabin is still a very cozy place to be. I am six feet tall and fit well in the plane top to bottom, however I've found the seats can be fatiguing on longer flights. Still, I can fit my full-size road bicycle in the cargo area (with both wheels detached) if I happen to be flying somewhere solo, although admittedly I have to figure out how to get the frame through the door every time I do it. I plan trips at 95 knots and 6 GPH, but do a little better than that overall (it's closer to 100 knots true and 5.5 GPH).

Insurance costs have been $400-$600 per year. Annuals have averaged about $2500, with a high year of $5700 and a couple of low years a little above $1000. Spark plug fouling had been an issue from early on, so I now lean religiously everywhere except for approach and takeoff. This has helped to mitigate the problem, but it still exists to some extent. The time between plug cleaning has lengthened so I can just have it done at the annuals.

I'll sum up the flying experience with a few words: Simple, slow, forgiving, fun, economic. With a standard-day liftoff in well under 1000 feet, and initial climbs of 800-900 FPM, getting out of most airports isn't a problem.

My 152 has also been a fine IFR aircraft. While I believe many people would be put off by its lack of autopilot and its light wing loading, it has been a good plane to enhance and practice instrument skills. Moderate turbulence can make approaches more challenging to fly precisely, so I'll typically up my minimums in that situation. Headwinds can be

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2015 EDITORIAL INDEX

STATEMENT OF OWNERSHIP, MANAGEMENT, AND CIRCULATION (Required by 39 U.S.C. 3685). 1. Title of Publication: Aviation Consumer. 2. Publication No.: 0908-2600. 3. Filing Date: 9/21/15. 4. Issue Frequency: Monthly. 5. No. of Issues Published Annually: 12. 6. Annual Subscription Price: $84.00. 7. Known Office of Publication: 535 Connecticut Ave., Norwalk, CT 06854-1631. Contact person: Greg King, 203-857-3119. 8. Headquarters or General Business Office of the Publisher: Same as above. 9. Publisher: Same as above. Editor: Larry Anglisano, Belvoir Aviation Group, LLC. 535 Connecticut Ave., Norwalk, CT 06854-1631. Managing Editor: Rick Durden, Belvoir Aviation Group, LLC. 535 Connecticut Ave., Norwalk, CT 06854-1631. 10. Owner: Belvoir Media Group, LLC 535 Connecticut Ave., Norwalk, CT 06854-1631. 11. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amounts of bonds, mortgages or other securities: None. 13. Title: Aviation Consumer. 14. Issue date for circulation data below: August 2014. 15. Extent and Nature of Circulation (Average No. Copies Each Issue During Preceding 12 Months/ No. Copies of Single Issue Published Nearest to Filing Date): a. Total No. of Copies Printed (10,721/10,200) b. Paid and/or Requested Circulation: 1. Paid/Requested Outside-County Mail Subscriptions Stated on Form 3541 (9,045/8,599). 2. Paid In-County Subscriptions (10/12). 3. Sales Through Dealers and Carriers, Street Vendors, Counter Sales, and Other Non-USPS Paid Distribution (552/522). 4. Other Classes Mailed Through the USPS (0/0). c. Total Paid and/or Requested Circulation (9,608/9,103). d. Free Distribution by Mail: 1. Outside-County as Stated on Form 3541 (788/788). 2. In-County as Stated on Form 3541 (0/0). 3. Other Classes Mailed Through the USPS (0/0). 4. Free Distribution Outside the Mail (158/162). e. Total Free Distribution (946/950). f. Total Distribution (10,554/10,083). g. Copies not Distributed (167/117). h. Total (10,721/10,200). j. Percent Paid and/or Requested Circulation (91.0%/90.6%). 17. I certify that all information furnished on this form is true and complete. Gregory M. King, VP Circulation, 8/19/15.

The Aviation Consumer

Cessna 150/152

(continued from page 30)

a big weather nemesis. With such a low cruise speed, a 30-40 knot headwind can make some trips a lesson in patience—or downright impractical.

The 152 has been a good fit for my flying mission. Of course, I'd like to have more capacity and speed, but for the cost, all things considered, its total utility has been hard to beat.

Tom Gibney
Ballston Spa, New York

I bought an IFR-capable 1970 150K the week before the checkride for my private pilot certificate and have flown it for four years and 900 hours as a time builder and runabout, although the plan was to do IFR training. I can fly plenty of VFR and although I practice a lot of IFR procedures, I never got around to completing the rating.

With a little luck and a tailwind, students can go the qualifying distance for the commercial cross-country flight requirement, but it's that 250-mile leg with a decent fuel reserve that can take a bit of doing.

I've flown some long cross-country flight in my 150—1890 nautical miles over 24 hours being the most recent. Just think of it as a series of 2.5 hour legs, with two-hour legs and a bigger fuel reserve at night. For day VFR fuel minimums, consider one-hour reserve and not the FAA rules. Accidentally running the engine full rich (with a relatively small fuel supply to begin with) you might embarrass yourself.

As for budget, with an engine replacement fund, insurance, tiedown costs in New England and 250 hours per year operation, my operating cost is $68 per hour. I perform all Part 43 owner-allowed maintenance to meet that cost, while allowing a discretionary $1000 a year for upgrades.

Insurance for me flying 250 hours per year, phased in the FAA Wings program and completing a flight review every year (because I choose to) runs $402 per year (through EAA), with a $25,000 hull coverage.

At 5000 hours on the airframe and a life as a trainer, stuff is wearing out. My mindset is to not screw around with salvage parts if new parts are available reasonably. I've found that McFarlane Aviation offers most of the important stuff at reasonable prices. I suggest that a potential buyer should boroscope the aging airframe as part of the inspection. Even a show-winner can have corrosion.

When you know it's corrosion free, ACF or Corrosion-X it and get some peace of mind for the future, especially when basing near the coast. Anytime you have the airframe opened up, renew the treatment.

See those little pairs of holes along the belly? They are there to drain water from the hull. Clean the mud from around them and every time you wash her off, poke some safety wire in the holes to make sure they are still clear.

There is a lubrication schedule in the service manual, mostly based around 50-hour intervals. Spend the effort getting at all those sheaves and bellcranks in the tailcone, hull and wings clean and lubed. While sealed for life (40 years ago), you will enjoy a lighter control feel.

Consider fitting the spin kit (and lose the AD-limiting placard) and get some quality spin training, plus install shoulder harnesses. The attachment nut plates are almost certainly in place since it was a factory option. An hour's work could save you smashing your face on the yoke and could save your life.

I think the 150/152 is just big enough to be a proper airplane for flying in the national airspace system. This is not to say a Cub, for example, is not, but a long cross-country flight in a Cub will likely require a lot of sitting out. A 150 can be flown IFR with care and make real trips, but I suggest spending some money to reupholster the seats with modern materials. Your back will thank you.

Graeme J.W. Smith
via email

FEEDBACK WANTED

PIPER SUPER CUB

For the March 2016 issue of *Aviation Consumer,* our Used Aircraft Guide will be on the Piper Super Cub. 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 (full-size, **high-resolution**) you'd like to share to the email below. We welcome information on mods, support organizations or any other comments. Send correspondence on the Super Cub by January 1, 2016, to:

Aviation Consumer
e-mail at:
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