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The Aviation Consumer

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IT'S WORTH WHAT SOMEONE WILL PAY

Walking the annual classic car show at the New England Air Museum, I came upon a Ford Model A pickup, which appeared to be in mostly original condition. I made a classless blunder asking its owner what the truck was worth. He let me have it, offering an emotional explanation of why it's priceless and the same is true for his restored biplane. "The prices you see in *Hemmings Motor News* are only good for bankers, estate planners and divorce lawyers," he said. That got me thinking about the *Aircraft Bluebook* and *Vref Aircraft Value Reference* publications and the savvy eye required to determine realistic values.

And then I ran into a Skyhawk owner at my local airport who was turned down by a traditional lender to borrow $28,000 for a modest avionics project. The upgrade, the bank reasoned, would financially turn the old airplane upside down, so it just wouldn't mortgage it to cover the note. If that's true, that lender doesn't know much about the avionics retrofit market. A Garmin GTN650, ADS-B system, audio panel and Aspen PFD is an invoice north of $25,000. This upgrade trend is recognized in the *Bluebook*, but you need to look beyond the "average retail" price column, which is a value report based on data from the previous yearly quarter.

The folks at *Bluebook* publish an avionics supplement, documenting the new list prices for each aftermarket avionics system. Knowing the list price of a box is only a rough value estimate because it may not represent the actual cost of installation labor. The supplement also includes a depreciation chart, which says to deduct 60 percent of the new list price when the equipment is one year old. It continues to depreciate around 10 percent each year. *Bluebook* offers that some brands and types of avionics will retain more or less of their original value than others. That's due to popularity, technology and the type of aircraft in which they are installed. In other words, put the fat book away and put a read on market trend, which will reveal an anything-goes avionics retrofit market.

For my airport neighbor's airplane, *Bluebook* pegs the 1973 Cessna 172M at an average retail value of $34,000, and $26,500 average wholesale. I scoured the actual market and found sizable price variations for M-model Skyhawks. In general, asking prices seem proportional to avionics improvements. The highest priced 172M I could find was a 1976 model year Skyhawk II with 1100 hours on the airframe, a new 180-HP engine and new prop, new leather interior and if my math is correct, roughly $120,000 in avionics upgrades. The asking price is $199,000. Considering the avionics investment, that's a fair price and a pretty nice old Skyhawk, actually, optioned way out of *Bluebook* published guidelines, not counting avionics. It prices the 1976 Skyhawk II (with a 150-HP Lycoming O320-E2D engine) at $38,000 and bumps the value up $1400 if it has strobes, glideslope and—get this—an ADF.

A growing refurbishment market is putting a new twist on market values. Some aircraft refurbers say to ignore the *Bluebook* because its refurbishment package isn't represented. But *Bluebook* does address refurbishment, if not indirectly. It says that historically, most modifications fall far short of their original cost in the resale market, but that many modifications and conversions add value. It correctly advises that mods should be evaluated based on perceived worth to the end user. Still, perception may not fly in the lending world.

As for my neighbor whose lender sent him packing, I referred him to the NextGen GA Fund and NEXA Capital. It lends money for avionics upgrades of at least $10,000, doesn't put a cap on the amount to be lent and doesn't require a mortgage on the aircraft. Recall that Congress approved the use of federal loan guarantees for ADS-B and other avionics upgrades, but to date the FAA hasn't acted to release the funds. NEXA Capital says it has already loaned $2 million in low-interest commercial notes through direct investments. We'll look at that program in detail in an upcoming issue of *Aviation Consumer*. —*Larry Anglisano*

ELECTRONIC DATA COSTS

Thanks for the helpful article on the cost of navigation data subscriptions in the September 2015 issue of *Aviation Consumer*. One point you did not mention was the cost of data for a portable GPS.

For example, Garmin's pricing for the Americas' database bundle is $499.99 per year for its aera 796. This is almost as much as data for a panel-mounted unit, and much more than $149.99 for the same data for the Garmin Pilot tablet app.

I could never understand why data updates are so much more expensive for the aera 796 than they are for the Apple and Android tablets.

Mike Wrob
via email

Garmin said the difference in pricing structure for its portable GPS databases compared to its app has much to do with the royalties it pays to third-party vendors, including Jeppesen and AOPA, to name a couple. There is also a big difference in sales volume comparing its tablet app and portable GPS products.

CONTINENTAL AND ECI

I'm a longtime subscriber to *Aviation Consumer* and a fan of what you've done with the magazine. I want to share with you a recent maintenance experience with my Continental engine.

At the end of June 2015 the Continental IO-360-ES from our Cirrus was sent to Pacific Continental in Pacoima, California, for overhaul. They do not do crankcase work in house, so they shipped the crankcase to Engine Components International (ECi) in San Antonio, Texas. Pacific Continental was aware that ECi, along with all other businesses associated with Danbury Aerospace, was about to be acquired by Continental Motors, but did not expect this to have any change in operations.

Pacific Continental was notified that as a consequence of the acquisition by Continental Motors, ECi would be suspending all work until an inventory would be completed. Finally, after nearly two weeks, Pacific Continental was notified that ECi would no longer be performing case work on Continental engines.

The case was eventually sent to DivCo in Tulsa, Oklahoma, where the work was finally completed. It appears that the consequence of the acquisition of Danbury Aerospace's assets by Continental Motors is to eliminate competition with Continental's own in-house maintenance and repair operations. This is bad news for aircraft operators.

Roger Freedman
Santa Barbara, California

Continental's head of global marketing, Emmanuel Davidson, responds: "While we regret Mr. Freedman's experience, there are good reasons behind our actions as we bring our new team members in San Antonio, Texas, into the Continental Motors family of businesses.

Continental Motors acquired the assets and intellectual properties of the Danbury family of businesses (commonly known as ECi) in late July of this year. We hired many of the employees that used to work for ECi and Danbury.

These operations include a manufacturing business for gasoline engines (under our traditional Continental Motors' brand), the business for our diesel products and a full repair station providing airframe, avionics and engine maintenance/overhaul.

The assets of Danbury brought us new opportunities which will continue at the San Antonio, Texas, location, such as PMA Lycoming part manufacturing (cylinders, crankcases, crankshafts and pistons, plus manufacturing the Titan engine line for the experimental/kit market. Others include aspects of the repair station that Danbury used to operate and the Continental line of PMA parts.

We suspect that Mr. Freedman found himself caught in the period during which closing of the sale occurred and our decision to listen to the local team members on how to improve the business. Our decision to make these moves do mean that we have stopped some activities and will restart some or all as the moves are completed. We believe that this acquisition will bring new products to both the Experimental and Continental Motors' lines and greater investment in existing product segments.

AVIONICS SANDBOX

I read with anticipation your update on this year's AirVenture at Oshkosh in which you said that Garmin announced that it will bow to market pressure and open up its architecture to third-party manufacturers. Nice to see Garmin playing nice in the sandbox and sharing with the other kids.

I decided to upgrade my Cessna 177RG, which has a GNS430W, Aspen PFD and a Garmin GDL88 ADS-B (rather than Aspen's.) My reasoning was that because Garmin had a proprietary interface, I needed to choose between traffic, radar and text weather on the Garmin GNS430W screen or only traffic and radar on the Aspen.

I'm happy with the prospect of adding Garmin's ADS-B traffic and weather to my Aspen PFD. Unfortunately when I emailed Aspen to ask when their equipment would interface with the GDL88 they told me my letter was the first they heard of the interface.

Mark Klebanoff
Worthington, Ohio

Aspen and Garmin said they are working on integrating the GDL88 ADS-B with the Aspen Evolution PFD and plan to have an STC in place by the end of this year, if not sooner.

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PT-6 Overhauls: Complex and Expensive

Don't think of them as anything like piston overhauls. There are so many model variants that an owner is well advised to seek an expert to see the work through.

CHECKLIST

- PT-6s famously deliver reliable power in a variety of airframes.
- The overhaul market is competitive and well served...
- ...but both factory and non-factory overhauls have escalated sharply in price.

by Paul Bertorelli

As a variation on the tired trope about not being able to afford something if you have to ask its price, we offer this: If you want a detailed understanding of all there is to know about the myriad models of Pratt & Whitney's workhorse PT-6 turbine, you'd need a career change just to frame the question. If variety is the spice of life, the PT-6 is off-scale high on the Scoville index.

Daunting or not, PT-6s eventually have to be overhauled and the market for such services is competitive and well-served, albeit structured a bit differently than the piston-engine overhaul world. Given the complexity, newbie PT-6 owners—and there appear to be more every year—may be unavoidably dependent on advice from shops which either specialize in aircraft powered by the PT-6 or, better yet, independent consultants who understand these unique engines.

Because turbine overhauls are so expensive—think the price of a recent model used Cirrus—the value of the airframe is more tightly linked to decisions about renewing the engines. For some aircraft, it might be quite possible to put the airplane's value completely underwater through a wrong decision on engine overhauls.

In this article, we'll examine what's involved in a PT-6 overhaul through a visit to United Turbine near Miami, an established PT-6 shop recently bought by the Continental Motors group. We also talked to companies specializing in turbines about their recommendations on PT-6 overhauls.

Outwardly, there's not much to a PT-6, below. But the innards are stuffed with enough expensive components to push overhauls into the mid-six figures.

LATE TO THE PARTY

During World War II and in the years immediately following the end of it, Pratt & Whitney Canada was a stalwart in the military and airline piston market, supplying a range of engines with a tilt toward British-designed aircraft. But when the jet age arrived, again led by developments in Great Britain, P&WC lagged behind Rolls-Royce, General Electric and the company's own U.S. division, where jet development built rapidly on captured German technology. While PW&C did develop a turbojet as early as the mid-1950s, for lack of funds and manpower, it was taken over and completed by the U.S. mothership to become the JT12. This turned out to be a blessing in disguise.

While GE, Allison and Rolls-Royce had a lock on the emerging turboprop market, P&WC noticed there was a gap in the 250- to 1000-HP range and both the military and civil companies such as Piper were considering airframes requiring such engines. In 1958, P&WC developed a spec for the engine and by 1963, it had certified what became the PT-6, an engine that today dominates the low- and mid-horsepower market and which proved scalable and flexible. After months of deliberation, Pratt developed a free-turbine

design which means that the engine consists of two major segments—a turbine/compressor section or gas generator that produces high-energy gas flow and a power turbine section that generates rotational motion from the heated gas. A third component, a two-stage gearbox, reduces the power turbine's 35,000 RPM to something more prop friendly. Other than a small seal between them, there is no physical connection between the gas generator and the power turbine.

As P&WC saw it, the free turbine design was more complex to manufacture, but required less starting energy, hence it could self-start easily without ground support and it could have simpler fuel controls. Furthermore, while turboshaft engines require expensive, dedicated propellers, a free turbine does not and in the event of an engine failure, a free turbine exacts less drag than a turboshaft does and compared to its arch competitor, the Garrett TPE331, the PT-6 is much quieter on the ground.

OVERHAULS: WHAT'S REQUIRED

Just as the PT-6 is available in staggering variety, so too do its TBOs and overhaul specs differ. For this article, we'll address the lower power variants of the PT-6A series—the -21,-135,-28, -112, -144 and the -42A found in aircraft like the King Air 90 series, the Cessna 425 Conquest, the Caravan, and Piper Meridians and Cheyennes.

Generally, when it emerges from the factory, a new PT-6 is considered a 3600-hour engine, with a mid-time TBO on the hot section—the burner can and power turbine—at the mid-point. However, a so-called "hot" is really just an inspection, not a required overhaul. And work on the hot section at that stage is based on condition, although those familiar with the PT-6 tell us that hot inspections usually uncover at least something that needs fixing and sometimes they require high-dollar repairs or replacements, especially on engines operated in humid or dusty environments.

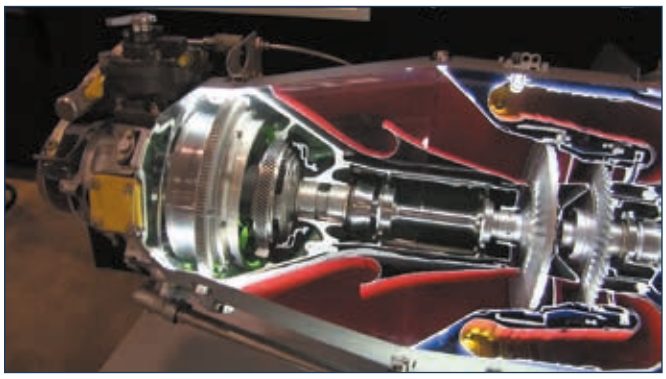
The major components mentioned above each contain complex parts that require attention at overhaul and some have different time requirements for inspection or replacement. The gas generator section consists of compressor turbines—three axial and one centrifugal wheel for the smaller engines—and the burner where fuel is mixed with the compressed air to generate hot gas.

For the smaller horsepower PT-6s, the power turbine, or PT, is a single wheel connected to a complex, two-stage planetary gear reduction section which, again, carries its own overhaul and inspection requirements that aren't the same as the engine itself or that of other components.

When applied to the PT-6, "overhaul" is somewhat of a fuzzy term. Overhaul times can be extended or adjusted through the use of trend monitoring programs that carefully track the wear of critical items. Such programs don't make the engine immortal, exactly, but they obviate teardowns at specific intervals just to see what's inside that might need work.

And at this juncture, expert guidance is needed. An owner looking at a serviceable airframe—say an older King Air C90 or a Cessna Conquest I with run-out engines needs to tread cautiously indeed. In all their infinite variety, PT-6s also have a stack of service bulletins that shops and operators must be cognizant of. Throughout our conversations with PT-6 experts and operators, we constantly heard cautions about knowing the service bulletin level before digging into PT-6 ownership or overhaul.

"You can take a pair of engines and put them into a shop and not really know what it's going to cost to get them back out. That's a heart attack. How do you plan for that? Worse, you're stuck doing the overhauls and maybe you get back a set of engines that you're going to have to throw away the next time," says Conrad Jones of Kansas Aircraft, a brokerage and maintenance house



PT-6 overhauls always include repacement of the sun gear system, top. Much time and effort goes into the power turbine, right, including blade replacement and balancing. At United Turbine, lower right, reusable parts are carefully inspected for allowable wear.

"BEST CASE" OVERHAULS ARE RARE

As part of its business plan to expand opportunistically, Continental Motors got into the PT-6 business in 2015 by purchasing United Turbine, a Miami-area shop with 24 years of turbine overhaul experience.

Like other shops of its type, United is a Swiss Army knife of sorts, taking on virtually all models of the PT-6A and the Twin-Pac PT-6T. Shop manager D.J. Davant ran us through the workflow on a recent visit.

As with piston overhauls, engines are brought in, stripped, cleaned and inspected for damage and out-of-spec parts. A good deal of that inspection involves non-destructive analysis to detect hidden cracks. United, as per FAA requirements, strictly follows the P&WC overhaul manual, but unlike the factory, it can rely on less expensive PMA parts or FAA-approved repairs that the factory might or might not use. (As noted, P&WC isn't forthcoming about the details of its overhauls and won't quote even price ranges until it sees an engine.)

Davant says United can offer a general range of what a PT-6 overhaul might cost, but like the factory, won't commit until the engine is opened up. "Best case" overhauls seem to be as real as the tooth fairy, but for most of the lower-power models, prices start in the $180,000 to $250,000 range.

For engines used in harsh environments or otherwise mistreated, it goes up from there and $350,000 isn't unknown. Those prices, by the way, have escalated sharply during the past decade for two apparent reasons: P&WC has steadily raised its parts prices and more labor hours are required because of increasing regulation on overhauls. According to *Bluebook Price Digest*, a PT-6A-112 used in a Cessna Conquest I cost about $150,000 to overhaul in 2005; now, it's closer to $350,000.

Shops like United compete intensely and aircraft resellers tell us they can beat factory numbers by 15 to 20 percent and may even be faster on turnaround. Davant said it takes a month to six weeks to turn a full engine, which is similar to piston turnarounds. The shop also does hot section inspections, which it tries to turn in 24 to 48 hours.

Davant says Pratt allows more generous limits on what it considers a serviceable part than United is willing to allow. "When we let engines go right to the overhaul limit, we find that the customer won't have it too long before he starts complaining," Davant says. One reason for that is that some tolerances in turbines—especially the turbine blade tip clearance—are critical and even small variances will affect power and efficiency. As with piston engines, each PT-6 is given a test cell run to verify its temperatures and power output.

United appears to be competitive with other non-factory shops. For a -27 or -28, Davant said average overhaul costs are about $185,000, while a -34 is $205,000 and a -114 costs about $225,000. However, those numbers assume that major components are serviceable and/or repairable. Any owner going into a PT-6 overhaul should expect and be prepared to budget for the worst and then be pleasantly surprised when less than the worst happens.

that specializes in turbine aircraft. As with piston engines, the variability in what an overhaul might require and what it might cost is considerable, but the actual dollar values can be much higher—into the six figures.

"From the consumer perspective, we've had customers say, 'I really like your airplane, but I'm scared to death with the unknowns related to the PT-6, especially on the King Air 200, where you have service bulletins on the PT [power turbine] discs that can really drive the prices up," says Michael O'Keeffe of Banyan Air Service, another company that specializes in turbines.

For all its reliability and power, the PT-6 can be a bit of a Pandora's box. Even if the airplane has good logbooks and the service bulletin status can be determined ahead of time, the unknowns when the engine is opened up and inspected can reveal expensive repairs and replacements. "You really can't know what it's going to cost until you've got them off the airplane, disassembled and inspected and by then, it's almost too late to make a decision," says Kansas Aircraft's Jones. And the decision would be to find used engines on the open market, opt for the Blackhawk conversion (see sidebar at right) or even new engines from P&WC if the airframe justifies that kind of expenditure. Some do, some don't. But the fantasy of buying a nice King Air or Conquest with run outs for a song and re-engining it to own a bargain turboprop is, well, probably a fantasy.

"As a company specializing in resale," says Banyan's O'Keeffe, "to take an airplane with runouts and overhaul them to sell it is very difficult." PT-6 overhauls have simply escalated so much during the past decade, that "reasonable" and "overhaul" may not appear in the same sentence. Although factory overhauls are the most expensive, non-factory overhauls have also kept pace, even if they can be 15 to 20 percent lower than the factory numbers.

And not all factory-approved shops provide exactly the same services or the same prices, says Paul Jones of Specialty Turbine Services, a company that provides turbine pre-buy and overhaul consultation. "We brief our clients on what to expect on an overhaul. For example, if it's the first overhaul, they reinstall the compressor turbine blades. That's always in exclusion in the estimate the shops provide, yet it's a $100,000 part," says Jones.

FACTORY VS. NON-FACTORY

Of course, getting the factory numbers is difficult because P&WC's official policy is not to quote prices; not even ranges. This is understandable given that the condition of the engine and its service bulletin status will determine the bottom line price and that can't be assessed before the engine is opened up. P&WC has three designated overhaul facilities or DOFs, one in St. Hubert, Canada, one in Bridgeport, West Virginia and one in Ludwigsfeld, Germany. In addition, there are another five approved main-

tenance facilities in the U.S. that can provide factory-approved overhaul services. P&WC has a range of options for its overhaul customers, including exchange engines, loaner engines and TBO extension programs for high-utilization operators.

Shops familiar with both factory and field or alternative overhaul options for the PT-6 say it's difficult to compare the two options in terms of what new parts are used, nor does it necessarily matter for the quality of the overhaul. P&WC told us that its factory overhauls include these new parts: compressor turbine vane ring, power turbine vane ring, third-stage compressor stator and spacer, first-stage compressor blades, impeller housing amd the compressor bleed-off valve, to name most of the major parts.

However, both factory and field overhauls may contain reconditioned or repaired parts, as allowed by the FAA-approved overhaul manual. This varies from shop to shop and overhaul to overhaul, so we weren't able to form a clear picture of the precise difference between a P&WC factory overhaul and a competing field overhaul.

Dealers we spoke to seem to have a clear preference for factory overhauls and for one reason: sustaining resale value. "We only go with factory overhauls. And the reason for that is that it removes a rejection on resale. It just takes it off the table," says Banyan's O'Keeffe. But this advice isn't universal. An owner who is either buying a PT-6-powered aircraft or overhauling one he intends to keep indefinitely can save up to 20 percent by buying a non-factory overhaul. That isn't a trivial sum. On a twin-engine aircraft, it could amount to $150,000. And any owner who expects to recoup the premium cost of a factory overhaul will likely be disappointed. "Unfortunately, especially on the upgrades, the consumer just doesn't share the value assessment. So recouping all of his investment can be challenging," says O'Keeffe.

BLACKHAWK UPGRADES

Throughout our conversations with PT-6 operators, sales professionals and shops, one word recurred: Blackhawk, specifically Blackhawk conversions for PT-6-powered aircraft. These loom large in the PT-6 universe because they compete favorably with overhauls and many operators see the economics of upgraded, new engines compared to overhauls as far more favorable.

And that's what the Blackhawk conversions are: STCs to install more powerful, factory new engines in place of overhauling an existing PT-6. Blackhawk's Chris Dunkin told us the Blackhawk program current applies to King Airs, Piper Cheyennes, the PT-6-powered Cessna Conquest I and the Caravan.

Basically, a customer turns in a run-out core and Blackhawk provides a factory-new engine to replace it that's both more powerful and at least marginally more efficient.

Although the new engines have more horsepower, they're flat rated to whatever limitation the airframe has. For example, in the Cessna Conquest I, the PT-6A-114 is limited to 450 SHP. The replacement engine is a 750-SHP -135A flat rated to 450 SHP, but capable of delivering that full power to higher altitudes than the -114 it replaces. That means faster climbs and cruise speeds for not too much more money than a factory overhaul for a new engine with a factory warranty.

Prices of these upgrades vary by model, but Dunkin told us the King Air C90 conversion costs about $682,000 complete. Blackhawk has a lower-priced option for the C90 in the -28 engines as well.

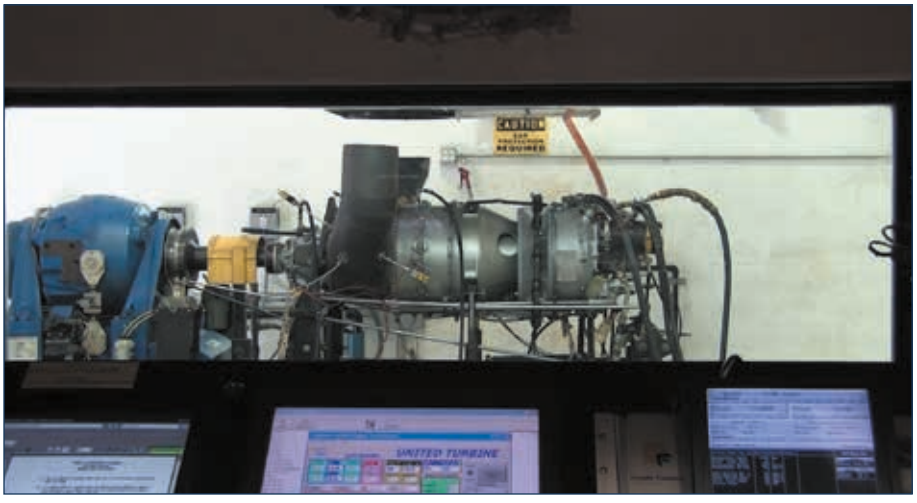
Although Blackhawk does some engine installation work at its Waco, Texas, shop, most of the conversions are farmed out to approved shops in various parts of the country. The Waco facility mainly does R&D and STC work. For more, see www.blackhawk.aero

RECOMMENDATIONS

PT-6s are simply too complex and the aircraft values too variable to make one-size-fits-all recommendations on overhauls. Without detailed knowledge of the various dash numbers, the service bulletin status and economics of potential upgrade paths, an owner will be swimming in a sea of unknowns when overhauling this class of turbine. The probability of making a costly error nearly equal to the value of the airframe is high.

We think the best approach for an

continued on page 32



At United Turbine, right, a PT-6 gets a full test cell run to check temperatures and power output.

Lightspeed's PFX, main photo, and the Bose A20, inset, both have advanced wireless Bluetooth functionality that rivals high-end audio control panels.

High-End ANR Headsets: No Wrong Choice

But we favor Bose's recently upgraded A20 for overall audio quality and comfort. For the best-sounding inflight music, Harmon's AV100 is a standout.

by Douglas P. Fields, Jr. and Larry Anglisano

For buyers willing to drop as much as $1100 for an aviation headset, the current market has no shortage of choices. Moreover, models in this high end of the market sport more advanced features than ever, while promising the best sound quality, comfort and build quality money can buy.

To subjectively determine which model takes the top spot (not an easy task, considering the personal nature of selecting a headset), we spent the better part of a year flying with four models we think represent the best of the best. While our evaluation turned up an overall favorite, each model has its strengths and weaknesses and our takeaway is it's hard to make a wrong choice.

The ones that made the top four got there based on our previous independent evaluations. They include Lightspeed's Zulu PFX, the updated Bose A20, Harmon's AKG AV100 and David Clark's on-ear DC Pro-X.

HOW WE EVALUATED

We flew with them, of course, in a variety of aircraft (piston singles, twins and a turboprop) and with different audio systems. As we've done with previous headset reviews, we handed them out to a diverse group of pilots for their feedback. Eyeglasses, ballcaps, earings, small heads, big heads and big hair were all considerations. We also plugged each one of the headsets into an avionics test bench to evaluate microphone modulation quality.

No, we didn't send the headsets through an audio lab. While we've done this in the past, we don't think raw specs alone are as critical as real-world performance in a variety of aircraft cabins on a variety of heads.

What is critical is fit and finish, Bluetooth performance, music quality, ease of operating the ANR control module and feature set, plus the headsets' ability to sustain abuse on a day-to-day basic. We weren't gentle.

What might you expect from a headset that cracks the $1000 price point? A carry case, of course, and all four come equipped. They also all come with straight interface cords,

CHECKLIST

- Bose A20 finally gets the Bluetooth features we want—and then some.
- If you are an audiophile, Harmon's AKG AV100 rules the cabin-music roost.
- To really know which model is for you means trying it first. Find a retailer with a liberal exchange policy.

As with propellers, there isn't a one-size-fits-all headset. We strongly suggest trying before buying and ask the retailer about its exchange policies.

universally adjustable boom microphones and batteries. There is an option to bypass batteries and plug them in to ship's power through a LEMO or Redel plug. But to do that, you'll pay a shop to install an interface jack. We did. This can be a hefty invoice, so get a quote first.

In our trials, each headset was evaluated with its noise canceling on and off, receiving typical radio transmissions and ATIS briefings, and with music streamed in through the audio panel as well as through the onboard Bluetooth when applicable. iPhones 5S and 6+ were used for Bluetooth. Headset comfort and performance was evaluated both with and without eyeglasses.

Evaluation criteria included the noise level with ANR both on and off. The quality of radio transmissions, panel-provided music and Bluetooth music was compared directly. To determine ease of use, all headsets were used without first reading the manual, for example, to see if the Bluetooth pairing process was intuitive. All audio panel radio and music comparisons were made with the headset volume controls at maximum and no adjustments made to the panel volume controls or music input volume. Bluetooth volume controls were made at the maximum volume of the iPhone. Let's look at each model.

BOSE A20

This past July, Bose released an update to its five-year-old A20, which adds much-needed music Bluetooth features to the set's stellar ANR performance. Worth noting is the A20 came out on top in previous *Aviation Consumer* reviews, but we've been dinging it of late for lack of modern Bluetooth features. A new field-replaceable cable/ANR module assembly changes all of that for the better, enabling Bluetooth music capability and the ability to prioritize multiple wireless sources. We covered this update in the September 2015 issue of *Aviation Consumer* and liked it.

While the quality of the A20's music when sourced through the audio panel is quite good, it's not the best in the group, in our view. However, if it were not for side-by-side comparisons with music sent into PS Engineering's Bluetooth audio panel we might not have questioned it at all.

But to our ears, music sent directly into the headset via Bluetooth resulted in excellent base response and is greatly improved compared to the quality of the wired intercom music. See the sidebar on page 10 for more on cabin music quality and wiring.

When the A20's ANR circuitry is off (passive), the A20 was among the worst in the roundup—even the on-ear David Clark edged it out. That's cause for keeping fresh batteries on hand or plugging the set into ship's power. Additionally, when eyeglasses are worn, several evaluators complained of deteriorated noise reduction, noting a fair amount of high-frequency hiss, much like the over-ear David Clark model.

As for comfort, we think the A20 is quite good, but perhaps not the best. The headband has an unusual springed hinge which due to this design, seems to put slightly higher inward forces on the ears and downward forces on the head. Still, some users may find other headsets more comfortable, or the Bose the most

TOP ANR HEADSETS COMPARED

MODEL	PRICE	WEIGHT	BATTERY LIFE	AUTO SHUT-OFF, AUTO MUSIC MUTE	COMMENTS
AKG AV100	$1099	13 ounces	50 hours	yes	Top performer for music quality, clever earcup flashlight function, music play/pause control, notable comfort, but mediocre ANR performance.
BOSE A20 BLUETOOTH	$1095	12 ounces	45 hours	yes	Consistent favorite among a diverse group of evaluators, advanced Bluetooth and multiple inputs are configurable for priority, simple in-the-field Bluetooth upgrade for older A20 models, poor passive performance.
DAVID CLARK PRO-X	$637	7.5 ounces	50-plus hours	yes	Excellent value for the price, on-ear design is less intrusive, but ANR quality is a trade-off, fold-flat storage, no hard-wired input for music.
LIGHTSPEED ZULU PFX	$1100	14 ounces	22 hours	yes	App-configurable software makes it the most advanced model on the market, excellent ANR quality, battery life isn't great, control module is too bulky for our liking.

ANR CONTROL SETS COMPARED

From left to right: We favor the AV100 controller for its music play/pause control and flashlight function. The DCProX is simple with power, volume and Bluetooth pairing key. The Bose A20 module enables music muting functions. The Lightspeed PFX module has good ergos, but we think it's way too large.

comfortable. Still, the ear cushions are the least thick of all the headsets reviewed, but we don't think this affects overall comfort. Minor nits: Auto-power-on/off and Bluetooth/intercom priority and the stereo/mono controls are tucked away behind the batteries.

Compared to the previous Bose A20, the revised $1095 A20 ($995 without Bluetooth) adds Bluetooth music, auto-power on, a revised mic with slightly longer boom and more control over audio priorities. ANR performance seems to be unchanged. A field upgrade for existing A20s costs $295. It includes an aux music cable and is available in six versions, including models with coiled cords, helicopter plugs and even an Airbus plug. The ergonomics of the control box are identical, although functions have slightly changed and some buttons have become a more visible gray. We like that music can be auto-muted or can be set to play over panel audio.

HARMON AKG AV100

We reviewed the $1099 AKG AV100 headset in our June 2014 issue. A head-to-head evaluation now reveals that this Harmon Kardon-produced headset has excellent audio quality, decent ANR performance and is also the most comfortable, in our view.

It came with a number of extras that no other brand included. For instance, it comes standard with a LEMO plug and an adapter to the standard dual-plug adapter, which Bose sells as a $60 option. The headset comes with a pair of white map light LEDs pointed down and forward from the earcups, which could be convenient for reading checklists or charts at night. There are verbal prompts about the status of the Bluetooth interface. Finally, the control box offers a dedicated play/pause button to control music via Bluetooth.

The AKG's earcups are the most distinctive in the group, being almost V-shaped and also the most padded in the roundup. The downside is ANR performance. With eyeglasses, the AV100 offered the worst ANR performance, but evaluators raved at the set's overall comfort. For easier storage, the earcups twist flat.

The AKG really shines in audio quality with excellent music fidelity. Subjectively, the clarity and volume were fantastic, both via Bluetooth and panel-input music, although the PFX offers more customizations. The same observations were made of radio traffic, although it was mostly a higher volume that was noticeable. Oddly, the Bluetooth volume control box does not remotely control the iPhone volume when listening to music (although it does adjust the volume internally), but it does remotely control the volume when using the phone. We did experience infrequent fraction-of-a-second drop-outs of the audio in Bluetooth music mode, but not reliably repeatable.

Perhaps the first thing many users will notice is the length of the AV100's microphone boom. It's a half inch longer than the others and an inch longer than the one on the previous Bose A20. Turns out this is a good thing, especially since it's easier to flex, plus it clearly indicates which side to speak into. It can be attached to either earcup, the cord is slimmer, lighter and more flexible than the others, but it only comes with one cord clip—making it a challenge to neatly stow in smaller cabins.

As for ANR performance, the AV100 consistently fell short. Evaluators noted that it wasn't as good as the Bose, noting a high frequency hiss. In the twin, an early model of the AV100 revealed some ANR flaws when the propellers were out of sync, but a replacement headset solved the problem. With the ANR circuitry turned off, the AV100 did well. Speaking of ANR power, we like that the set turns on when power is applied, as does the Bose.

LIGHTSPEED ZULU PFX

Lightspeed's $1100 PFX is the newest model in this roundup (we reviewed it in the July 2014 issue of *Aviation Consumer*). Available in dual-plug, LEMO and helicopter models, this headset is the only one which has software control modes for each interface. It also comes with a USB cable for updates.

The PFX is the most advanced headset in this roundup and in our view is the king of features. Indeed, there are so many features that some can only be accessed by a free companion phone app called FlightLink.

Additionally, the headset's features can be updated by connecting the control box to a Mac or PC and downloading new firmware; a recent firmware update earlier this year increased battery life, added a new "save" feature and fixed unspecified bugs.

The PFX's claim to fame is its

flexible CPU and configurable ANR circuitry. Dubbed "Streaming Quiet," the headset is constantly monitoring the sound environment and making periodic changes to the ANR performance. In addition, the headset performs acoustic response mapping by playing calibrated sounds into the earcups to adjust its noise reduction and audio equalization to your particular head. The iOS app allows separate settings of bass and treble for both intercom and Bluetooth music inputs, while a feature called "Front Row Center" attempts to make music sound three-dimensional, while "Voice Clarity" attempts to make the intercom modulation more intelligible. The app can also record and playback headset audio over a Bluetooth connection.

With all of this technology, it should come as no surprise that the PFX has excellent music quality, in our view. Out of the box, it isn't as good as the Harmon AKG, but it can be tuned to taste. Surprisingly, the ANR performance is, in our estimation, on par with the Bose A20 rather than clearly leading the pack with all of that advanced software. Headset comfort was good, but not as good as the AKG and similar again to the Bose, although the other headsets may have a slightly better fit over the ears, depending on the shape and size of those ears.

The PFX has several warts, however. It uses four AA batteries instead of the usual two, and only gets roughly 20 hours out of them—less when streaming Bluetooth music. Our other nit is the size of its control module. It's huge and has both cords on one side of it, making it a bit harder to find a place to stow. In some aircraft we tried, the module wouldn't even fit in a map pocket.

The set's ANR performance is extremely sensitive to how the headset sits on the head, and slight adjustments can make large differences in noise reduction, which could be problematic if you are a frequent head mover. But as we've noted in the previous review, we like that software patches can help improve the sets performance, moving forward.

Incidentally, we were able to improve the ANR performance of a PFX by swapping the headpad with a taller one provided by Lightspeed at no charge. On some heads, the thinner pad doesn't offer enough downward adjustment of the slider to place the earcups entirely over the critical area on the side of the head. The simple swap of the headpad brought the PFX's ANR quality to a level that matched the Bose A20.

The Lightpeed Zulu PFX is the only one with user configurable software, top. The David Clark DC Pro-X, bottom, is the only model that fits on top of the ear.

DAVID CLARK PRO-X/P

The $637 DC Pro-X is the least expensive model in the roundup, but it made our top-four favorite because of its performance, comfort and overall value.

Not only is it the lightest at only 7.5 ounces—almost half the weight of the PFX—it was also the only on-ear headset. By that we mean its cushioned ear seal sits directly on—rather than around—the ear. The Pro-X and Pro-XP models differ solely by connector: a dual-plug or a LEMO plug, respectively. Their performance is identical.

The Pro-X shines in comfort. The headset is 7.5 ounces and the clamping forces are low. The ear cushions are quite wide with a small hole in the center for sound and ANR. Due to this design, there is almost no difference in noise levels or sound quality when wearing glasses. There is still a little pressure on the head from wearing glasses, but it is now located under the ear where eyeglass temples usually bend down. Because the earcups are circular, the headband can be tilted backward and forward through its entire range, and the earcups also swivel. In short, positioning on the head is more important for this headset than the others, but the reward is that this model could be the most comfortable of the bunch.

The ANR performance of the Pro-X is modest. While we don't think it matches the others in the roundup, it's still competent. The DC actually has quite good low-frequency ANR signatures and its midrange ANR is comparable to the Bose. Due to the complex shape of human ears, it is probably not possible to match the total noise reduction of the over-ear headsets, but the DC nonetheless holds its own reasonably well. Surprisingly, when the ANR circuitry was turned off, the DC was among the better performers when passive.

BETTER TUNES VIA BLUETOOTH?

That may be the case if your aircraft has wiring issues. While the cabin of a noisy piston-powered aircraft is perhaps the worst environment for listening to your favorite tunes, it's often the aircraft wiring that makes the sound quality laughable by even the lowest standards. Bluetooth audio panels help because eliminating the patch cable that connects your music player to a music input jack can also eliminate noise. But they aren't the cure-all for subpar music quality. Even with a flagship Bluetooth audio panel like Garmin's GMA350C and PS Engineering's PM8000-series, music playback quality will only be as good as the wiring between the audio panel and headset jacks, the health of the ignition system, charging system, grounds and a slew of other variables.

That's a benefit of streaming the music directly into a stereo headset that excels at music playback, including the Harmon AKG AV100, pictured below, compared to listening through a wired source. But that's not a good option if you want everyone in the cabin to hear the same tunes.

Until headsets can share audio via their Bluetooth circuits, there is still a place for audio panels and the quality wiring required to make the music sound good.

The Pro-X has the simplest control box of the group, with just three controls: power, Bluetooth and stereo volume. Auto-off and stereo/mono controls are provided in the battery case. The volume is digital and does not work when power is off. This only adjusts the panel input volume; Bluetooth volume for both music and phone calls is adjusted using only the connected device.

Uniquely, there is no auxiliary audio input jack available. The two LEDs on the control box are multicolored and gently pulse on and off.

The music quality is adequate. Compared to the rest of the bunch, it is more tinny, with less bass and treble. This was not consistent, as sometimes it felt like it had better bass response than the Bose.

This leads to a hypothesis that audio quality might be very sensitive to the location of the earpiece. Surprisingly, when listening to music from the PM8000C audio panel, the sound quality was better when the DC's ANR circuitry was turned off. Music volume, however, is good. Aircraft radio audio also had this tinny quality to it, and with ANR off the radio volume was particularly low and would need to be adjusted on the panel. To be fair, this was the case with all the headsets, but it was particularly marked for the DC.

The Pro-X folds up quite small for easy traveling, plus DC provides a trademark green cable tie for cord management. A longer cord would be welcome. The mic boom swivels a full 270 degrees for use on either side of the head. It's not entirely clear which side of the microphone to speak into with the provided wind muff attached, but this should only be an issue while getting acquainted with the headset. David Clark claims a 50 hour battery life—the longest lasting in our roundup.

ROUNDUP WRAP-UP

As you can probably tell, it's hard to pick an overall winner because all of these high-end headsets have some strengths and some weaknesses. Further, none of these shortcomings are fatal and it is possible to make some general recommendations.

After a year of living with all four headsets, sharing them with passengers and other pilots and randomly comparing them back-to-back, the Bose A20 always seems to be a favorite. Its new auto-on and Bluetooth music features make it even easier to favor. Its five-year-old ANR still seems to be the best (although in some aircraft the PFX matches it) and the audio quality and light weight are such that even five-plus-hour flights prove comfortable and unfatiguing. Its recent update brings it to a feature parity with the other headsets and the easy upgrade saves $800 over buying a new headset.

The Lightspeed PFX is a top contender. It has the most features, excellent sound quality and solid ANR, plus it can be upgraded over time to keep up with the latest technology trends. On the downside, it is sensitive to how the headset is worn, has an inconveniently large control module and eats batteries four to five times faster than the others.

For the pilot seeking the best comfort and music quality, we think the AKG AV100 wins, but its ANR performance—although good—doesn't match the Bose.

For sheer lightness and comfort, the David Clark Pro-X can't be beat. Users who don't like full-ear enclosure headsets will find this an excellent option. It has the smallest travel size and better, the smallest price tag.

In the end, we think it comes down to personal preference, so we recommend trying one or more of these out before you part with your one grand. Fortunately, there's almost no wrong choice to be made.

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Tailwheel Training: Bring Your A Game

If your're new to tailwheels, your insuror will insist on training and the required endorsement. Here's what to expect.

by Rick Durden

You've been thinking about getting a tailwheel checkout and endorsement and, to be truly honest with yourself, about buying a tailwheel airplane. You can't help it, the advertisements with the tailwheel airplane sitting on some lovely backcountry airstrip have gotten to you—or you want to switch over to a legacy light sport bird. Plus, you're a little tired of hearing "real pilots fly tailwheels" when you don't—yet.

What's involved in getting a tailwheel checkout? What kind of airplane is best for the checkout? How much time does it take? Can it count as a flight review? What about if I buy a tailwheel airplane but got checked out in something else—do I have to go through it again? Can I get insurance?

We'll look at those questions, and more. For now, the short answers are that tailwheel flying is a heck of a lot of fun; figure on 10 hours for a checkout and endorsement; it can be turned into a flight review; you should get a thorough checkout in whatever type of tailwheel machine you buy—more so than nosewheel airplanes, they have personalities, quirks and hidden vices—and unless you buy something truly exotic, you can probably get insurance coverage.

EYES WIDE OPEN

Going in, recognize that if you fly a tailwheel airplane you are effectively going to triple the risk that you're going to have a landing accident. Each month as part of the Used Aircraft Guide in this magazine, we go through the 100 most recent accidents for the type of airplane reviewed. For nosewheel airplanes, runway loss of control (RLOC) accidents usually make up just under 20 percent of the total accidents. For tailwheel airplanes it's almost always above 50 percent. While real pilots may fly tailwheel airplanes, they sure tear up a lot of them.

It's a hard fact of aeronautical life—tailwheel airplanes, by design, are directionally unstable on the ground. That means that if one starts to turn or swerve, it will continue to do so, at an increasing rate, until the pilot takes action to stop the turn. The available controls and brakes may not have enough authority to stop the turn if it has progressed beyond a certain point. To add to the challenge, many tailwheel airplanes have poor visibility forward so the cues available to the pilot that a turn has started may be subtle and not recognized until too late to stop it. If the turn cannot be controlled, it becomes a groundloop.

At best, a groundloop is merely embarrassing. The airplane comes to a stop pointed in an unintended direction, prop swishing around quietly as your adrenaline sprays out of your ears. Things can get much worse: Side loads on the landing gear may tear it off, the prop may get pretzeled and wing(s) torn up. The airplane may flip over with varying degrees of violence. If there is not sufficient open space, the airplane hits something, causing extensive damage and increasing the risk that

CHECKLIST

- ⊕ Good tailwheel training is available, but you may have to travel to get it.
- ⊕ Insurance is available; plan on at least 10 hours of dual to qualify.
- ⊖ Your chance of a landing accident is much higher when flying tailwheel.

The Cessna 140, right, has excellent manners on the ground, for a tailwheel airplane.

CAN I GET INSURANCE?

We asked Jon Doolittle, principal of Sutton James aviation insurance brokers and a CFI, about the insurance market for a new tailwheel pilot buying his dream airplane. He told us that it depends a little on what kind of airplane. For Cubs, Champs, Citabrias and similar, fairly benign handling machines, 10 hours of dual, including a tailwheel sign off, will work. Some companies do not require a specific number of hours, just an endorsement will suffice.

Nevertheless, a pilot getting into something that is more than the conventional, entry-level tailwheel airplanes such as, for example, a Pitts Special, Cessna 185, T-6 or Boeing Stearman will probably take longer than a bare 10 hours to get coverage. The pilot may have to fly with an instructor or mentor pilot for some additional time beyond what is needed for a tailwheel endorsement.

What an insurance company will require for time in type and dual instruction also depends upon the limits of liability. An owner carrying $1 million smooth (no sublimits) policy will probably be required to fly more than the pilot buying a $1 million policy that has $100,000 per person sublimits.

Value will factor into the decision of the insurance company about the experience the pilot needs. The new owner getting checked out in a Beech 17 Staggerwing will probably have to spend more time than the owner checking out in a Stearman that is worth only a third of the value of the Staggerwing.

Then there's the unknown factor that goes into buying aviation insurance—insurance brokers tell us that sometimes they cannot understand how an aviation insurance underwriter comes up with a requirement. Few underwriters have had a chance to fly a tailwheel airplane, so some have exaggerated fears of covering them and some don't know that they should have some healthy fear—so there can be a randomness to the process. In today's soft market, brokers are telling us that they have been able to place coverage for relatively inexperienced pilots that they could not have placed 10 years ago.

someone gets hurt. A lot of the old tailwheel airplanes have crummy restraint systems—usually just a seatbelt—and they have hard, sharp things for one's head to hit in the cabin during even a slow-speed stop.

CHECKOUT

With the risks clearly understood, it's obvious that a comprehensive checkout is in order. Part of that checkout will involve recalibrating the pilot with regard to what is acceptable in terms of heading control when the airplane is on the ground. The pilot must establish a visceral understanding that, unlike nosewheel airplanes, a tailwheel airplane requires constant attention to detail when it is on the ground. If the nose wanders even a degree to the left or right of the desired direction, the pilot must make a correction immediately. Sashaying 10 degrees left and right down a taxiway as is common in a nosewheel airplane can and will lead to loss of control in a tailwheel airplane.

Our survey of the market uncovered a pleasantly large number of flight schools and clubs that give tailwheel training and checkouts. The airplanes used varied. Almost all required a 10-hour checkout to be approved to rent and fly the airplane solo. Sadly, we saw some stupid advertising. One outfit said tailwheels "separate the men from the boys"—they must not want women flying their airplanes. We can't help but wonder if that kind of macho mindset isn't one of the reasons for the high landing accident rate in tailwheel airplanes. In contrast, we also saw some websites with good, detailed information on what a pilot should expect on a checkout along with the school's training syllabus.

We found schools that offered training in Champs, Taylorcraft, Pitts Specials (figure on well over 10 hours to check out), Citabrias, Cubs, Super Cubs, Huskies, Boeing Stearmans, Decathlons and Maules. The Citabria series appeared to be the most common trainer among the schools we surveyed. That's to be expected, they set the standard for good-handling tailwheel airplanes.

We noted that a number of schools offer aerobatic instruction in conjunction with tailwheel training—something that we've observed as a successful combination for pilots. We just note that the landing and takeoff practice should be held before the aerobatic portion of each lesson as incipient airsickness does not improve a pilot's performance on landing.

For the initial checkout we like the Cub, Champ, Citabria, Decathlon, Scout, Husky, Cessna 120/140 and Taylorcraft. All are user-friendly enough that pilots have to work hard but won't go crazy in the process of achieving initial proficiency.

SYLLABUS

After examining numerous syllabi for tailwheel training, we liked almost everything about the ones we saw other than one that said wheel landings are always used in crosswinds—that's not true and can be dangerous in some airplanes.

An example of what we felt to be a good checkout procedure was provided to us by Derek DeRuiter, owner of Northwoods Aviation in Cadillac, Michigan. His company has checked out hundreds of pilots in the Piper J-3 Cub and Super Cub. His company, and many others, are set up to accommodate the pilot who has to travel to the site and stay for a few days for intensive training. Following discussion of tailwheel ops,

The Citabria series (7KCAB shown), top, is highly recommended for initial tailwheel training. The Globe Swift, middle, and Pitts Special, bottom, have handling features that require, in our opinion, a specialized checkout.

the pilot is introduced to hand propping (if in the Cub), then taxiing and the challenge of heel brakes and the concept of limited forward visibility. That's followed by a standard takeoff and flight to explore the fact that the handling of a Cub or Super Cub is more challenging than most modern airplanes. There is substantial adverse aileron yaw and the need to assertively use the rudder to keep the ball centered.

Next comes learning the flare and three-point landings. [Three-point/full stall/tailwheel-first landings are considered together in this article—all are minimum energy touchdowns with the airplane at or near stall speed.] Initially, all operations are on grass runways as the airplane is easier to control, partially because of the extra drag on the tailwheel in grass.

Once three-point landings are becoming comfortable, wheel landings are introduced. [A wheel landing is any landing where the touchdown is on the mains only—even if the tail is only an inch above the runway—and the first part of the rollout is on the mains. The airplane does not necessarily touch down in a level attitude.] Crosswinds are introduced for both three-point and wheel landings and then the process is repeated on a paved runway, which DeRuiter told us "can be a whole different animal."

DeRuiter, as did other instructors, told us that he trains to proficiency, and his company requires 10 hours of dual and renters insurance for a pilot to rent the airplanes after checkout. He also insists that the new tailwheel pilot make all landing for the next few hours on grass runways. Instructors told us that some pilots take more than 20 hours to proficiency. Those tend to be homebuilders who have not been flying while building their airplane or nosewheel pilots who are in the habit of letting the airplane go where it wants.

WHEEL VS. THREE-POINT

We are not going to get into the bar fight regarding the value of wheel versus three-point landings other than to note that there are strong opinions on each side of the issue. We recommend, in the strongest terms, that a pilot learn to do each type and understand the values and limitations of each in the particular airplane being flown. For example, the Aviat Husky POH calls for rolling the tailwheel first on all landings in crosswinds. By the same token, three-point landings are impossible in a Luscombe Sedan due to up elevator limits established during certification for stall/spin issues.

We also point out that wheel landings should be made with an approach speed the same as used for a three-point landing. Extra speed on approach in a tailwheel airplane is a recipe for loss of control on rollout. Tailwheel RLOC accidents do not occur because the pilot cannot hit the runway—they occur because the pilot cannot manage the airplane's energy after touchdown. Touchdown should be as made as slowly as possible under the conditions. That minimizes the energy to be dissipated as the effectiveness of the flying controls diminishes and it's necessary to rely on rolling control of a directionally unstable machine.

continued on page 32

Borescope Imaging: Getting the Inside View

If your shop says you need new cylinders, ask if it performed a borescopic inspection. Our research revealed it may be worth the effort.

by Rick Durden

Ever since the Wrights, one of the vexing problems of aircraft maintenance has been access to the nooks and crannies of the machine. Maintenance technicians have spent major portions of their lives with flashlights and mirrors peering through inspection ports trying to assure that all is well within; at significant expense, major assemblies have been unbolted and removed to allow visual inspection of their insides because of a symptom of illness—often to find that they are healthy—while the act of removal and replacement itself caused damage.

The first borescope—a skinny tube with an objective lens on one end and eyepiece on the other with a relay optical system in between—was developed shortly after the first World War . It proved effective; although the miniaturized optics meant it wasn't cheap and getting effective illumination to the area of interest was a challenge.

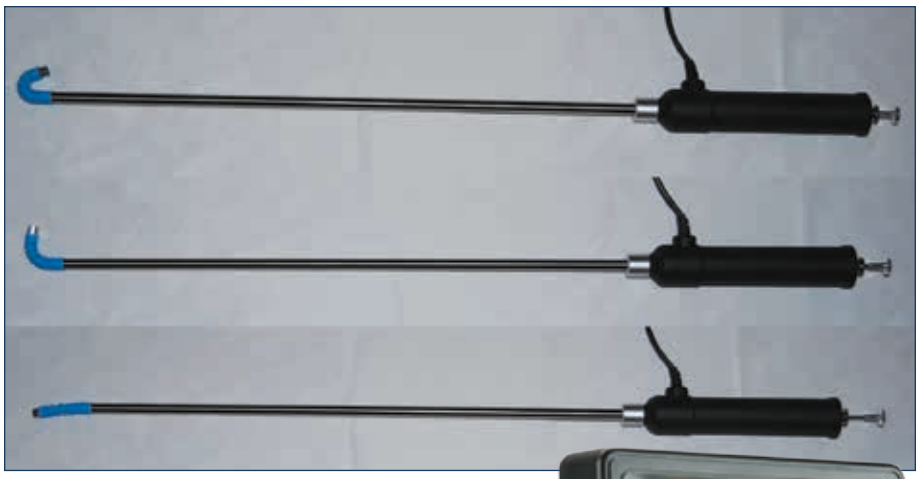
The aviation applications proved self-evident. Engine manufacturers begin recommending their use in the piston world and mandating it in turbine applications. Because they were expensive and not absolutely required for piston engine aircraft, it was rare to find a borescope in a shop that didn't cater to the turbine set. (There is now at least one AD that requires borescope use in a piston engine cylinder inspection.)

Another problem was that the original, rigid tube borescopes were

CHECKLIST

- Prices are down, quality up; we think every shop should have a borescope.
- Using a borescope can save an owner $ in unneeded cylinder work.
- More training aids for borescope use are needed for technicians.

Scott Utz of Arapahoe Aero uses his shop's GE XL VU videoscope to examine the engine of a Cessna 340, left. Using the articulating camera head, a healthy exhaust valve can be seen clearly, below.



Three shots of a ViVidia Ablescope showing tight radius of rotation of its articulating camera head, right. Gradient Lens Hawkeye V2 Videoscope with LCD display, below right.

limited to straight line applications. One could be inserted through a spark plug hole of a cylinder and get an excellent view of the top of the piston and a little of the cylinder walls. Even with a mirror or prism arrangement, it could be tough to see what was most often the area of concern, the valves.

The advent of fiber optics allowed flexible borescopes to become a reality—suddenly it was possible to snake the tip into more locations and find corrosion that had been hiding. Articulated tips were developed so that they could be turned to look back in the direction from which the scope had arrived—getting an excellent view of valves and their seats. Still, cost stayed high as it took a lot of fibers in the fiber optic relay to give acceptable image quality.

MINIATURE CAMERAS

The borescope world changed with the advent of the inexpensive, high-resolution miniature video camera and LED lighting. Now, what is technically referred to as a videoscope—a tiny camera mounted on a flexible or rigid tube—has become ubiquitous. We are of the opinion that a videoscope with image quality suitable to be a useful tool in a maintenance technician's arsenal to help make an informed decision about the health of a cylinder and find corrosion in hidden areas of an airframe can be purchased for under $1000.

We think that there is no longer an excuse for a shop not to own one. We also recommend that any owner who has been advised of low compression on a cylinder not agree to pulling that cylinder until it's been inspected with a some type of borescope—even if that means going to another shop to have it done.

When we surveyed the market for videoscopes, we found some for under $50 that may well be just the thing for looking into the tight places in the airframe. However, without an articulating head, we don't think they're adequate for getting a good view of all of the inside of a cylinder. As with much in aviation, you get what you pay for with a borescope or videoscope and image quality is everything. When it comes to assessing the condition of the inside of a cylinder, we think that it's possible to buy an adequate unit for under $500.

When it comes to inspecting turbine wheels and blades for FOD and cracking, the need for precise imaging and significant magnification as well as being able to take and record measurements means going to a much higher quality, precision videoscope. Our market survey indicated that a shop should be prepared to spend on the order of $10,000 to $25,000 and work with vendors to get a scope that is right for the inspections the shop does.

Another factor to consider in selecting a scope is the risk of damage to the head should it be dropped or jammed against something during an inspection in a tight area. The less expensive scopes are not particularly damage tolerant, so what might be considered a low-speed impact may mean it becomes junk. The high-end scopes have camera housings made of tungsten or titanium.

Some videoscopes have displays included with the kit, others must link to a computer, smart phone or tablet to display the image.

DEMONSTRATION

We were given a demonstration of a GE Measurement and Control XL Vu Videoprobe, a $17,000 precision instrument, by Scott Utz, principal of Arapahoe Aero Aircraft Maintenance at Denver's Centennial Airport. The unit included a display that was far clearer than our iPad, with better contrast.

Utz told us that it's a regular practice to connect the videoscope to a large computer monitor when showing a customer the condition of his or her engine. He told us that while the display on the GE unit is excellent, the resolution of the optics can be best appreciated on a computer monitor. When a customer can clearly see an area that a maintenance tech is concerned about, it helps the decision process.

As with other videoscopes, still images and video from the GE unit can be emailed or streamed in real time to allow a customer to see them from anywhere in the world or a maintenance tech to get a second opinion on an issue.

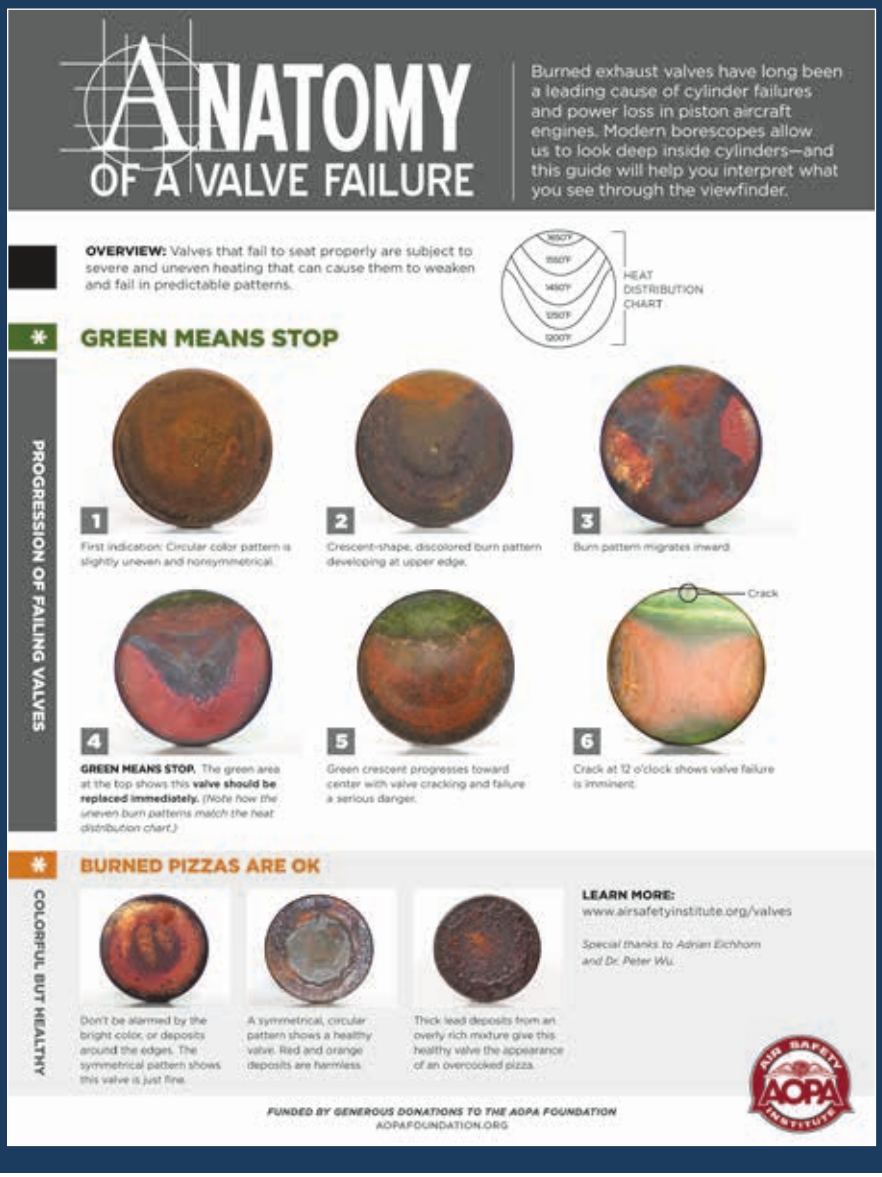
IS AN EXHAUST VALVE REALLY FAILING?

Twelve years after Continental issued service bulletin SB03-3 directing maintenance technicians to use a borescope to inspect each cylinder every time a compression test is performed, its instructions are being routinely ignored—at a high cost to aircraft owners.

A compression test is one of the valuable tools available to a mechanic to diagnose cylinder health, yet it requires a degree of skill to perform accurately and even the best techs admit that they may not get the same results twice in a row. Above all, it is only one tool in the tech's arsenal and should never be used by itself to make the decision to pull a cylinder off an engine. Too often low compression accompanied by a leaking exhaust valve has resulted in a yanked cylinder only to find that the valve and its seat are perfectly healthy.

Continental makes it clear, and we think it's applicable for Lycomings, that a borescope must be used to check on exhaust valve condition. If it's in good shape—AOPA's poster below is a great reference for what it should look like—there is no reason to pull the cylinder.

If the borescope discloses signs of valve distress, pull the cylinder—if not, that borescope exam just saved you significant money.



Utz went through a routine cylinder exam, first looking at the top of the piston for evidence of overheating, burning or detonation. The resolution of the image on the attached display was such that it almost seemed to be in 3-D.

Using one hand on the controls just below the display, Utz articulated the camera head slowly, allowing a close-up view of the cylinder walls. They were smooth and shiny through much of their length until some small corrosion pits became visible near the very top. Utz said that for the calendar age of the engine and the number of hours on it, such pitting is not unusual on a Continental engine—or of concern.

EXHAUST VALVE

With the camera head articulated nearly 180 degrees, Utz focused on the exhaust valve. It displayed a symmetrical, circular color pattern on its face, with no indications of burning, cracking or uneven deposits. Utz explained that with a little maneuvering it is possible to see much of the valve seat.

Utz then used the videoscope to look over the inside of the cylinder head, the spark plug that was still in the cylinder and the intake valve. All areas looked normal and healthy with no indications of distress.

As we discussed the capability of the borescope, Utz said that for piston-engine airplanes, "We don't want to pull a cylinder unless we absolutely have to. The borescope is a powerful tool, one of many that we use to make a decision about pulling a cylinder. The others are a compression check, regular oil sampling, the history of the engine and the time on the engine."

We commented on how smoothly the scope articulated, but that it sometimes took a few moments to get oriented when looking at the display. Utz said that the technicians in his shop had gone through the training provided by the manufacturer when they bought the videoscope. As with any sophisticated tool, there's a learning curve involved with making effective use of it. The literature on borescope use and human factors in borescope inspections refers to the situational awareness needed in using a borescope much as a pilot needs it when flying an airplane.

SELECT VIDEOSCOPES

PRODUCT	PRICE	COMMENTS
AGPtEK 16-FOOT WATERPROOF BORESCOPE INSPECTION CAMERA	$12.15	Image sensor: 1/6 CMOS sensor. Resolution 640 x 480. Illumination: adjustable LED lights. Camera head diameter 14.5 mm. View angle 52 degrees, but no mirror for angled viewing is included. USB interface is used for viewing on a computer monitor. No articulating head. At the price, an inexpensive tool for looking at areas in the airframe.
VIVIDIA 9mm PORTABLE FLEXIBLE INSPECTION CAMERA WITH 2.4 INCH LCD MONITOR	$69.98	Image sensor: 0.3 MP color CMOS sensor. Monitor: 2.4 inch full-color LCD, resolution 640 x 480. Focal range 4 cm to infinite. Illumination: four white LED lights. Camera head diameter 9 mm. Kit includes four AA batteries and mirror for angled viewing. This basic unit does not have an articulating head; display resolution low; cannot save images.
LEMONBEST HD 720p HANDHELD WIRELESS WIFI INSPECTION BORESCOPE WITH 2.0 MEGAPIXEL CAMERA	$87.69	Image sensor: 2 megapixel CMOS. Resolution 1280 x 720. Illumination LED lights. Camera head 8.5 mm, 60 degree viewable angle. Wi-Fi transmits image to a smartphone, tablet or computer and can capture snapshot or video. No mirror for angled viewing. A higher resolution basic unit without an articulating head.
VIVIDIA ABLESCOPE HD USB BORESCOPE WITH 180 DEGREE ARTICULATING 8.5 mm PROBE	$149.98	Image sensor: CMOS. Resolution 640 x 480. Illumination six LED lights. Camera head 8.5 mm, 60 degree viewable angle. Camera head articulates 180 degrees in a 30 mm radius. USB interface for viewing on a computer monitor, capture still images or video. An example of the minimum unit needed for a good view of valves in a cylinder.
VIVIDIA HIGH PERFORMANCE BORESCOPE SYSTEM WITH ARTICULATING 5.5 mm DIAMETER PROBE AND WIRELESS 3.5	$569.98	Image sensor: 1/13-inch CMOS. Resolution 640 x 480. Illumination four LED lights. Camera head 5.5 mm, field of view 54 degrees, 110 degree sweep and 340 degree rotation in 45 mm bending radius. 3.5-inch detachable LCD display. Can capture still or video images on micro SD card and data can be transferred to a computer via USB cable.
GRADIENT LENS HAWKEYE V2 VIDEOSCOPE	$8995.00	Basic model of a sophisticated line of videoscopes designed for turbine engine inspection with a 6 mm camera head with 150-degree articulation, 70-degree field of view with a 90-degree prism tip attachment. Tungsten braid sheath, detachable micro LED light illumination and 5-inch LCD display. 640 x 480 still and video format.
GE MEASUREMENT AND CONTROL XL Vu VIDEOPROBE	$17,000.00	Kit meets multiple MIL-specs for imaging equipment and includes multiple camera heads to allow best imaging for specific tasks. Image sensors are SUPER HAD CCD cameras in titanium housings with pixel counts of 290,000 and 440,000. The system has continuous 5x digital zoom, 360-degree joystick control tip articulation and graphic and text annotation of imagery. It is an example of the type of equipment that meets the needs of a sophisticated turbine-engine shop.

Utz told us that the controls on the GE scope were easy to use and became easier with experience. As a tech used the videoscope more and more, he or she rapidly developed a feel for where it was pointed when being articulated.

Our research found that one common complaint among borescope users was non-intuitive articulation movement. Many of the systems use a small joystick, so movement can be described as akin to flying an airplane in three dimensions. If the design is such that the camera head doesn't go where the user anticipates when moving the stick, the learning curve for the user is going to be steep.

Utz told us that it was common for techs to involve other techs during borescope exams, both to get the thoughts of those had more experience and help educate those with less experience.

In researching this article, we found that there were a number of organizations that offered training for borescope use in turbine applications, but a dearth of training information for piston engine aircraft. We also received word from aircraft owners of mechanics who didn't understand what they were seeing through a borescope—notably two that were convinced that an exhaust valve that had red deposits was distressed and about to fail. That's not the case, red on an exhaust valve is not a bad thing, green is—see the sidebar on the opposite page.

We think that a shop that is buying a borescope for the first time should explore what sort of training materials are included with the scope. There is a learning curve.

Finally, we were told to make sure to clean the borescope after use following the manufacturer's instructions. The chances are high that the head will have come into contact with fluids or debris that can degrade viewing clarity or damage the unit if not removed.

CONCLUSION

With the radical leap in capabilities and concurrent drop in prices, we think that every aircraft maintenance shop should have and use a borescope at least capable of doing a full cylinder examination in conjunction with every compression check performed. We think the ability to look into otherwise inaccessible areas of our aircraft is essential.

AVIONICS FLIGHT TRIAL

Safe Flight SCc: Speed Control, Plus AoA

The market is saturated with AoA systems, but SafeFlight's new SCc helps manage speed and angle-of-attack by measuring the wings' stagnation point.

by Larry Anglisano

Long FAA certification delays enabled Safe Flight Instrument Corporation to improve its first-generation leading-edge speed control/AoA system. For one, it ditched the remote computer in favor of a simpler and lighter two-piece system (sensor and display), while redesigning the cockpit display for better readability and easier operation.

The result is the third-generation model SCc leading edge sensor system, which is currently certified under the FAA's ASTM policy standards for AoA systems. We recently flew with the $1895 SCc system in Safe Flight's Cessna 172 for a closer look and liked what we saw.

LEVERAGED TECHNOLOGY

When we flew with Safe Flight's first-generation speed control system a few years ago, we were surprised that the company struggled to earn FAA approval. After all, it's no stranger to the process. Safe Flight invented the stall warning lift detection system in the 1940s, it pioneered the lift transducer system in the 1950s, plus its wing leading edge lift sensors are certified for primary stall warning detection on everything from single-engine piston models to military fighter jets. Safe Flight is also the company that essentially owns the autothrottle market, with a long list of patents and certifications as proof. In Safe Flight's defense, its earlier AoA system was introduced before the FAA developed a liberal ASTM approval process (FAA Memo AIR100-14-110-PM01), which made it easier for manufacturers to bring AoA technology to market.

The new SCc system leverages similar leading edge wing sensor technology used in Safe Flight stall warning systems. Safe Flight says a leading-edge lift transducer is the most accurate way of measuring AoA because the system is accurate regardless of aircraft weight, wing loading, turbulence or wing flap configuration. The theory in which Safe Flight's SCc measures AoA boils down to the very basic fundamentals of wing lift.

The latest generation SafeFlight SCc has a glareshield-mounted digital speed indexer with Geiger counter—like audio output. The display in the photo to the left indicates an on-speed condition for landing.

As the aircraft wing moves through the air it divides the air mass. At the center of this divided airflow is a narrow region known as the stagnation point. The location of the stagnation point uniquely represents the wing's AoA. The system's lift transducer—installed on the leading edge of the wing—senses the location of the stagnation point by means of a spring-loaded vane. Walk any airport ramp and you'll find a similar vane used for stall warning detection on a variety of aircraft, although it's not the same sensor used in the SCc system, nor is it a stall warning vane—or intended as a replacement for an existing stall warning system.

The AoA lift transducer is a dedicated electromechanical vane specifically designed to detect the location of the wing's stagnation point and then relay this signal to the indexer/computer that's installed on the aircraft glareshield. Unlike other AoA systems, the Safe Flight SCc generally doesn't require the installation of a wing flap position sensor.

The transducer measures 2.8 by 1.8 by 1.8 inches and weighs 0.3

CHECKLIST

- ⊕ Speed control functions are useful in all phases of flight
- ⊕ Speed indexer is intuitive to use and sunlight readable.
- ⊖ Cutting the leading edge of the wing for the lift sensor means an involved installation for some aircraft.

pounds. The indexer/computer measures 1.3 by 2.3 by 3.4 inches and weighs 0.2 pounds.

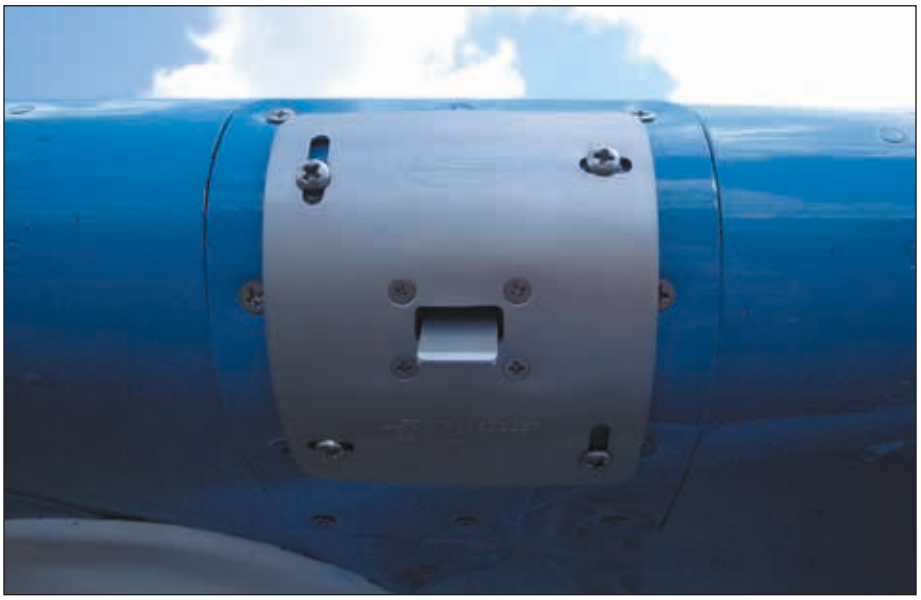
INSTALLING IT

If there's a downside to measuring a more accurate AoA by referencing the wing stagnation point, it's the effort that might be required to mount the lift detector on the leading edge of the wing. On many aircraft, this will require the cutting of the wings leading edge to mount the sensor. (It was also an issue Safe Flight faced when it presented its first-gen AoA for FAA approval.) The lift transducer and spring-loaded vane is a single component that's installed with a mounting plate that contours to the curvature of the wing's leading edge.

The installation of the transducer and vane assembly mimics that of the company's stall warning vane. In general, the AoA transducer must be installed on the wing opposite to the existing stall warning sensor, at the same or close to the same spanwise position. While there is some flexibility in mounting location—perhaps positioning the sensor so it can be accessed from an existing inspection port in the wing—its accuracy is dependant on it being mounted at 1 percent total wing chord.

Additionally, the mounting location should be clear of any internal interference from ribs and other aircraft structure. Plus, installers need to note locations of pitot/static lines, electrical wiring, fuel tanks, fuel lines and other hardware that might interfere with the sensor. Safe Flight provides a doubler plate that also serves as a template for cutting the hole in the leading edge of the wing. Once the outline is drawn, out comes the cutting wheel. As drastic and critical as this may sound, we think any competent shop that's skilled in installing antennas, riveting and performing sheet metal repairs and other metal work can handle the installation.

The indexer/computer is installed on top of the instrument panel using a doubler and a sturdy ball mount. This enables the pilot to adjust the indexer to match the seating position. The indexer/computer interfaces with the transducer via two harnesses, which are fabricated by the installer. The system can accept 12-24 volts and can also be interfaced with the audio system for aural alerts.



The SCc electromechanical lift transducer, top, is generally installed in the opposite wing of the stall warning vane. That's a rear view of the indexer/computer, with its interface cables.

The SCc system is calibrated using a two-step process. First is determining the accurate placement of the lift transducer and then performing an inflight calibration procedure using landing approach and stall warning speed data points, based on aircraft POH published speeds.

The indexer/computer has a dedicated calibration mode accessed by holding two buttons on the indexer. Once in the calibration mode, you can fine tune the landing approach indications by matching the system to the speed being flown.

FLYING IT

We flew with the system on a gusty day, which was a good way to compare the AoA indications to that of the stall warning system in the Cessna. We think most pilots will find the indexer intuitive to use and its LED annunciators and controls have been much improved over earlier models we flew. For instance, the old mechanical AoA reference marker has been replaced with an LED marker. This is a scrolling white LED arrow on the right-hand side of the indexer/computer and is used to designate a pilot-selected AoA reference. This reference is adjusted by two buttons on the side of the indexer. The top button moves the marker closer to the high AoA side (up) and the bottom button moves the marker toward the low AoA side (down) of the display.

For takeoff, set the reference marker at the center portion of the display, which represents an on-speed condition, and fly the aircraft at the POH listed airspeed for the normal takeoff. After rotation, simply keep the five green vertical and horizontal LEDs displayed to maintain the

SAFE FLIGHT'S SCC: A TICKET TO BETTER LANDINGS?

If you use Safe Flight's SCc as it's intended—which is really a speed control computer—our flight trials proved that it can lead to more consistent on-speed approaches. This, of course, can lead to a better landing flare and hopefully, a smoother touchdown. This saves wear and tear on the tires, brakes, airframe and best of all, avoids an unintended trip into the weeds—or worse. You should be able to get the same positive results from referencing a properly calibrated airspeed indicator, but Safe Flight's speed control system is simply more intuitive for dialing in the correct speed for the conditions. This also includes takeoff and climb.

In our trials, before takeoff on a gusty runway 36 at Waterbury Oxford Airport in Connecticut, the drill was to position the AoA reference marker in the center of the display, adjacent to the three-dot green indication in the center of the display. After rotation, using the SCc to maintain an on-speed climb proved far easier than flying the mechanical airspeed indicator, which was fluctuating as much as +/- 15 knots in the moderate turbulence. If you use the display as an airspeed trend indicator, you'll likely have better results getting the aircraft on speed and keeping it there.

So is the SCc an AoA, speed control computer or a stall warning system? It can actually be used for all of those purposes, even though it's not intended to replace the existing stall warning system or airspeed indicator, of course. But we think the SCc betters the stall warning system simply because the indexer/computer is an in-your-face device, positioned in the same location your eyeballs should be when taking off and landing. Once you fly with it, you'll likely be focused on it during every takeoff and landing. While we don't think it—or any other AoA system—is the solve-all for stall/spin loss of control wrecks, we're convinced it can help pilots achieve what they should be doing anyway: fly the correct climb and approach speed every time.

on-speed climb. Unlike some AoA systems that stow from view above critical airspeeds, the Safe Flight SCc is used in all phases of flight.

For example, it has a long range cruise mode with an AoA reference that is adjustable to give a reference that takes the headwind/tailwind component into consideration for max range flight. Using the POH figures for the required speed for a given tailwind or headwind component, you can set the indexer reference marker to fly the correct AoA for the conditions.

We found that flying the SCc during a landing approach is intuitive. Start by flying the aircraft by the book speeds for a given gross weight and flap setting. If the system is calibrated properly, the centermark LEDs will be illuminated to indicate a fast (green dots below the center mark), on-speed (five center dots) and slow (amber to red dots at the top of the display.)

The system also has a low airspeed awareness, or LAA mode. When the airplane reaches the near maximum limit AoA, the indexer will display two flashing red LEDs and sound an increasing frequency of the Geiger counter-like audio (if it's wired into the aircraft audio panel and or pilot headset audio.) The audio alerts will begin when one amber and one red LED are illuminated and will increase in frequency as the AoA increases. Between this low speed audio alert in the headphones and a blaring stall warning horn, a pilot really must be asleep at the wheel to allow the aircraft to stall.

APPROVALS

The Safe Flight SCc is not approved for any FIKI (flight into known icing) certified aircraft. Additionally, the SCc applicability is determined by the presence of a Safe Flight stall warning system being part of the original equipment list. This includes common single and twin-engine Beechcraft, Cessna, Piper, Mooney and Grumman models.

As for installation effort, the shops we spoke with estimated it might take two days, including paperwork and calibration, to fully install the SCc and wire it into the audio system. At $110 per hour, that's roughly $1800, plus $1895 for the hardware. The $1495 model SSx is available for experimental aircraft.

Contact www.safeflight.com, 914-946-9500.

ForeFlight Mobile 7.3: Two-Way Garmin Play

Transferring flight plans between the panel and tablet isn't the big news, but the ability to overlay Garmin's certified ADS-B data on ForeFlight's tablet app is.

by Larry Anglisano

For some, the ADS-B buying decision rides on the system being compatible with a favorite tablet app. While shops we've spoken with report that Garmin's GDL84 and GDL88 transceivers have been dominant sellers, some buyers are reluctant to make the investment because the system was only compatible with Garmin's Pilot app, and not the popular ForeFlight Mobile program for iPad. Not any more.

ForeFlight recently announced two-way compatibility with Garmin panel avionics, including the ability to interface Garmin's GDL-series ADS-B transceiver on its Mobile iPad app. But there has been some misinformation and confusion about what this interface will and will not do. Here's a clarification.

FLIGHT STREAM WIRELESS

The backbone of the Foreflight/Garmin interface is Garmin's Bluetooth Flight Stream 110 ($549) and 210 ($999) gateways. These are remote wireless transceivers for transferring data between the tablet/smartphone and Garmin panel avionics.

ForeFlight isn't new to this kind of wireless cockpit interface. Recall that its Mobile app was the only one compatible with Aspen's Connected Panel cockpit Wi-Fi interface released several years ago. This minimal interface can send flight plans from ForeFlight into Aspen's Evolution MFD and ultimately load the data into Garmin's GNS navigators. But it's more than flight plan automation.

By connecting to the Flight Stream model 210 via the ForeFlight Connect wireless interface, the app receives GPS and AHARS data for driving the app's synthetic vision function (the Flight Stream 110 won't work—it doesn't have AHARS).

It's worth mentioning that ForeFlight's synthetic vision doesn't require an attitude source, but when the data is received from a Flight Stream or a Stratus 2 receiver, it enables the synthetic vision to display dynamic pitch and bank functions.

As it does with Garmin's Pilot app, the Flight Stream gateway sends ADS-B traffic and weather data received by Garmin's GDL84 and GDL88 to ForeFlight, eliminating the need for a dedicated panel display. The interface also includes transfer of pressure altitude data, ADS-B messaging and status information, when available. You'll need ForeFlight version 7.2 for this ADS-B compatibility, in addition to the Flight Stream unit and a $3994 GDL88 or GDL84, which is $3995 and won't work on a panel display.

ForeFlight version 7.3 adds the ability to send and receive flight plan data to and from Garmin's GTN and GNS WAAS panel navigators, in addition to the G3X Touch experimental suite. This data includes routing and waypoints, arrival, departure and approaches. Expect to see the entire approach procedure and step-down's overlaid on ForeFlight's map view and the "plates on map" function, not just initial approach fixes.

There are things the wireless interface will not do. For instance, ADS-B weather and traffic received from a Stratus-series portable receiver can't be streamed onto a Garmin panel display. If you have a Garmin GDL69 SiriusXM satellite weather system, it's not compatible with ForeFlight. Version 7.2 and 7.3 are free updates to an existing ForeFlight subscription (which start at $74.99) updated from Apple's App Store.

Contact www.foreflight.com.

ForeFlight Mobile version 7.3, far right, receives ADS-B traffic and weather from Garmin's GDL84/88 remote ADS-B receiver and streams flight plans to and from the GNS-W and GTN navigators.

Beech Baron 55:

It's a bargain to acquire, but far from cheap to maintain and operate. Still, the 55-series "baby Baron" pays back in speed and handling qualities.

Fly most any Beechcraft model and you will likely come away impressed with its sturdy feel, excellent build quality and, especially, its handling qualities. All the way down to the lowly Musketeer, Beech just took pains to get the airplane's flying manners a cut above everything else, and that applies in spades to the Baron series. Even so, every aircraft company has to make compromises. In the 55 Baron, for instance, what many find to be pleasant handling characteristics can prove to be a handful in poor weather, or when the air turns green with turbulence. And nothing comes for free, particularly in a higher-end Beech.

Shops won't feel sorry for the owner who rolls up in a Baron, and this airplane is far from cheap to own or operate. The bright side is a perennially soft market for piston twins means a Baron may not be ruinously expensive to acquire. In fact, there are some real bargains out there on model 55s—also known as the "baby Baron." Older Baron models are often priced lower than older Bonanza models.

In the current market—the autumn of 2015—we think model 55 Barons represent good buys, as well as good investments for pilots who already own them. While the prices of other light twins have tanked several years ago in the sour economy and high gas prices, Barons have declined just slightly less. But even in the current improving market, there's enough softness left for the canny buyer to negotiate a deal on most twins, including a Baron.

As twins go, the Beech Baron 55 has decent if not exceptional payload. It's also faster than the naturally aspirated Aztec and Cessna 310.

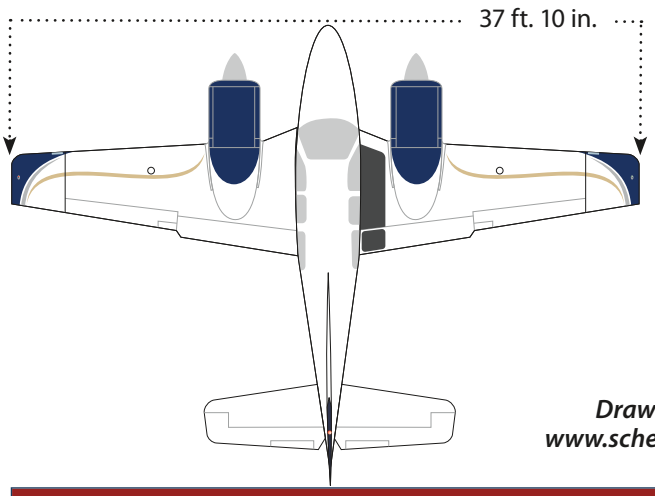
MODEL HISTORY

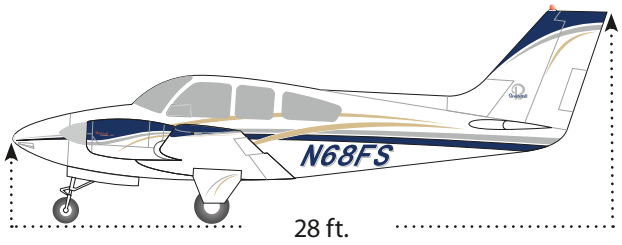
Although Beech (now Textron) isn't quite the master of the parts-bin model evolution that Piper is, the Baron has nonetheless been through some changes.

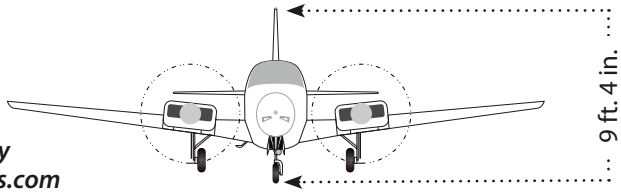
Like the Bonanza, it came in two sizes, long- (model 58) and short-cabin(55). There are several subtypes: The 58 could be had for a time with turbocharged engines and, if desired, pressurization. There aren't many P-Barons flying around and today, only the long-body 58 remains in production. Plan on an eye-popping invoice well north of $1.3 million, complete with a Garmin G1000 glass cockpit and no shortage of luxurious appointments in its cabin. But there are more palatable options if you haven't budgeted that kind of dough for a Beechcraft twin.

That's Carl Carlson's B55 Baron, main photo, photographed from the lead aircraft in a formation flight.

BEECH BARON 55





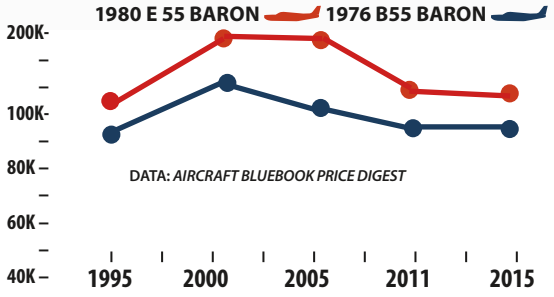


Drawings courtesy www.schemedesigners.com

SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1961 BARON 55	CONT. 260-HP IO-470-L	1500	$30,000	112/142	1920 LBS	191 KTS	±$45,000
1962-63 A 55 BARON	CONT. 260-HP IO-470-L	1500	$30,000	112/142	1920 LBS	191 KTS	±$48,000
1964-66 B 55 BARON	CONT. 260-HP IO-470-L	1500	$30,000	100/146	1864 LBS	196 KTS	±$55,000
1966-67 C 55 BARON	CONT. 285 HP IO-520/C/CB	1700	$30,000	112/142	2225 LBS	200 KTS	±$59,000
1967-71 B 55 BARON	CONT. 260-HP IO-470-L	1500	$30,000	100/146	1864 LBS	196 KTS	±$62,000
1968-69 D 55 BARON	CONT. 285 HP IO-520/C/CB	1700	$30,000	112/142	2225 LBS	200 KTS	±$67,000
1970-73 E 55 BARON	CONT. 285 HP IO-520/C/CB	1700	$30,000	100/166	2009 LBS	195 KTS	±$80,000
1972-75 B 55 BARON	CONT. 260-HP IO-470-L	1500	$30,000	100/146	1864 LBS	196 KTS	±$84,000
1975-78 E 55 BARON	CONT. 285 HP IO-520/C/CB	1700	$30,000	100/166	2009 LBS	196 KTS	±$115,000
1976-79 B 55 BARON	CONT. 260-HP IO-470-L	1500	$30,000	100/146	1864 LBS	196 KTS	±$107,000
1979-81 E 55 BARON	CONT. 285 HP IO-520/C/CB	1500	$30,000	100/166	2009 LBS	195 KTS	±$137,000
1980-82 B 55 BARON	CONT. 260-HP IO-470-L	1500	$30,000	100/146	1864 LBS	196 KTS	±$130,000

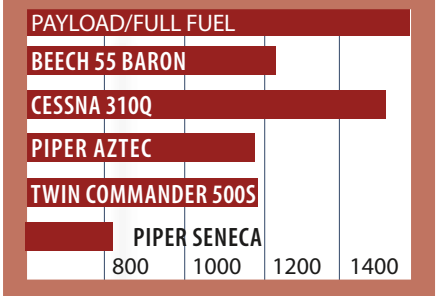
RESALE VALUES

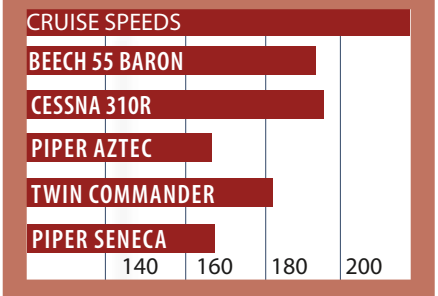


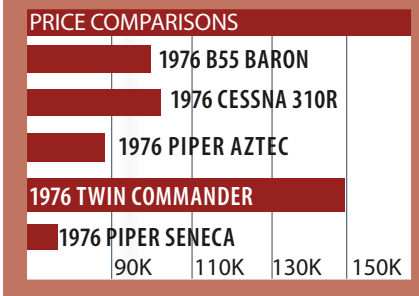
SELECT RECENT ADs

AD 09-25-01	SHOULDER HARNESS FASTENERS
AD 08-13-17	CIRCUIT BREAKER REPLACEMENT
AD 07-08-08	UPLOCK ROLLER MOD/REPLACEMENT
AD 08-18-02	ELEVATOR SKIN REPLACEMENT
AD 90-08-14	WING SPAR INSPECTION/REPAIR

SELECT MODEL COMPARISONS







A Baron cockpit is a comfortable place to be on long hauls, especially after an interior upgrade, top. When you arrive, the airplane has plenty of ramp appeal. When it breaks, expect a warm welcome by maintenance shops.

The Model 55 was Beech's first Baron. It came out in 1961 as a replacement for the Model 95 Travel Air, which was a bit long in the tooth to meet competition from Cessna's 310 and Piper's Aztec.

Like the Travel Air, the 55 comprised a Bonanza fuselage fitted with a conventional tail, not the V-tail. In place of the Travel Air's somewhat anemic 180-HP Lycomings, the original Baron had 260-HP Continental IO-470L engines.

After building 190 Barons that first year, Beech came out with the A55, which has a 10-inch longer fuselage and could be ordered with a second fold-down rear seat, bringing potential seating capacity to six (more on that later). A total of 309 A55s were built in 1962 and 1963. The airplane's nose was then extended seven inches for more baggage and avionics equipment, and gross weight was bumped from 4880 to 5000 pounds. The airplane was redesignated B55.

This version remained in production the longest, until 1983, when all 55s were dropped from the line, along with the 58TC and V-tail Bonanza. Browsing the for-sale ads, expect to see more B55s than any other model because there are simply more of them. Beech built 1954 of the "long nose" B55s from 1964 through 1982, not including about 70 T-42A versions for the U.S. Army. Among a number of minor refinements during this time was an increase in gross weight to 5100 pounds, starting with S/N TC-955 in mid-1965. Earlier B55s were eligible for the higher gross through a Beech STC kit. The big-engine version arrived two years after the B55. The C55 Baron appeared in 1966 with a 12-inch longer fuselage and 285-HP Continental IO-520C engines. The "little Baron with the big engines" also was certified with a gross weight of 5300 pounds. The airplane was redesignated the D55 in 1968 and the E55 in 1970. It, too, was dropped from production in 1983, after 1201 were built, 451 Cs, 316 Ds and 434 Es.

Big-engine 55 Barons are easily identified by the air scoops atop the cowlings. The difference in length is less obvious, but it shows up when it comes time to load the airplane: The nose baggage compartment is larger, as is the cabin. Other differences included the level of standard equipment, and the availability of a 166-gallon fuel system on the big-engine version.

BACKWARD SWITCHES

Designing an airplane is one decision after another followed by one compromise after another. You have to put switches and controls somewhere and Beech decided to put the flap switch on the left, and the gear on the right. There's nothing at all wrong with that arrangement. But as it happened, everybody else in the industry decided to do just the opposite. The result was (and is) predictable:

A new Baron pilot reaches for the flap switch on rollout and retracts the gear instead. The record shows a long string of gear goofs over the years and although some insist that the switch location has nothing to do with this, other models don't seem to suffer the same kind of incidents. The picture is further confused by the fact that in response to customer pressure and its long history of gear retraction accidents, Beech changed the controls around in later years so they matched the rest of the industry. (This only showed up in later versions of the 58 Baron. The 55 was out of production by the time the change was made.) The "backward" switches aren't really

Pilots transitioning to the Baron 55 might not be used to a left-to-right prop, throttle, mixture engine control arrangement, top photo. Identifying the correct lever in an engine-out situation is especially critical. Unlike the 58-series Baron which has a rear door, rear passengers enter the 55's cabin from the right wing walk, bottom photo.

a bad design, it's just that a pilot has to remain aware of them. Many Baron pilots make a particular point of touching nothing until they're clear of the runway and stopped, so that they can devote their full attention to the controls. And it's not just the gear and flap switches.

Beech's throttle quadrant is different, too. Instead of the more usual throttle-prop-mixture, Beech put the throttles in the middle. But the power levers are taller, so they don't demand the kind of care you need with the gear switch. While there have been some fuel mismanagement accidents, the Baron's system is simpler than some others. Early models can draw fuel into the engines from the main tanks—37 usable gallons, each side—or the auxiliaries, each with 31 gallons. The fuel system was simplified in 1974 with interconnected tanks and three-position (on, off, crossfeed) selectors. Also that year, extra aux tanks became available for the E55 model, boosting max fuel capacity to 166 gallons.

CABIN, COCKPIT, PAYLOAD

Beech cabins are notably plush and comfortable, and the 55s—even the early ones—are par for the luxury course. The tapered fuselage, however, can cramp normal-sized adults banished to the rear seats, although it does provide a couple of big windows to ease their exile. Since the rear seats can be gained only by clambering over the middle seats or through the baggage hatch, they're of little use. Many pilots get rid of them, using the space for baggage. The front seat of a 55 Baron has to qualify as one of the world's greatest places to be, with comfort enhanced by a retractable center armrest, adjustable rudder pedals, lots of headroom and good visibility over the nose and out the side windows. Beech was less successful at the finer points of panel design. The massive tube-like structure carrying the yokes obscures instruments on the lower portion of the panel and hides circuit breakers and switches. Also, the seats have limited forward and aft travel.

As twins go, the 55 Baron has decent if not exceptional payload. A typically equipped 260-HP Baron can carry about 1800 pounds of people, bags and fuel; a 285-HP model, about 1950 pounds. There is no zero-fuel-weight restriction, but care is needed to avoid busting the aft CG when the rear seats or aft baggage compartment is used, a typical Beech weak spot. Balancing the load is facilitated by a nose compartment that can hold up to 300 pounds (270 pounds in early models with gross weights below 5100 pounds). With the fifth and sixth seats removed, 400 pounds can be loaded into this space. Many Barons also have an extended aft baggage compartment approved for up to 120 pounds.

True airspeed of a small-engined

Like many twins, the Baron's nose can serve as a convenient avionics bay for mounting remote sensors and weather radar. The B55, left photo, doesn't have radar, but it does have clean wiring.

Baron cruising at 75 percent power is about 190 knots on 27 gallons of fuel per hour. That's faster than the naturally aspirated Aztec and Cessna 310, but a good bit off the Aerostar's pace.

The big-engined Baron is about five knots faster and five GPH thirstier than its stablemate. Takeoff and landing performance is average. A B55, for instance, can take off or land over a 50-foot obstacle within 2160 feet. The E55 needs only about 2050 feet to clear the obstacle on takeoff but a bit more than 2200 feet to get back over it on landing. Short-field technique can cut these figures roughly in half, but it's hairy, involving lift-off below Vmc, for example.

Two-engine climb rates of 1630 to 1700 FPM for the small-engined Barons, and 1670 to 1680 FPM for the more powerful models, outpace the Aztec by a wide margin but lag behind the Aerostar and 310. The B55's single-engine climb rate is a paltry 318 FPM—again, better only than the Aztec.

At 388 FPM, the E55's single-engine performance is about par with the 310 and Aerostar. None of these are exceptional single-engine performers, so the wise pilot will keep them as light as possible.

Range, of course, depends on fuel and that varies a bit in the 55 Barons. Depending on year and model, standard tankage was 100 to 112 gallons but optional tanks of 142 or 166 gallons were also available. The 56TC Baron could be fitted with as much as a whopping 204 gallons of gas. With 112 gallons aboard, the 55 has acceptable but not exceptional endurance and range.

Figure on 26 gallons an hour at 185 knots in the mid altitudes and three- and four-hour legs are easily doable. Without larger tanks, four-plus hours chews into the reserves. The Baron is not a 1000-mile airplane, but it'll knock off 600 miles without breaking a sweat.

The 55 Baron is proof that a light twin doesn't have to handle like a truck. Responsive and well-harmonized, the airplane's controls are one of its biggest selling points. As one owner put it, "Once you've flown an E55, everything else feels like a tin can." As mentioned earlier, however, hand-flying may be delightful in nice weather, but when it gets bumpy, an autopilot comes in handy. There are trim controls for elevator, rudder and ailerons. Early models have relatively low gear- and flap-extension speeds (143 and 113 knots, respectively). Gear speed was raised to 152 knots, beginning with airplanes built in 1969. The B55 came with approval to lower flaps 15 degrees at 153 knots, and full-flap speed was raised to 122 knots, beginning with TC-955 in 1965.

MAINTENANCE, MODS

Owners of all Beech models consistently complain about one thing: The high cost of Beech parts, especially control surfaces in need of replacement due to hangar rash or corrosion. Fortunately, the 55s aren't considered maintenance hogs and owners say replacement parts aren't needed often.

Much maintenance relates to the engines. The O-470s are among the most robust and reliable engines in the Continental line and although the O-520s are nearly as good, they might suffer premature cylinder wear. Some owners complained of low compression on Continental cylinders after 500 or fewer hours.

Owners say annuals range from $2000 (we don't think that happens often) to as much as $6000 (realistic), but we think the wise owner will budget at least $10,000 a year to cover both the annual and ongoing maintenance. As an hourly maintenance cost, one owner told us a good guideline is to double the fuel cost. With avgas running about $4.50 a gallon, that works out to about $230 per flight hour. Fly 150 hours a year and you'll spend about $35,000 to include engine reserves.

The IO-470L is considered a bulletproof engine, although a few owners, as well as several Service Difficulty Reports, mentioned occasional cylinder problems. The IO-520's reputation is not so good; operators have been beset by cracking crankcases. Continental's switch to so-called "heavy" cases in the late 1970s helped somewhat, but case cracks and broken camshafts have appeared frequently in the SDRs.

Among the notable Airworthiness Directives are: 87-18-06 Rev. 1, requiring replacement of recline actuator handles on copilot and center passenger seats to prevent inadvertent unlocking; 84-26-02, replacement of paper air filters; and 84-09-01, requiring various inspections and modifications to ensure that the emergency window will open. Prospective buyers should also ensure that 91-15-20 (repair or reinforce cracked engine mounts) has been complied with.

There are three ADs on the props: 97-18-2 (repetitive inspection, A55 and B55 Hartzell props); 95-24-5, (repetitive inspection, E55 McCauley

props); and 91-15-4, on the A55. AD 89-5-2 deals with cracking elevator components, with possible replacement of the elevator. Owners of Beech 55, 56TC, 58 and 95 Barons should look for cracks in the wing forward spar carry-through. The cracking, according to Airworthiness Directive 90-8-14, could lead to "loss of the airplane." Beech first apprised owners through a mandatory service bulletin. The bulletin—No. 2269—was originally issued in August of 1989. In March 1990, Beech revised the investigation has shown that increased allowable crack lengths as described in this service bulletin will not compromise the integrity of the forward spar carry-through structure."

The AD specifies that the carry-through must be inspected at 1500 hours total airframe time and repeated every 500 hours if no cracks are found. To get at the carry-through, the mechanic must remove the front seats and the carry-through cover on the floor. From there, it's a standard crack inspection. The carry-through and webs are cleaned, then checked using visible dye-penetrant. If no cracks are visible, he can button it up and come back in 500 hours.

If cracks are visible, it's time to get out the rulers. The cracks must be measured and, depending on where they are and how long they are, repaired. Beech sells a kit to do any required repair work. The other area of concern is the spar web face, in the area of the huck fasteners. Here, cracks are limited to one inch length. Only one crack is allowed per side, and Beech specifies that it can't be stop drilled. Instead, the mechanic must look at it again in 200 hours to see if the crack has grown. If it has grown, or if it was more than an inch long to begin with, another Beech kit is needed for the proper repair. The repair must be made within the next 25 hours, or immediately if it is between two fasteners and extends more than a half inch beyond the fasteners.

Beech figures one tech should be able to complete the inspection in four hours, provided the airplane is already apart for an annual or similar inspection. Like EPA mileage estimates, your labor charge may vary. If cracks are found, there's the added cost of stop drilling, plus the price of the kits if the cracks need repair. The kits cost several hundred dollars each. Installation time depends on the shop's sheet metal proficiency. The average shop should be able to install one kit in about 55 to 60 hours.

Many mods are (or once were) available for the Baron, including the usual engine upgrades from Beryl d'Shannon and the defunct Colemill. General Aviation Modifications makes GAMIjectors for the Baron line. One mod in particular deserves mention, since it gives such a dramatic improvement in performance: vortex generators. VGs are available from a couple of different manufacturers. We tested V/G Systems' product for an early issue of *The Aviation Consumer*. Bottom line: They work as advertised. Kits are available from Beryl D'Shannon and Micro AeroDynamics of Anacortes, Washington.

Baron owners don't have an association of their own, but the Wichita-based American Bonanza Society supports the Baron along with the Bonanza. The ABS publishes an informative newsletter and conducts service and proficiency clinics at about a dozen locations each year. Contact them at American Bonanza Society, Mid-Continent Airport, P.O. Box 12888, Wichita, Kansas 67277, phone 316-945-1700 or www.bonanza.org.

OWNER FEEDBACK

Because of its safety record and single-engine performance, I bought a nice 1975 model 95-B55 with the Colemill upgrade around five years ago. I have added most available upgrades which might improve safety, plus an interior upgrade to include heavy duty noise insulation. In my view, some of the best safety items are dual shoulder harnesses, vortex generators, a thicker windshield, Garmin GTN750 touchscreen navigator, Garmin G500 PFD/MFD, Cobham 55X autopilot (shooting a low approach into a strange airport in heavy IMC with synthetic vision is close to doing it visually), plus a good graphic engine monitoring system.

I fly mostly on the West Coast and make it a point to avoid ice, but I'm not bothered by weather flying, small airports or to other countries. I frequently fly long distances

BARON CRASHES: OTHER AND FUEL

The NTSB reports of the 100 most recent B55 Baron crashes turned up some unexpected results: there were only three runway loss of control (RLOC) events, far fewer than we expect for tricycle-gear airplanes; for an airplane with a fuel system that has a reputation as simple, the majority of the 15 fuel-related accidents involved mismanaging the system and fuel selectors and over half of the pilot-induced gear-up events involved retracting the gear on rollout.

We have long been impressed with the landing gear design on the Baron—it doesn't take a rocket surgeon to maintain. Only two of the Baron accidents involved a system failure in which the pilot could not get the Firestones down and locked.

We're less impressed with the design of the landing gear handle/pilot interface. It has allowed pilots to retract the gear while on the ground at a rate higher than any other airplane we've reviewed—probably thinking they were raising the flaps. While inadvertant gear retraction carries virtually no risk of injury, it causes expensive damage. We think Baron pilots should be aware of the situation and make an extra effort to not touch the flap switch until off of the runway on landing and seriously consider not doing touch and goes.

Six Baron pilots ran their airplanes out of fuel, including one who couldn't figure out how to shoot an LDA approach and elected to divert to another airport even though he didn't have enough fuel on board to make it. Nine pilots either tried to take off with the aux tanks selected—they're for level cruise only—or ran tanks dry and then didn't select tanks that had fuel in them.

Improper maintenance of the fuel system led to two explosions and one fire when the pilot went to start an engine and wasn't aware of a maintenance-induced fuel leak.

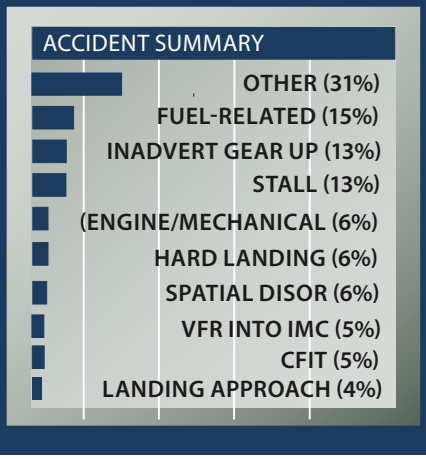
Four pilots shot approaches to well below published minimums in awful weather. Three flew into the ground or water. One missed the approach after the controller gave a low altitude alert, but succumbed to spatial disorientation and a diving spiral during the miss.

A Baron is no slouch in the cruising speed department, yet no fewer than five pilots tried to scud run in their aerial hotrods. As might have been predicted, their attempts at VFR into IMC did not succeed.

There were six engine power losses for unexplained reasons, fewer than we expected to see. Nevertheless, in a few of those events, as well as in some of the fuel-related engine stoppages, the pilot did not feather the prop on the silent engine, contributing to a return to earth other than on a runway.

The unconventional (for general aviation) arrangement of the prop controls and throttles caused one pilot to inadvertantly shut down both engines while dealing with an open cabin door. He thought he'd pulled the throttles to idle, but had instead feathered both props, stopping the engines. Lacking unfeathering accumulators, he could not restore the props to a blade angle that allowed generation of thrust and had to glide to a landing.

Nine pilots inadvertantly stalled their Barons in flight and entered spins from which they could not recover, including one pilot who was distracted trying to troubleshoot a landing gear indicator malfunction.



(Mexico, Canada and Alaska). I typically cruise in the mid to high teens and see 12.5 GPH per side lean of peak and cruise at 185-195 knots TAS and purposefully climb at 500 FPM climbs after 3000 feet, and at 1500 FPM to 3000 feet. I descend at 400 FPM unless ATC requires 500. At 12.5 GPH in cruise at 2400 RPM I typically see cool CHTs of 350-390 degrees and EGTs of 1350-1450 degrees with a GAMI spread of 80 to 90.

This is a six-seat (four adults, plus two small people) aircraft, but many Baron owners take out the back two seats. The Baron 58 models with side doors work better for carrying more than four people.

Avionics and autopilot upgrades have totaled $100,000, but a shrewd shopper can easily cut that in half. Annuals typically run $5000 and up to $12,000 with squawks. I replaced two cylinders during a five-year period ($1900 per cylinder) and I change the oil at 30-hour intervals. While I maintain things like door seals and minor nuts and bolts, I am too busy flying to want to do my own oil changes and assist in annual inspections. That said, my five-year average costs—including avionics and other upgrades, plus a $700 per-month hangar and a $4000 insurance premium—has been around $60,000 annually, with an average of 40-plus hours of flying. Actual hourly costs are around half of the above totals. Some owners can probably get by for less than that if they can avoid the "toys" upgrades. However, my flying philosophy is I would rather be on the ground figuring out how to pay for things than up in the air wishing I had them.

If you can find a Colemill President II (P2) conversion (IO-550s) with low-or mid-time engines, you might be better off with a 1975 or later 95-B55. Though Colemill is out of business, the aftermarket mod is fully supported by most shops. The original cost of the conversion was $100,000-plus. The present $15,000 to $20,000 premium for a used Colemill 95-B55 is a good deal, in my view, while adding a layer of safety. The single-engine maximum altitude (14,000 feet) climb rate at a 1000-pound gross weight is proof. Plus, the centerline on each engine is at least six inches closer to the hull

than other production twins, taming engine-out situations. For flights over 1.5 hours, I comfortably fly in the mid-to upper teens and use portable oxygen. The extra horsepower of the IO-550s means a fuel burn per mile equal to a pair of IO-470s.

The airframe is a bit heavy due to the landing gear and wing design, but it's solid in turbulence and readily handles crosswind landings. The only modern Beech that's more fun to fly may be the V35, but I wouldn't fly my routes with a single engine.

Airspeed builds up rapidly in a descent, so plan your numbers well ahead when shooting approaches to keep within flap and gear extension speeds on final.

Last, a competent multiengine CFI for flight reviews is an absolute must. I also think a membership in the American Bonanza Society and participation in the Bonanza/Baron pilot proficiency program is the best investment you can make to be safe and proficient in a Baron.

Ronald Hayes
via email

I've had my 1980 B-55 Baron for nearly 15 years and 800 hours. I generally cruise between 8000 to 10,000 feet burning around 25 GPH at lean of peak. It trues at around 175 knots and I generally flight plan for four-hour legs or a little longer, which leaves 1.5 hours endurance at the destination. Useful load is roughly 600 pounds with full fuel.

The IO-470 engines have run well and at nearly TBO, the original cylinders still have strong compressions.

Beech parts are expensive, but are available. My engines are coming up on TBO and I expect to pay around $80,000 or more for replacing both of them with factory remanufactured engines with new hoses and accessories.

After my initial purchase I invested in a new paint job accomplished by Dial Eastern, plus a new leather interior by Airmod. Both shops were rated high in *Aviation Consumer* surveys. In addition to new windows I also installed new Garmin avionics, plus a Stormscope and XM satellite weather and radio system. Since the King analog HSI with remote gyro and flight director system has been showing its age, I plan to install an Aspen PFD system in the near future.

Additionally, I added vortex generators and a TKS FIKI-certified anti-ice system. The TKS fluid reservoir is in the nose where the old alcohol tank was previously installed, providing 90 minutes of continuous use.

There are times when I would like an aircraft with pressurization and air conditioning, plus the ability to go faster and higher. However, the added complexity comes at a premium and for now the Baron meets all of my needs. Until I can afford something that burns jet fuel, I plan on keeping my Baron.

James Ray
via email

I have owned my B55 Baron for a little over seven years and I fly it between 125 to 150 hours per year. For me, the Baron is an easy twin to fly. It's a stable platform for IFR and the controls are positive and responsive. The large vertical stabilizer and rudder make for good control during single engine operation. In turbulence, there is a slight wing rock, but I have never found this distracting. Many Barons have been converted to dual control yokes, but still do not have copilot brakes.

Between 9000 and 12,000 feet, LOP fuel burn is around 25 GPH at 185 knots. On short trips powered back to 22 inches and 2200 RPM, I have seen 150 knots at 18 GPH, LOP.

My Baron has only needed a few repairs. Many of the systems are similar to those found on the Bonanza, so with the exception of a second engine and propeller, it does not impose expenses beyond that of the Bonanza. A second engine to maintain, additional fuel burn, larger hangar and higher insurance is the main difference in expense between this twin and a complex single. The Continental IO-470L engines pose few problems, but an occasional repair is still necessary.

Since I bought my Baron, there has been a large price increase for some parts. I check Beechcraft first and then start checking around for FAA PMA replacements. I usually can find ones at a fraction of the cost of OEM parts, but I'm sometimes surprised to find OEM parts cheaper.

Carl Carlson
Kansas City, MO

The Aviation Consumer

PT-6 Overhauls

(continued from page 7)

owner considering a PT-6-powered aircraft is to engage a broker who's a specialist in the model under consideration and to be wary of buying an airframe with runouts and a plan to overhaul the engines.

"If you buy an airplane and you do the engines, you're gonna be stuck with it," says Conrad Jones of Kansas Aircraft. "Otherwise, you'll take a hit improving it for the next guy. What I tell people is the best place to buy an airplane is one that's already been overhauled. An airplane with zero-time engines and one with 500-hour engines are worth virtually the same because the overhaul cost is so far in the future, nobody stops to consider it," he adds. Indeed, with an overhaul 2000 hours into the future, many owners figure they'll sell the airplane long before that.

Otherwise, for an owner approaching a PT-6 overhaul for the first time, we think retaining a service such as Specialty Turbine Services is hands down, the best way to go. STS's Paul Jones told us the company averages about $5000 in fees to help select an overhaul source and see the engine through the process. Given the consequences of bad decision-making on a PT-6 overhaul, that's a mere pittance.

CONTACTS...

Pratt & Whitney Canada
800-268-8000
www.pwc.ca

Specialty Turbine Services
724-776-3925
www.specialtyturbine.com

United Turbine
305-885-3900
www.unitedturbine.com

Tailwheel Training

(continued from page 15)

Touching down at the speed of heat in a wheel landing means a long period of exposure to RLOC during deceleration.

YOUR AIRPLANE

If you are planning to purchase a tailwheel airplane and do not have experience in it, we recommend taking at some dual in the type, if possible, to see if you like it—you may find it's not for you. We also recommend that a flight that includes some takeoffs and landings by a pilot experienced in the type be a part of the pre-buy examination to see if the landing gear is properly rigged. For example, the Cessna 195 has ground handling that is among the nicest of the tailwheel airplanes—if the landing gear is properly rigged. If not, it can be nearly uncontrollable.

We recommend that you take dual with an instructor experienced in the type of airplane you've purchased if you have not received a full tailwheel checkout in the type. That is especially true if you are buying one of the more exotic birds such as a North American T-6/SNJ or Beech 17 Staggerwing. In addition, plan on more than 10 hours of dual to get to the proficiency level required, not to mention obtaining insurance.

CONCLUSION

We are strong proponents of tailwheel airplanes—so long as a pilot recognizes the increase in risk of a landing accident and is willing to take the training necessary to fly them safely. A reputable school should be willing to train you to proficiency and not guarantee you a sign off in any specific number of hours.

It should provide you with a syllabus as well as reading and video materials prior to you beginning your training and rent the airplane to you once you have completed it. The training will keep you on the edge of your skill level and may frustrate you at times. That's a good thing; the most rewarding things in aviation often require the most initial work.

FEEDBACK WANTED

CESSNA 182

For the January 2016 issue of *Aviation Consumer*, our Used Aircraft Guide will be on the Cessna 182 Skylane. 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 Skylane by October 1, 2015, to:

Aviation Consumer
e-mail at:
ConsumerEditor@hotmail.com