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EDITOR

Larry Anglisano

SENIOR EDITOR

Rick Durden

CONTRIBUTING EDITOR

Frank Bowlin

EDITOR AT LARGE

Paul Bertorelli

SUBSCRIPTION DEPARTMENT

P.O. Box 8535

Big Sandy, TX 75755-8535

800-829-9081

www.aviationconsumer.com/cs**FOR CANADA**

Subscription Services

Box 7820 STN Main

London, ON 5W1

Canada

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FIRST WORD**DON'T IGNORE SERVICE BULLETINS**

One of the biggest gotchas with major upgrades—and it doesn't matter if it's avionics retrofits or airframe and engine mods—is not keeping the system current with the latest software and hardware mods. These may come in the way of service bulletins, software bulletins and service letters. At the least, you may not be taking advantage of a system or its interface to its fullest, but more serious is doing nothing, potentially leaving you vulnerable to an inflight failure. That's what FAA ADs are for, of course, but they (sometimes, not always) don't always occur until something crashes or comes close to crashing.

Your biggest resource for this ownership responsibility is your shop. I've always suggested picking a shop that knows how to communicate well, not only when it has the aircraft on its hangar floor for the work—but also when the job is long complete. Face it, it's easy for a busy owner to miss service and software bulletins and even more critical—ADs. On the other hand, it's really not the shop's responsibility to remind

customers to come in for updates—it's the manufacturer's—but good shops will keep an open line of communication (and it's easier than ever thanks to texting, email and social media) and nudge its customers when it's a good idea to see the aircraft back for an update—even when it doesn't make big profits in doing so. In a competitive market this level of service is really a good way to keep customers.

This whole issue came to mind when I was talking with Jacob Klinginsmith at Tamarack Aerospace for a follow-up on a piece we wrote in our August 2019 issue on FAA regulatory alerts. Tamarack produces the ATLAS active winglet system for small jets—an otherwise good product that was hit by an FAA AD after reports of an uncommanded roll in a Tamarack-modded Citation, and an ongoing investigation of the crash of a CitationJet that happened to be equipped with the ATLAS system. To recap, the Tamarack winglets are paired with control surfaces on the extended outboard trailing edge area of each wing (see the photo above) that act as automated ailerons. Sensors monitor the wing loading, deploying a spoiler for dumping lift and relieving the wing structure of overload. Citation owners I heard from couldn't be happier with the performance increases—which include better fuel efficiency thanks to higher climb rates to altitude.

Flash back to April 2018 when Tamarack sent out a proactive service bulletin (SB1480) to ATLAS owners recommending a fleet-wide (over 90 aircraft) no-charge replacement of the actuators used in the system within 100 hours of operation or one calendar year. The issue was the potential for a screw to work loose inside the actuator, which in turn would short out components and malfunction the ATLAS logic. That's precisely what happened in one ATLAS-equipped jet in the U.K.—the component came loose, shorted the servo and the aircraft had an uncommanded roll. Tamarack also offered an optional mod that puts small centering strips on the load-alleviation surface of the ATLAS, which creates a failsafe should an actuator fail. Both of these service bulletins were available long before the FAA issued the Tamarack AD. Worth mentioning is the reported uncommanded roll condition that ultimately prompted the AD happened in April 2019—a full year after Tamarack's service bulletin was issued.

While the company waited for the FAA to approve the actuator swap and centering strips as a means for satisfying the AD (it ultimately approved it, and the entire fleet is now covered), Tamarack through its worldwide dealer network worked with all of the existing customers in upgrading their airplanes, and the AD has been addressed on every one of them. At press time Tamarack is installing its 95th ATLAS mod and is focusing on expanding the mod to other jets.

The takeaway here is that manufacturers issue service and software bulletins for a reason. Why some owners of ATLAS-equipped jets decided to not do the no-charge upgrade on a critical flight control system is probably the same reason you might put off a software update to your avionics—scheduling and downtime. But these days when you commit to an upgrade, you're also committing to ongoing upkeep. That could ultimately be a lifesaver. —Larry Anglisano



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

Periodicals postage paid at Norwalk, CT, and at additional mailing offices. Revenue Canada GST Account #128044658. Subscriptions: \$84 annually. Bulk rate subscriptions for organizations are available. Copyright © 2019 Belvoir Aviation Group LLC. All rights reserved. Reproduction in whole or in part is prohibited. Printed in the USA.

Postmaster: Send address corrections to AVIATION CONSUMER, P.O. Box 8535, Big Sandy, TX 75755-8535. In Canada, P.O. Box 39 Norwich, ON N0J1P0, Canada. Publishing Agreement Number #40016479

WHICH IFR NAVIGATOR?

I read the IFR GPS navigator article in the September 2019 *Aviation Consumer* and think you missed an option: upgrading a Garmin GNS 430 to a GNS 430W, which has WAAS.

At Air-Venture I was looking at the new Garmin GPS 175 to replace my old GNS 430. The Garmin rep told me there was a nice rebate available if I traded my GNS 430 for a new GTN-series navigator—something like \$4000 toward the GTN. I asked what they were doing with the trade-ins and he said they refurbished them and sold them, but I'm guessing not in the U.S. I asked if that meant that Garmin was continuing to support the GNS 430W and he said absolutely.

As a result, I'm upgrading the GNS 430 in my experimental Europa. There is no rewiring required; just install the new antenna. The box fits in the same tray. I understand how to operate my GNS 430, so there is no new learning necessary, plus the interface to my GRT EFIS does not change.

Jim Butcher
via email

We asked Garmin about this and were told it often offers rebate incentives on these discontinued units so customers can send them back. But, Garmin doesn't resell the units. Instead, it uses them for spare parts (displays, in particular) to help support the fleet of units still in the field. But you're correct in that upgrading a legacy GNS 430 to WAAS offers decent utility with a fairly easy mechanical installation.

WHO NEEDS INSURANCE?

Larry Anglisano's First Word commentary on the "hardening" of the insurance market (August 2019 *Aviation Consumer*) reminded me



of what a hot topic this has become. Most older pilots live in abject fear of the day the insurance company cuts them off. I've read many helpful articles about how to forestall the inevitable (like more training and simply flying more hours), but I've never seen mentioned an easy alternative. There is no requirement that you insure your aircraft.

I'm in my mid-70s, brutally healthy and haven't heard a peep from my insurance company yet, but if or when I do and they cancel me, I'll just continue to fly. I've owned my airplane for 42 years and if I prang it tomorrow, so what? It's been a good run. I happen to be in the happy position that I can afford to fix my airplane or just buy a new one outright, but even if I weren't, that's fine. Either I'm dead and it doesn't matter, or I survived and can look back on many happy decades flying. The ability to insure my plane is not the determinant on whether I fly or not. The fact is I've paid over \$150,000 in insurance over the years and never once made a claim. I should have self-insured.

I know there is a liability issue, and no one would want to hurt someone and have the victim left without recourse. But one can minimize risks. My usual passenger is my wife. Uninsured, I would rarely fly others and never any children (including Young Eagles), but I would fly.

Carlos Diaz
Pensacola, Florida

PILATUS VERSUS TBM

In the September 2019 *Used Aircraft Guide* where you compared the Pilatus PC-12 to the TBM850 in the max cruise speed data block, you show the 2006 TBM850 as having a max cruise speed of 290 knots. This is not correct. At normal cruise I routinely get 305 knots in my TBM, and

the POH value of 315 knots is not unreasonable. I usually fly at FL260 to FL280, where 305 knots is pretty typical.

A. Davidson
via email

SUPERCHARGING

I can't see any articles where you've written about superchargers, such as the ones made by Forced Aeromotive. Have you considered a report on them? If so, here's another vote for one. Love the magazine.

Jack Downey
via email

We'll add it to the list. In the meantime, if anyone has real-world experience with aircraft supercharging, we want to hear about it.

CORRECTION

In the "Which IFR Navigator" article in the September 2019 issue we incorrectly called the Garmin GTX 375 unit a GTR 375 in the caption on page 15. Garmin offers so many choices even we can't keep the model nomenclature straight.



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CONTACT US

Editorial Office
860-614-1987 (EDITORIAL ONLY)
Email: consumereditor@hotmail.com

Subscription Department
P.O. Box 8535
Big Sandy, TX 75755-8535
800-829-9081

Online Customer Service:
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On The Cover: Our thanks to Icon Aircraft for providing a slick cover photo of its latest A5 LSA amphib. As you'll read in the main article starting on page 8, the company announced a major reorganization including a sizeable reduction in its workforce. It's also scaling back production to just a few aircraft per month.

ADS-B in Canada: Satellite-Based Snag

That means the majority of mandate-complaint systems installed in U.S.-based aircraft might not play without major upgrades.

by Larry Anglisano

If you haven't been following the proposed ADS-B equipage requirements for flying in Canada—and you plan to fly your ADS-B-equipped aircraft there—this report is for you and you're not going to like what we're learning about the technology.

While the U.S. ADS-B Out equipage mandate may be old news and although you've equipped your aircraft for flying in controlled airspace starting this January, you could very well face an expensive dilemma if you want to fly your machine in Canada—or in other countries, for that matter.

While not yet carved in stone,

in a nutshell it's looking like the majority of ADS-B Out gear that's installed to meet the U.S. mandate won't work in Canada and other countries. Here's an overview of the tech, equipment compatibility and what might happen when you drag the airplane back to the avionics shop so you can fly in Canada and beyond.

THE AIRSPACE AND TECH

Canada is implementing its space-based ADS-B airspace requirements in phases, which Nav Canada (the country's provider of civil air navigation services) recently outlined in a Notice of Change letter. It also says

it conducted a study to determine the minimal performance requirements (the equipment you'll need to have in the aircraft) to support this new global ADS-B surveillance network, implemented by Virginia-based Aireon. Founded in 2011, the company's surveillance payloads will be hosted on Iridium's NEXT satcomm low-earth orbit satellite constellation.

Worth mentioning is that Iridium has invested heavily in upgrading its satcomm network and boasts near worldwide coverage—giving the space-based ADS-B concept long legs to work in plenty of other countries besides Canada. To say there has been a lot of money invested in this is an understatement, and while the final Canadian ADS-B ruling hasn't been carved in stone, it's apparent that satellite surveillance is a sure thing. That's potentially problematic for buyers who already equipped for the U.S. ground-based ADS-B spec on the cheap. More in a minute.

As for the timeline, the Notice of Change letter says the first phase is slated for implementation on Feb. 25, 2021, in Canada's Class A (FL180 to FL600) and Class E (above FL600) airspace. Phase II is effective Jan. 27, 2022, in Canada's Class B (12,500 feet to FL180) airspace—an obvious sweet spot for turbocharging and for terrain clearance. Phase III was in the original proposal, but was removed for reasons unknown to industry and that would affect Canada's Class C, D and E terminal areas, which basically cover every controlled airport. This is the phase everyone—or at least ones who fly below 12,500 feet—will be watching.

TRANSPONDER ADS-B

We're told that authorities didn't even want to entertain the notion of using 978 MHz UAT (Universal Access Transceiver) tech, so it picked

Among others, the NGT9000 ADS-B transponder, top image, might be useless for satellite ADS-B without an upgrade to Diversity. The graphic at the bottom is the proposed Canadian ADS-B infrastructure using Iridium NEXT satcomm satellites for aircraft positioning.



the other ADS-B—1090ES extended squitter transponders. You should know that is the ADS-B equipment you need for flying in the U.S. ADS-B airspace above 18,000 feet starting this January.

That means your uAvionix sky-Beacon system—or Garmin GDL 88, GDL 82 and any other UAT-based system—won't work. If that's not maddening enough, mandate-compliant 1090ES ADS-B transponder interfaces might not work either. Here we're talking Garmin's GTX 345, L3 Lynx 9000 or any other transponder that doesn't have Diversity, with an accompanying top-mounted L-Band antenna. We'll pause, while you read that again.

Diversity is a class of Mode S transponder that's been around for years. In simple terms it has two antennas, two receivers and constantly listens for interrogations on both, and then replies on the antenna with the best signal. That increases the link between the aircraft and SSR (secondary surveillance radar). If the aircraft is maneuvering and the lower antenna is shaded from the SSR, the top antenna might work better.

There are specific airworthiness requirements in place for transponder performance. One example is FAA AC 25-7D, Flight Test Guide for Certification of Transport Category Aircraft. It says in part that the transponder has to be able to furnish a strong and stable return signal to the interrogating radar facility in straight and level flight throughout the airspace within 160 NM of the radar station, from radio line of sight to within 90 percent of the maximum altitude for which the aircraft is certified. If the aircraft can't fly above 18,000 feet, the standard is reduced to 80 nautical miles.

Of course that doesn't always ensure a continuous reply from the radar. There's shading and synchronous garble that can cause signal dropout, or coasting, from a radar standpoint. But per AC 25-7D, the dropout should not exceed 36 seconds.

Get your stepladder and climb atop the cabin of any newer jet or turboprop and you'll see transponder blade antennas, which work along with the blades on the bottom of the aircraft. It's a require-

ment for TCAS II traffic alerters, which coordinate traffic threat resolution.

Enter transponder ADS-B, which rides almost entirely on transponder system performance, while broadcasting the aircraft's ADS-B data once per second. A Diversity system alternates the transmissions once per second (alternating between the top and bottom antenna) to the ADS-B ground stations. With non-Diversity, it pulses the data once per second from the bottom antenna. Incidentally, L-Band Diversity isn't just for transponders. There are 978 UAT systems that have Diversity and the end goal is the same—to minimize shading when maneuvering.

LET'S DO THIS WITH SATELLITES

That's precisely what Aireon is doing with its space-based ADS-B system, and the tech is clever and innovative: Sniff down on the skies below and listen for ADS-B broadcast signals. To be clear, there's no interrogation—it's not radar. The concept was innovative and convincing enough for Nav Canada to invest \$150 million to take a 51-percent ownership stake in Aireon—an investment, we're told, that was made before the Iridium NEXT satellites were up and running with Aireon 1090ES receiver payload. So will it work? Maybe, but not without a top antenna.

Consider that the closest an Iridium NEXT satellite comes to the user is directly ahead by 485 miles. Existing transponders have certainly never been demonstrated to have that kind of range. The antenna used for a transponder or UAT are



Unless you want to fly inverted, the typical bottom-mounted L-Band transponder antenna, shown in the upper photo, won't work alone in a space-based ADS-B system. The photo at the bottom, courtesy of Garmin, shows two top-mounted antennas on a Baron—one for each Diversity ADS-B transponder.

1/4-band monopole style, with a distinct donut-like lateral radiation pattern. But a monopole won't work well vertically. We noodled this theory with Garmin's Bill Stone, and couldn't argue with his observations.

"Whether the aircraft has Diversity or not, L-Band antennas were never intended to broadcast straight up. If we were designing a system to communicate with spacecraft, we would clearly use a different antenna system," he said. According to Stone, Garmin attempted to engage Nav Canada and Transport Canada on the concept, but didn't

get hard data.

However, in trials—using a Diversity ADS-B transponder—it's said that the target refresh rate is once per five seconds. With a non-Diversity system the refresh rate decays to eight seconds—one second longer than it takes to ensure separation in the airspace. As Stone pointed out, by comparison, that's at odds with the FAA's AC 25-7D for transponder performance.

And no, the Iridium NEXT satellites will not respond to 978 UAT transmissions. It would appear that UAT tech will only be a U.S. solution, where at least you'll receive free datalink weather services. Stick and carrot—remember?

UNANSWERED QUESTIONS

Or at least tough ones because what will the thousands of buyers (on both sides of the border) do now that they've invested in 978 UAT or non-Diversity systems? Those who want to fly in a space-based ADS-B infrastructure will likely be dragging the aircraft back to the avionics shop for another upgrade. It would appear that will be an easier chore for ones already equipped with a 1090ES ADS-B transponder, and an expensive total redo for UAT-equipped aircraft.

If you've paid for antenna work during an avionics upgrade you know the invoice can be hefty—more so for pressurized aircraft because of the additional engineering work that's involved. There's also the hassle of removing the aircraft's headliner, running a new signal cable and the real possibilities of moving existing antennas around to get the best performance. On small airframes that's no easy day at the avionics shop, and a big hit to the budget.

And since 978 UAT systems aren't a player in a space-based infrastructure, you won't be able to receive free traffic and weather. Transponder-based 1090ES ADS-B is Out only, and that void in weather reception will seemingly be filled by subscription-based SiriusXM Weather. That will make cross-border flights interesting for those accustomed to having current weather show up on an app or

panel display. But it seems the lack of weather data isn't the immediate concern.

WILL MANUFACTURERS STEP UP?

So what to do if you've purchased a 1090ES ADS-B transponder without Diversity? Logically, there are thousands of owners who will be looking for an upgrade path—which is the majority of piston aircraft fleet, in our estimation.

We asked Garmin about upgrading a current GTX 345 (that's Garmin's flagship ADS-B transponder with Bluetooth connectivity and internal WAAS GPS) to a GTX 345D and were told at this time you either purchase one with Diversity or not. We know that means it hasn't come up with a Diversity upgrade program yet and we'd be surprised if there wasn't one eventually. To date,

The majority of ADS-B Out gear that's installed to meet the U.S. mandate won't work in Canada and other countries.

the GTX-series ADS-B transponders are one of the most popular ADS-B solutions out there, based on what shops tell us.

The current price for the GTX 345 with Diversity is \$7995, compared to \$4995 for the non-Diversity model. That doesn't include the additional required antenna work. The GTX 335 with Diversity (this model has ADS-B Out only—it won't receive weather or traffic) is \$6495, compared to \$2995 without Diversity. Yeah, big price delta.

The L3 Lynx NGT9000 product, now supported under the ACSS division of L3Harris, is a multifunction transponder that can be purchased with or without Diversity. We've been fond of this system because it does double-duty as an ADS-B Out transponder and also displays weather and traffic on its touch display. Forget about it receiving weather and traffic in Canada, of course. But smartly, the box was designed so Diversity

can be added via a software unlock procedure, for a current list price under \$1000. Once the Diversity software is unlocked, the unit wears the NGT9000D nomenclature. Your shop will of course have to install the top directional antenna.

The base NGT9000 is \$5143 and \$6508 with the Diversity option, not counting the additional antenna work. But there's something unique about the system that could save existing owners—especially of higher-end aircraft—a lot of grief. Some versions of the NGT9000 have built-in TAS (traffic alerting system), an option that's attractive for aircraft that already had an L3 SkyWatch TAS system.

Since the TAS inside an equipped NGT9000 uses the existing top-mounted SkyWatch directional antenna (in those installs you remove the old Sky497 traffic processor, but retain the antenna), the directional antenna can be used to satisfy the Diversity antenna spec. The NGT9000 with built-in TAS has been a popular option for turboprops, jets and higher-end pistons, but perhaps not so much for lower-end aircraft.

Speaking of lower-end ADS-B solutions, just when you were feeling pretty good about all the dough you saved by installing the sub-\$2000 uAvionix skyBeacon ADS-B/lighting system, you'll be disappointed that it won't work with Aireon's system because it's UAT based.

But uAvionix is well aware of the dilemma and is already hard at work designing a similar product, but with a built-in 1090ES Diversity transponder.

Similar to the skyBeacon (and tailBeacon products), the in-development skyBeaconX also has built-in LED position and strobe lighting. We saw a model of the device this summer and it has two blade antennas built in—one for the Diversity.

The skyBeaconX will theoretically replace the existing transponder, but wire into a panel control head for tuning the codes and such. No pricing has been set for the skyBeaconX and it will likely be awhile before the product hits the market. Remember, it needs an FAA TSO—not an easy task.

WHAT ABOUT SPACE-BASED SAR?

As an aircraft owner who's based in Canada, it's becoming clear to me that this space-based ADS-B story is even more complicated than you might think, including the future of search and rescue efforts. There has been ongoing debate among regulators, the NTSB, the TSB, search and rescue organizations, aviation lobby groups and Aireon regarding the effectiveness of ELTs. In essence, the debate centers around the number of false positives effectiveness of the ELT environment and the number of incidents where the ELT is not activated. Over 10 years ago, 121.5 MHz ELTs were replaced with 406/121.5 ELTs, with the hope of improving the time to find a downed aircraft, while Cospas Sarsat abandoned the monitoring of 121.5 ELT pings in favor of 406 technology.

In Canada, the process to manage a distress call was executed 1032 times in 2017, saving 49 lives. A recent study conducted by the Department of Defense's Canadian Mission Control Centre (CMCC) indicated that ELTs activate in only 38 percent of Canadian aircraft accidents where the aircraft sustained substantial damage. In 2017, roughly 7 percent of the ELT activations were real and a whopping 93 percent were false.

Nav Canada and the Canadian Owners and Pilots Association (COPA) believe that ADS-B technology

will be able to augment the 406 MHz ELT environment. However, Canadian aircraft operating in foreign airspace must comply with their mandates, such as the Mexican mandate for 406 ELTs and the U.S. ADS-B Out mandate. Nav Canada is collaborating with COPA to determine the feasibility of utilizing ADS-B Out data being broadcast



by properly equipped GA aircraft as an alternative source for search and rescue. Again, antenna Diversity comes into play.

In early 2019, Aireon offered a service (Aireon ALERT) operated by the Irish Aviation Authority (IAA) for the locating and tracking of ADS-B equipped aircraft by the aircraft operator. GlobalBeacon, a new product from Aireon and FlightAware, provides a solution for the compliance to ICAO's Global Aeronautical Distress Safety System (GADSS), which requires airline operators by

2021 to automatically receive position reports once per minute for an aircraft in distress.

The idea is to augment the current 121.5/406 ELT hardware utilizing ADS-B Out transmissions, big data and advanced computer analytics to determine if an aviation distress event has occurred. If an aircraft's flight characteristics are outside of normal operations, i.e., rapid deceleration, then the system could tag the flight as an emergency and push a distress alert to the search and rescue system. The CMCC and Joint Resource Coordination Centre (JRCC) would then investigate the event using current standard procedures.

A completed space-based ADS-B-based alerting service has the potential to reduce the number of false positives and deliver an improved SAR service to general aviation, but there are a number of technical and political obstacles to be overcome. Exemptions would be expected, such as aircraft without an electrical system, foreign aircraft penetrating Canadian airspace, etc. Additional research is underway to determine the operational alignment of the technology to the current ELT system. With the airline's mandate to have dual ELTs, 121.5/406 ELTs are here to stay, just like space-based ADS-B.

—Phil Lightstone

LAST-MINUTE BUYER?

If you've waited to install mandate-compliant ADS-B for flying in the U.S. your challenges are sizable. Not only are you likely faced with a big scheduling backlog at the majority of experienced avionics shops, now you have to decide if you'll equip for flying in a space-based ADS-B environment. Again, that more than likely includes Canada and other countries.

If you have no intentions of flying anywhere else but the U.S. and are out to simply comply with the

January 2020 mandate, we wouldn't sweat the decision. Our top pick for budget upgrades is still the uAvionx skybeacon/tailBeacon. But if the aircraft has an aging transponder we say bite the bullet and install a 1090ES ADS-B transponder. Whether or not you buy one with Diversity (only Garmin and L3Harris have these models) is a decision you'll have to wrap your head around. We favor the L3Harris NGT9000 because of the easy software unlock, and all eyes are on Garmin for an upgrade path.

We suspect a lot of U.S. buyers plan to fly in Canada, even if it's occasionally. At the very least, while the aircraft is opened up (and especially if the headliner is down), our advice is to have the shop route an antenna cable for future use. While you're at it, price a second antenna install—the typical L-Band blade antenna is around \$200.

If you fly low, you have more time to wait this out, since Canada's Phase II airspace requirement is a few years away. That's a good thing.



Icon's Reality Check: Demand is Elusive

Icon launched the A5 with a bold stroke, envisioning disruptive volume. But it's had to retool and retract in hopes of modest growth.

by Paul Bertorelli

When Icon came out of the ground in 2008, it proposed the A5, a sporty amphibious light sport airplane that would appeal to motor- and extreme-sports enthusiasts. But the company struggled with a long developmental period and serial production has been slow to materialize. In July 2019, with

investment flagging, the company announced a major reorganization, downsizing its workforce by 40 percent and cutting production to fewer than five aircraft a month. In this two-part report, we interviewed Icon CEO Thomas Wieners, examined the company's training program and took a trial flight in a recent-model A5.

Is the market focus for Icon still non-pilots who are motorsports and extreme sports enthusiasts or people already in aviation?

We're actually targeting both. But the intent was to target both pilots

and non-aviation background enthusiasts. And that's still the plan. To be honest with you, we actually see more pilots going through the training. We're seeing that it really takes time to create that new category. We're still confident that we're getting more and more folks excited

Icon's two factories are scaled to produce as many as 1000 aircraft a year, above. It now has to downshift to a fraction of that.

about it. My background is automotive and power sports and I'm going through the private pilot training myself. This is really creating a new market segment where one doesn't exist now.

How are you finding sales prospects?

The way the airplane was designed was to allow ... not moving from point A to point B, but instead to have a pusher configuration so no prop is in front of you, so you have that wide-open cockpit. So you basically see 360 degrees out. You take the windows out.

So the idea here is getting power sports and outdoor enthusiasts into the airplane and giving them the opportunity to explore the planet three dimensionally. And that's been successful.

We're trying to have the airplane speak for itself. We're trying to have as many demos as we can to see

Although millions were invested in two state-of-the-art factories, Icon only recently rolled out its 100th aircraft, right, from the Vacaville, California, assembly plant.

what the airplane can do and what you can do with it.

But how do you attract such buyers?

Miami is a good example. We're partnering up with the biggest Lamborghini dealer in the United States. We're displaying our aircraft on his floor. So people come in and look and shop cars say, wow, there's a plane here that has the same price tag as a Lamborghini, why not try this one? We had a sales event with Tesla, for example. Or Porsche. So we're trying to go a few different routes so we're not only addressing folks coming out of an aviation background.

What we're looking for is surprise interest, like "whoa, what's the airplane doing here? Pretty cool. And I actually could afford it. Because I can afford a Lamborghini, and I'd like an airplane as well." So we're able to get a foot in the door with exciting sport aircraft. And that's what we want to do. And that's actually happening through these events or partnerships.

What has the uptake been on these efforts?

My best guess at this point in time is that we're getting 20, 30 or 40 demos out of that appearance on the shop floor over the period of a quarter, I'd say. We have a sales representative on the floor and ask if the customers want to try it. That's what we're trying to do and it works fairly well.

What's the sales conversion rate on these demo flights?

That's hard to translate. We are fully aware that creating that new category and convincing someone who has not thought about buying an airplane to buy one, that's a long cycle.

Right now, what we're trying to



do is feed the funnel to create as many hot leads as we possibly can. It's our task to convert these into contracts. We're aware you have to be patient. You're not selling big numbers. You're not converting in a heartbeat big numbers of people who weren't even thinking about it. Our idea is that we let the plane speak for itself.

We have regional sales directors. They're all equipped with a plane, with a trailer, with a towing vehicle and meeting the prospect at his FBO of choice. We're trying to be as flexible as we possibly can be.

By traditional aviation standards, that's aggressive selling to cold prospects.

Yes, but we think it's necessary. It's also trying to control costs. You don't want to go

Icon CEO, Thomas Wieners, right: "It's now our responsibility to adjust. And that's what we've been doing, right sizing the organization that was laid out spec'd for high volume to what is and [will be] smart and healthy growth from that base."

and have brick and mortar in too many areas when you're not knowing where you'll find your prospects. We're trying to be in a few locations very aggressively, but then in parallel be flexible and say, look, we're going to meet you wherever you are.

Who have the buyers been so far?

I'd say it's still 70 percent-plus pilots or people who have been flying before and are renewing their license. Or changing from one plane to another. Around 30 percent are novices and are new to the game



and starting to enjoy that exciting adventure.

Do you have to reverse that ratio or does it matter?

Bottom line, it doesn't matter. We're trying to interest both. We believe we can do better on the non-pilot side, but we're aware that it will take longer.

When Icon first came out of the ground, the volume expectations were not just high by LSA standards, but by any standards. Was that unreasonable?

I call it extremely visionary and ambitious. What you're seeing is that we're correcting this with the reality that has kicked in. It's totally OK that the vision was assuming this. This allowed us to come up with the product as it is in the end.

But I think it's now our responsibility to adjust. And that's what we've been doing, right sizing the organization that was laid out spec'd for high volume to what is and [will be] smart and healthy growth from that base.

If you look ahead two to three years, what kind of volume do think is realistic?

So a very healthy volume for us is 250-plus. That would be the starting point. I actually hope and think it can be higher. Will it be thousands? I don't think so. I certainly think it could be in the 250 to 500-plus level.

Obviously, the initial investment was scaled to much larger numbers. Can you now downshift it?

I think we can and that's the reorganization we have just been initiating. Both of our facilities have a capacity of around 1000 aircraft a year. Now this is space and space translates into rent. We're considering subleasing space and we're considering taking on other projects that require space and would pay for themselves.

That's a fairly easy exercise, I'd

continued on page 12

ICON TRAINING: FOCUS ON AoA

Among a host of factors that drove the Icon A5's design, two stand out and they're related. Icon sought to limit its tort liability exposure through a restrictive buyer's agreement that also requires a customer to complete Icon-approved training as a condition of sale.

When Icon proposed its first buyer's contract, it was widely seen as draconian and the company immediately retrenched. But the current contract still requires a hold-harmless agreement and tacks on an extra \$10,000 if the buyer wants to retain the right to sue.

It also requires an owner to notify the company in writing before selling the airplane and/or to ensure that the secondary owner has also executed the hold-harmless contract with Icon. Failure to do that authorizes Icon to pursue a \$5000 penalty from the first owner.

Whether this has had a chilling effect on would-be buyers is unknown, although Icon says price escalations have definitely eroded the original depositors list. But buyers who hang in—whether new to aviation or transitioning from other air-

craft—are still impacted in the form of training that Icon has carefully shaped to limit its exposure through the expedient of training pilots to assess risk and avoid accidents.

In fact, there are 33 line-item risks in the contract that buyers must initial that they understand and the training addresses these. The program, reviewed for me by Icon's East Coast director, Warren Curry, and chief pilot Genesah Duffy is, for want of better description, a cutting-edge anachronism.

In an age where panels are festooned with acres of TFT displays, the A5 has little of that and is surprisingly analog. At the top of the pilot's panel is Icon's unique angle-of-attack indicator and below that an analog airspeed indicator and analog digital altimeter flanking a small electronic attitude gyro. Engine instruments, the tach and fuel gauge are below that. A word on that fuel gauge: It's just an analog dial reading directly in gallons. Whoever designed it resisted the urge to lard it up with some new-age dancing bars or worse, a tape.

The same spare philosophy was applied to the AoA which, while a differential pressure sensor and not true AoA, serves the purpose. The indicator is a wing section needle with four calibrations: green for top of cruise, white for approaches, yellow for caution and a yellow zone leading to red. It's the most intuitive

The A5's wings can be folded for trailering in a minute or two, below.



Automotive-style panel, top photo, has AoA front and center. Training materials, bottom, emphasize AoA.

AoA I've seen and is integrated into the training from hour one.

Manufacturer-provided training material isn't a new idea; Cessna did it for years and I imagine others have as well. But Icon's version is carefully aimed at what I'd call survival aeronautical training combined with the A5's unique operating environment: low-altitude flying and water operations. All of this is covered in four printed volumes that are well written and well illustrated. Icon also offers a computer-based online interactive version of some of its training materials.

The books hit the AoA concept hard and introduce the idea of total aircraft energy state as a means of understanding where the airplane is in its flight envelope. Airspeed isn't ignored, but with AoA as the star of the show, it gets the attention.

I was impressed with Icon's emphasis on the tactile feel of flight. When's the last time you read a training manual say this: "With a little practice, we can learn to sense our airspeed and AoA using visual, aural and seat-of-the-pants cueing." And in the first 30 minutes of flying with Genesah Duffy I was doing exactly that, without being told.

Icon declines to say how much money was invested in getting the airplane and company this far, but we know at least \$89.5 million was spent. The airplane shows evidence of that kind of expenditure. The one I flew was a recent production version, serial 93, and fit and finish were excellent. From what I could see, the composite work rivaled anything coming out of Europe—or Duluth.

The cockpit ergonomics are automotive comfortable. I was prepared to hate the panel, but the function of the AoA won me over to the extent of ignoring everything else unless it was immediately relevant.

Another temptation Icon ignored



was using a sidestick, in the fashion of other airplanes that fancy themselves new-age exemplars for fighter pilot wannabees. The Icon has a proper, perfectly positioned center stick. I found control forces well harmonized and because the split-incidence, stall-resistant wings are loaded up with vortex generators, roll control through the burble and incipient stall is positive.

The airplane is well mannered on the water. The A5's unique water wings—sponsons by another name—make boarding easy, allow you to egress while stopped on the water and provide so much roll stability that dipping a wing is all but impossible even in aggressive step taxiing.

If I had any wishes for the A5, it would be more power. Compared to a SeaRey or a Carbon Cub on floats, it feels slower off the water and initial climb feels less vigorous. I suspect this is due partially to the A5's waivered higher weight, at 1510

pounds, with a typical 430-pound useful load.

That higher weight was allowed for the airplane's heavier, stall-resistant wing. A worthy tradeoff, perhaps, but no free lunch. I was also surprised that it doesn't have an aural landing gear nag to provide some protection against a gear-down landing on water. Other seaplanes, such as the SeaRey, do have this.

Safety-wise, the A5 fleet has had seven accidents, two fatal. In my view, with just 100 out there, this is too few to judge the airplane fairly. When 300 to 500 are flying, we'll take another look.

For the short term, the A5 is a well-thought-out airframe, in my view, and appears effectively married to a training program designed to teach pilots solid stick-and-rudder flying while avoiding accidents. It's now up to Icon to prove the A5 can endure in the market and live up to its promise.



At Prestige Imports in Miami, left, buyers can pick up an Icon while they're shopping for a Lotus or a Lamborghini. The A5 has been on display since early 2019 and the company has sold four airplanes.

continued from page 10

say. The other one is equipment and tooling. It's highly capital intensive. We have tooling to support 250 units a year. The good news is we have the ability to scale up to 250 without needing more cash. At the same time, this is capital that has been invested, but is not fully utilized right now.

Are you capable of running the factories without additional capital input? And does this suggest you're at the break-even point?

Yes we are. No, we're not at the break-even point financially. Agreeing to the reorganization, you'll understand, has been a painful decision for us. We had been hoping for higher volumes coming in quicker. But with the reorganization, we have set ourselves up for funding that has come in that will support us to execute this plan. It will attract future funding that will ideally take us to healthy volumes.

Are the investors OK with this? What are investor expectations?

These are long-term investors. The money that's in is highly strategic investment for long-term return. If this was a quick investment for a quick return, we would not likely have the support we're having. With the investment that's already in, the investors have a lot of skin in the game and are highly committed.

When the aircraft first emerged, the price was estimated at \$139,000, but now it's \$389,000. How has this impacted deposit conversions?

Obviously, it has been hurting. And this was the risk that the company took when it came out early with price tags at \$139,000, \$189,000, \$259,000. At that point, the data was extremely weak about what it would cost to produce the aircraft. What will it take to bring it into serial production.

The company has been very optimistic and bullish that this could be done cheaper. Unfortunately, the airplane was not necessarily designed for manufacturability. The focus was on the flight characteristics and aesthetics of the airplane. So now, the deposit holder list is looking substantially different than it did before.

I would put this under the envelope of a reality check right now. It's not so much about deposits. Likewise, is the importance of new customers to us, who are sometimes even quicker in making decisions because they're not ... saying even if I had the money, I was told years ago that it was cheaper and now it is so expensive, I don't want to pay this anymore.

While there are other folks we put in the airplane [who are asked] how much would you pay for this? And there are people who actually don't know. Some might say, I'd pay \$500,000 for that thing.

So the deposit holders list that we have referenced in the past are

not actually that relevant to me today.

If I'm hearing you right, you're saying that pump-starter initial price wasn't a good idea.

I would say that's a correct statement. There are a lot of things we would do differently with what we know today. You're going out aggressively with what you hope and think the price could look like. But there are 373 individually laid up carbon-fiber parts. This is complex. This is, unfortunately, costing more than we ever wanted it to cost, but it needs to be done right. Quality and safety are playing a very big role in our manufacturing process and the product is delivering and we're not having any quality flaws. It comes with a certain price tag and this is more than we wanted it to be. But that's what it is.

Can the manufacturing process be significantly leaned to increase margins?

Yes, it can, and that's obviously one of our top priorities, and for potential new products as well. Conceptually, we're having a lot of new ideas and there are a lot of lessons learned that can go into new products. But in the existing A5, we're trying to do a lot of reverse engineering to make the product more manufacturable without compromising quality.

It's really highly volume dependent. So cutting down volume is putting on the brakes a little because there's a scaling effect. But there's a lot of low-hanging fruit that we'll be able to cut down in the next year and half, I'd say. I'm sure this will be helping us to improve significantly.

YouTube See a video of the Icon flight trial at <http://tinyurl.com/j95ht2a>.

Commercial Pilot Prep: King Schools Tops

If you want to fly for a living, we won't call you nuts, but intensive dual saves money and King Schools is best for the written.

by Rick Durden

The FAA draws a deep line in the sand for pilots to cross from being a private pilot—an amateur aviator—to the ranks of the professionals who carry innocent, paying passengers. To cross that line means demonstrating a new level of knowledge, judgment and ability.

The good news is that, in our experience, we haven't run across a pilot who couldn't complete the commercial rating so long as she or he was willing to work hard.

Put simply, the knowledge end of the rating involves returning to the subjects you learned for your private ticket and going into them deeper and with more breadth while adding a few new ones. On the flying end, you're going to do all of the maneuvers you mastered for your private, but with closer tolerances, and learn some new ones, such as spot landings, pylon-8s, chandelles and lazy-8s, that will teach you how to fly an airplane with much more precision, smoothness and subtlety. The commercial ticket, one acquaintance told us, is where airplane drivers have the opportunity to learn to be pilots.

The basic aeronautical experience requirements for the certificate are set out in the sidebar on the next page. We have always thought of the experience requirements as providing a level of seasoning—pi-

lots have to get out of their comfort zone and fly cross countries of some distance, operate at night and at controlled airports. We think that the FAA wants commercial pilots to have been around the block a few times—to have flown away from the nest and had more than a little exposure to the big, wide aeronautical world.

KNOWLEDGE EXAM

We are of the opinion that as a professional-pilot-to-be, someone seeking a commercial pilot certificate should be willing to fully immerse themselves in what it means to be a serious aviator—to acquire a visceral understanding of aerodynamics, aircraft systems, regulations and the overall why of flight. Making a living around airplanes, we believe, means having a depth of knowledge of the aviation world that may well prove to be a life or death matter when things go wrong in the sky and there's a load of trusting passengers behind the person with sweaty hands on the yoke.

Accordingly, we recommend that when a pilot studies for the knowledge exam (written) for a commercial ticket that he or she begin with a course that offers more than the minimum required to just get through the FAA exam. After all, the FARs are, by law, only minimum standards, and we feel strongly that someone who is responsible for the lives of others has an obligation to have a knowledge level well above minimum standards.

Once a pilot has worked through a solid, in-depth ground school, there are excellent, inexpensive, we'll-polish-you-up review courses that target the FAA written. However, we strongly recommend those as only the place to finish getting ready for the knowledge exam, not the place to start.

Many flight schools offer formal commercial ground schools. We've observed costs in the \$300-\$400 range, including study materials. Naturally, the quality somewhat depends on the instructor; however, we've observed that the true variable is whether the student is willing to read and review the materials and show up prepared for each class. A determined student can overcome the shortcomings of a mediocre instructor.

We also like the integrated programs offered by a number of flight schools—more than we could individually review in this article. The schools make use of a syllabus and training materials that combine written and practical test preparation as the student simultaneously progresses through flight and ground training. We've observed that the majority of these courses combine the instrument



Accuracy landings—touching down beyond but within 200 feet of a line—are an integral part of the commercial practical exam.

COMMERCIAL CERTIFICATE: THE REQUIREMENTS

FAR Part 61.29 sets out the aeronautical experience that a commercial pilot applicant have before taking the practical (oral and flight) test. As with most other ratings, the applicant has to have successfully passed the appropriate FAA written examination prior to the practical test.

We'll limit our review of the requirements to those for the commercial airplane, single-engine land rating under Part 61 and simply note that if the applicant attends a commercial pilot course offered by an FAA-approved Part 142 training center, some of the minimum flying time requirements are reduced significantly. In addition, the applicant under a Part 142 training center course can credit up to 100 hours of time in a full flight simulator or flight training device (as defined in the FARs) toward the rating rather than the 50 hours allowed under Part 61. We strongly recommend that anyone considering a commercial rating check to see if he or she can do so through a Part 142 school (there may be requirements that the applicant can't meet) and then run the financial numbers as it may save big bucks over training under Part 61 requirements.

Under Part 61, an applicant has to have 250 total hours of flying time, of which 100 hours must be in powered aircraft and 50 hours in an airplane. Minimum pilot in command (PIC) time is 100 hours, of which 50 must be in an airplane and 50 hours is cross-country time (at least 50 NM from the point of departure per Part 61.1), of which 10 of those hours are in an airplane.

Part 61.127 sets out requirements for specific training, including 10 hours of instrument instruction, of which five must be in an airplane, and 10 hours of instruction in a complex airplane, technically advanced airplane (TAA) or turbine-powered airplane. (We recom-

mend that you look for a school with a TAA Cessna 172 or Piper Archer as they are much cheaper to rent than a complex airplane.) The applicant must also have two hours of day cross-country dual in a single-engine airplane on a flight of at least 100 NM and two hours of night cross-country dual in a single-engine airplane on a flight of at least 100 NM. Finally, the applicant has to have received three hours of dual in preparation for the practical test within two months of the test.

Interestingly, the regs specifically require 10 hours of solo time, or "performing the duties of PIC with a CFI on board," in a single-engine airplane. During that time the applicant must have conducted one cross-country flight of not less than 300 NM consisting of landings at three points, one of which is a distance of at least 250 NM from the original departure point as well as five hours of night VFR including 10 takeoffs and landings at an airport with an operating control tower.

An applicant can credit as many as 50 hours of dual instruction with a CFI in a full flight simulator or flight training device (as defined in the FARs) toward the aeronautical experience requirements for the commercial pilot certificate. Frankly, from a cost standpoint, we think anyone seeking a commercial ticket would be wise to take advantage of every hour of simulator time that is allowed under the regs.

An applicant for a commercial rating is not required to hold an instrument rating; however, without one, upon successfully completing the practical exam, the new commercial pilot will have a certificate with the following limitation: "The carriage of passengers for hire in airplanes on cross-country flights in excess of 50 NM or at night is prohibited."



and commercial ratings such as the well-regarded program offered by Jeppesen (www.boeing-services.com). Because our review of integrated courses did not reveal any that offered practice FAA written test questions with immediate feedback, we limited the written test preparation portion of this article to courses specifically dedicated to commercial pilot training with the capability for the student to take practice written tests and get immediate feedback.

We looked at five written test prep offerings and will start by

saying that all are very good. This is a competitive field and we've been impressed by the fact that the competitors just keep getting better. We do note that only King Schools and Gleim provide the all-around, in-depth teaching we think is where a prospective commercial pilot should start his or her education. Dauntless offers what we consider a mix of ground school and test prep. Sheppard Air and ASA focus purely on written test prep—and are very good at it. We consider them the place to go if you want more prep before taking the exam, not where

to begin your studies.

Keep in mind that the FAA stopped publishing the questions and answers to its written exams more than 10 years ago, so no company can honestly say that it has all of them.

All schools we reviewed offer a guarantee that you will pass the written. The deal is that you have to complete the course and the practice tests per the terms of the guarantee. In our experience, if you do the heavy lifting required to apply yourself and study the material as well as take the practice exams,

Gleim's e-book, top, uses a no-frills, just-the-facts approach. King Schools videos make up a content-rich training program, middle. ASA's PrepWare is a test prep only system offered in multiple formats, bottom.

the FAA knowledge exam will be a snap.

KING SCHOOLS

The commercial ground school and written test preparation course offered by King Schools (www.kingschools.com) is priced at \$279 and can be used on any device with an internet browser and broadband connection as well as an iPhone and iPad. As is often the case, the King course is the most expensive of those available, but we think the quality justifies the price.

As with the other King courses we've reviewed, it's content-rich, well-organized, user-friendly and provides a number of study aids. It is organized into a recommended flow through subject areas in a sequence that makes sense to us for subjects that rely on previous mastery of other subjects.

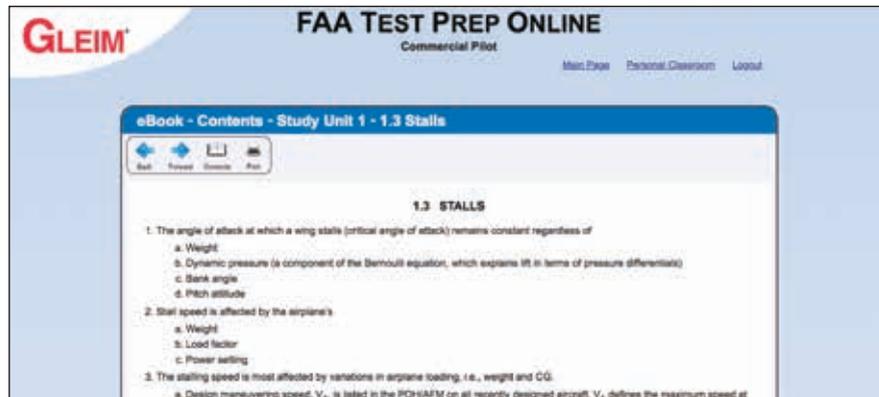
The lessons are presented in video format that breaks complex subjects into digestible bits. Once the video is over, review questions appear sequentially. You get a running report card that tracks progress through lessons and your percentage of correct question answers.

Lessons can be reviewed as many times as desired. Once the lessons are complete the student is directed to take practice writtens. With a score of at least 70% on three practice writtens, the student can receive an endorsement to take the FAA knowledge exam.

GLEIM

We've liked Gleim's (www.gleim.com) no-nonsense approach to training for years. Its \$69.95 Commercial Test Prep Online course first points the student to an e-book to be read, followed by practice quizzes and then very realistic practice tests. There are no videos.

The terse e-book breaks the material into units with each unit being broken into sections that rarely take



more than 10 minutes to read. We recommend reading the e-book material in the order it is presented due to the building-block nature of the subjects.

From the e-book the student goes to the question bank. When clicking an answer the student gets feedback regarding the chosen answer in impressive detail.

The course keeps a running tab of questions missed in a fashion that allows the student to see strong and weak areas.

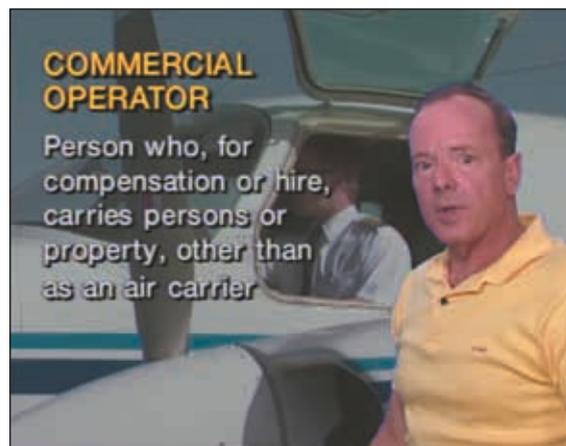
The test questions nicely mimic the FAA format. To get an endorsement to take the FAA knowledge test the student must have answered all of the required questions in the test prep correctly.

DAUNTLESS

Occupying an intriguing niche between full-blown ground school training program and pure test prep, Dauntless Aviation's (www.dauntless-soft.com) GroundSchool provides what it calls "learning by simulated testing."

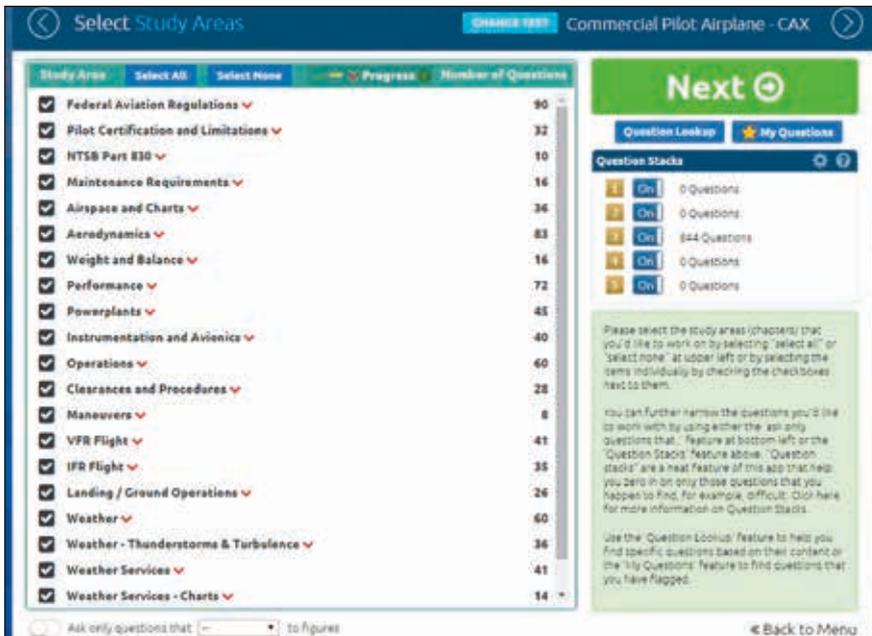
The company asserts that its method of starting with an FAA test question and an extremely detailed (and often highly illustrated) explanation of the correct answer provides more effective learning than simply reading facts in a book or watching a video.

Once the student has used the "test/study" mode (question with



correct answer) she or he moves to the "learning and practice" mode where the student answers questions, gets immediate feedback and repeats questions not answered correctly. The course moves through more intensive study modes via practice tests until the student is taking well-simulated FAA tests.

We like the quality of the Dauntless product and the fact that once you buy the downloadable software, Dauntless provides frequent updates to help ensure the student has the most current FAA test information. At \$49.99 for something that is significantly more than a pure test prep course, we think it is an excellent value. Our only hesitancy comes from the fact that the education provided is limited to the basic



Dauntless Aviation's GroundSchool uses "learning by simulated testing," above. Prep for the practical test involves intensive practice of the commercial maneuvers such as the chandelle, below.

and strongly recommends taking the FAA exam within 24 hours.

PRACTICAL TEST PREP

We'll put this bluntly. Unless you are in an organized, syllabus-based program that leads you through the instrument and commercial ratings, we think that getting ready for the practical test is best accomplished by first getting the flying time required while preparing for and taking the knowledge test. Use a simulator and the least expensive airplane you can find.

The next step is to take intensive dual (usually about 10-15 hours) and the practical test. Do it at a school that either specializes in such training or after carefully coordinating with your local school. The reality—it's all about the commercial maneuvers and flying precisely. Schedule the checkride before you begin the concentrated training as the biggest bottleneck we've observed in flight training across the country is scheduling checkrides.

We've seen it shown time after time—pilots who spread out the training for a rating take longer and spend more money. Intensive training works—that's why the military has done it for decades.

CONCLUSION

For a commercial rating outside of a structured, FAA-approved school setting, we recommend building time in a sim and a simple, inexpensive airplane by taking long cross countries and carefully tracking the flight experience the FAA requires. It will probably be cheaper to get 10 hours of dual in a TAA than a complex airplane.

For the written, we like King Schools with either Dauntless or Sheppard Air if you want a separate written prep, although we don't think you'll need it.

Then, schedule the checkride and take intensive dual to polish up and be ready to ace the ride.



two practice tests with a score of at least 80%, the student has the choice of an endorsement from ASA for the FAA knowledge test or ASA providing evidence of the scores to the student's CFI so the CFI can sign off the endorsement.

SHEPPARD AIR

Sheppard Air (www.sheppardair.com) unabashedly provides a product that is purely designed to get an applicant ready to pass the FAA knowledge test, nothing more and nothing less. We think Sheppard is good at what it does and we regularly talk with flight schools that recommend that their students polish off their ground school with Sheppard's test prep.

The downloadable software is priced at \$45 and is advertised to closely mimic the FAA exam. This is a cram-and-take-the-test program that encourages memorizing test questions—we do not recommend it as a starting place for ground school. We like Sheppard's pragmatic advice on how to take FAA writtens and that it has instructors available 24 hours a day, all year, to answer student questions.

If the student follows the study program as outlined, takes the practice exam and scores at least 90%, Sheppard issues an endorsement

FAA requirements and we think commercial pilots should have a wider span of knowledge.

ASA

For the commercial rating, ASA (www.asa2fly.com) offers its "Prepware" designed to help a pilot who has taken some form of ground school course intensively review to take the FAA knowledge exam. It may be purchased as a softcover book, e-book, DVD, download or online access. The price ranges from \$24.95 for the book to \$49.95 for the DVDs or download (each of which includes online access to prepware materials for 24 months). Online access by itself is \$39.95. Online access allows access by multiple devices as well taking an unlimited number of practice tests.

When answering a practice question the student is immediately advised whether the answer is correct and why as well as given references for further study. Upon completing

David Clark Pro-X2: On-The-Ear Comfort

At \$745 Clark's latest supra-aural headset is hardly a budget model, but we think it packs enough tech and performance to call it a decent value.

by Larry Anglisano

High-end aviation headsets from Bose and Lightspeed Aviation often steal the spotlight, but Massachusetts-based David Clark is a standing pioneer in the competitive aviation headset market, earning high points for customer service and quality.

A latest model is the \$745 DC-Pro-X2, a supra-aural (rest-on-ear) model that delivers on comfort and in overall audio performance. That's a tall order for an over-ear model that is really aimed at jet cockpits, but we think it works well enough to be a worthy option for pistons. Here's a field report.

IMPROVED SUPRA-AURAL DESIGN

David Clark's on-ear Pro-X2 is actually a rework of the first-gen Pro-X that came out somewhere around 2013. The new model is TSO'd to the latest C-139a (aircraft audio systems and equipment) spec, making it fair game for airline crews.

As with the early model, the latest Pro-X2 requires precise positioning of the earcup over the ear canal as you'd expect with a supra-aural model. And while the new set has the same ear pads as the original, David Clark redesigned the inner audio dome for a more elongated

oval shape, compared to the previous circular design. It also changed the electret microphone to a MEMS (micro-electromechanical system) designed mic and moved the



Finally, we found a headset that's versatile enough for every seat in the cabin.



The set excels at Bluetooth audio quality and has a good control set.



Don't expect Bose or Lightspeed flagship ANR performance. Supra-aural comfort is a compromise.

amplifier to the mic's boom, rather than in the controller where it was placed previously. The end result is better RFI (radio frequency interference) immunity.

Internally, the Pro-X2 gets new and higher-quality speakers in each earcup, which according to David Clark provide a more linear response for better sound quality when listening to Bluetooth music—a trait that has been greatly improved, in our view. Audiophiles will be impressed. But those new speakers also help with the set's active noise canceling performance and stability, especially with higher noise levels. And kicking the ANR performance up another notch is the addition of automatic gain control, or AGC. Turns out

The on-ear Pro-X2 works quite well with sunglasses and the adjustable headband allows for a precise fit on all head sizes. Off the head, they fold up compact for easy storage.





The Pro-X2 control module, top, is sized just right. The bottom image is what the ear dome and circuitry look like below the high-quality detachable Dura-Stitched ear seals.

that's an important update given the nature of a supra-aural headset used in noisy piston cabins.

The previous set had a tendency to click, crackle and pop when the ANR circuitry became overwhelmed. You've probably heard it before with some other ANR models as you're hauling down the runway at full

power, as the ANR's sensing microphones hit the rails, so to speak. A supra-aural ANR model is more susceptible to noise leakage by design, compared to a model that's fully enclosed around the ear. If you look at the condition as a sine wave, essentially what's happening is the ANR circuitry is overdriven to sharp peaks. The AGC smoothens those peaks during high-noise transitions.

FIT, FINISH, FUNCTION

In our estimation David Clark has all of the above nailed. The set has a rugged yet refined feel. The older magnesium alloy headband/suspension system has been replaced by an aluminum one simply because it's more durable and less likely to scratch. That along with the larger speakers actually makes the 8.7-ounce Pro-X2 heavier than the first-gen model by 1.2 ounces.

The set's LED-lighted control module is about as simple

and rugged as it gets. There's a power button, left- and right-ear volume button and a Bluetooth button for pairing with a smartphone. We wish the module had a dedicated volume control for Bluetooth music, especially given the high-quality audio the set produces thanks to DSP, or digital signal processing. The music mutes when there's chatter and then comes back on when it's quiet. You can turn the automute on or off by briefly pressing the Bluetooth button when the set is paired. The set also works in full duplex for cellphone communications when it's paired.

Two AA batteries should power the set for 35 hours and around 15

hours with Bluetooth. There are multiple panel-power options, including Bose-compatible 5-pin Lemo plugs. The set has a new enhanced auto-shutoff feature, enabled with a dip switch in the battery case. It will turn off after five minutes of powering down the audio panel or if they're removed from the audio jacks.

WHO'S GONNA BUY THESE?

Plenty, apparently. Mark Gardell, David Clark's VP of marketing, told us the \$745 Pro-X2 (priced slightly higher than the previous set) has been a brisk seller across a wide market—from Boeing 737 to Beech Baron cockpits.

Worth mentioning is that Gardell—an active Mooney pilot who obviously flies with David Clark products and talks with pilots at tradeshow—understands the impossible challenges of building a one-size-fits-all headset. It would seem David Clark, who has hung in the shadows of Bose and Lightspeed over the years, gets attention where it counts—sales. We asked John Zimmerman over at Sporty's to backstop our suspicion that David Clark models are favored in the mid-priced headset market and he didn't disagree, saying the David Clark H10-13S is a best seller. He also noted that the market's lower end is changing and there are a lot of options, but David Clark customers are loyal ones. In our view, it's payback for years of good customer service.

After trying them, the Pro-X2 is a set we would use even over our cherished Bose A20 in turboprop and jet cockpits. For loud pistons, we'd still reach for the A20, but would offer the Pro-X2 to passengers in any cabin. The way we see it, the Pro-X2 performance is about as good as it gets when you're willing to compromise ANR performance for supra-aural comfort. For long hauls, we think passengers might prefer them even over the Bose. They're less intrusive, compact, have excellent Bluetooth entertainment audio quality and they're built rugged enough to throw around the cabin. When you're parked, they fold nicely for space-saving storage. All that hits enough high points to recommend them.

Visit www.davidclarkcompany.com, or 800-298-6235 for David Clark in Worcester, Massachusetts.



The finger walking on the Garmin GNC 355 mapcomm pictured here is loading a precision GPS approach—the only ones available in Garmin's latest line of retrofit navigators.

BUYING DECISIONS

Is VHF Nav Dead? For Many, It Could Be

Garmin's new line of IFR navigators ditch the VHF nav receiver in favor of WAAS GPS. That's sparked a debate of whether ground-based nav is history.

by Frank Bowlin

Once upon a time, the well-equipped instrument panel sported two identical 760-channel King KX155 radios with VHF comm, VOR, LOC and ILS—the cat's pajamas. We needed two navs for cross-radial fixing and we needed two comms for ease in picking up the weather. Plus, let's face it; overall we needed two radios to make sure at least one of 'em worked.

But that dual navcomm mindset so permeated our culture that it remains the norm today. Even new panels today will typically include two identical GPS navcomm boxes, or one large and one small. The reality is that modern avionics have largely mitigated the reliability problem. We can still certainly make use of two comms, but do we really need dual GPS and dual VHF nav? In fact, do we really need VHF nav at all? Let's talk about this.

PRACTICALITY: VHF NAV TODAY

Be honest. If you have a certified WAAS GPS in the panel, when was the last time you navigated using

anything other than GPS? Even without a certified box on the panel but with something in your lap, when was the last time you used VORs as your primary means of cross-country nav? Either way, when was the last time you flew a VOR, LOC or ILS approach?

I fly about 120 hours a year, in all weather. I checked my logbook. My last VOR and ILS approaches were during my last instrument proficiency check (IPC). Before that, it was on the prior IPC. I kept looking further back in my logbook and after five years I gave up; I didn't find any VHF approaches outside of an IPC. I'll bet you'd find the same.

OK, I'll even take it one further. When was the last time you did the 30-day VOR check required by 14 CFR §91.171(a)(2)? This year? Probably not. OK, then, without that 30-day check, you're not legal to use VORs for navigation under IFR. Tell me again: Why do you have one of those in your panel, let alone two?

Let's have a reality check, shall we? I'm a lot like you. I have two VHF nav radios in my airplane, and of

course, two VHF radios. I just have one GPS, though, having recognized the wasted money in having two. (See the sidebar.) But, not to toot my own horn or anything, I actually do those VOR checks. No, I don't do them every 30 days because I don't always fly every 30 days. But, I do one early in nearly every trip. This way, should I ever need to use that VOR, I'm legal to do so.

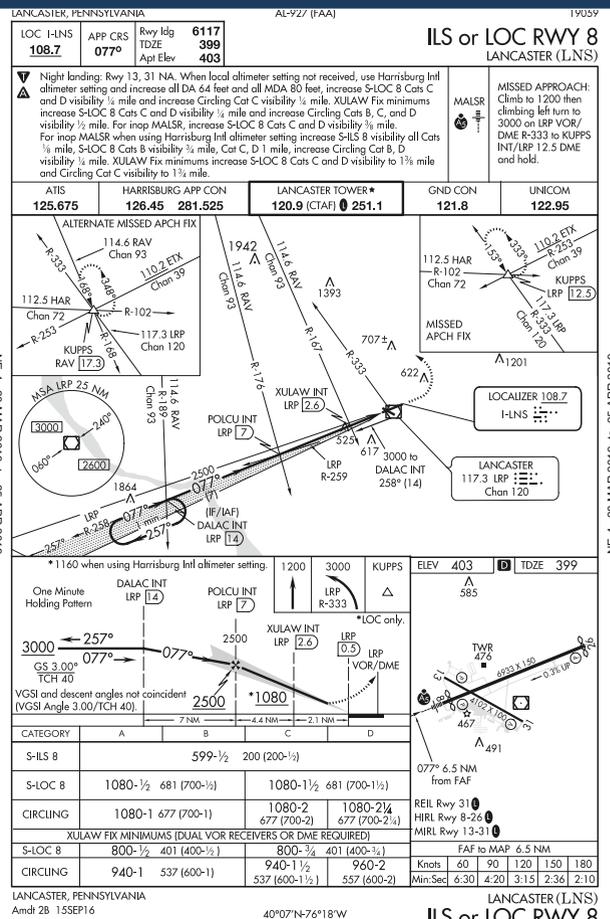
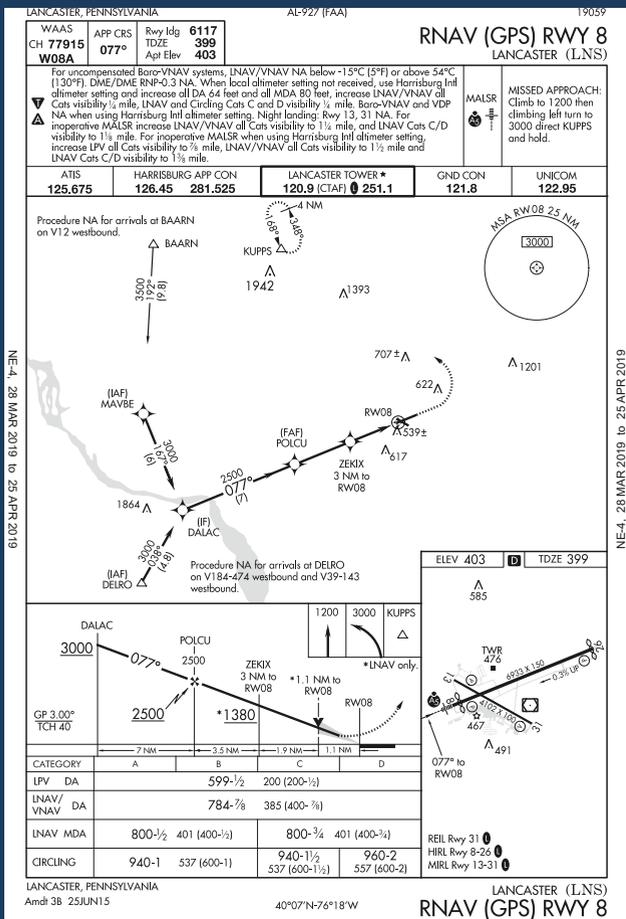
Now, that brings us back around to the main point. VHF nav today in general aviation in the U.S. is primarily useful as a backup to GPS. I live in the southwest, where we get GPS interference NOTAMs nearly every week. So, yes, I have need to back up my GPS occasionally. I keep a nearby VOR tuned in and when the GPS signal goes away, I'm ready.

Still, though, that only takes one since I've also got DME (for reasons that might someday find their way into a separate article), so having two VORs is unnecessary. If you ever need to identify a cross-radial fix using VORs and you don't have DME, chances are amazingly high you could just ask ATC and they'd steer you as needed. And, if you needed to do that because GPS is out, well, they'd probably lead you by the hand wherever you needed to go.

What about on approach? With

CHECKLIST

-  Ditching the VHF nav means no more costly upkeep of aging antennas.
-  Investing in Garmin's new budget IFR WAAS navigators gets you the absolute latest in GPS tech.
-  But without VHF nav, they lack the VOR/LOC/ILS redundancy you might never need.



WAAS permitting GPS approaches with LPV minimums often the same as an ILS, again we can default to GPS nav. So, what's the difference and do we care?

GPS VERSUS VHF NAV APPROACHES

All GPS approaches essentially follow one of a couple different design models that are virtually the same when you hit the final approach fix. Whether or not you have vertical guidance is primarily dependent on the terrain and obstructions. The technique for flying any of the GPS approaches is essentially the same.

Even those without published vertical guidance like LNAV/VNAV or LPV often have LNAV+V simulated vertical guidance provided by the box, so you rarely have to worry about those pesky step-down fixes requiring a "dive-'n-drive" technique like you might on a VOR or LOC approach.

So, given the choice of a VOR or even LOC approach versus the typical GPS approach, most of us would rightfully choose the GPS approach every time. Adding LPV precision minimums on GPS approaches brings the comparison to ILS versus LPV, allowing us to essentially disregard VOR and LOC approaches.

When it really counts, an ILS and an LPV approach both get you down to the runway, usually offering similar minimums, and the skill needed to fly one is the same as the other. In fact, the LPV is a bit easier to fly with less button pushing and knob twisting, and—especially with an autopilot—is more seamless in the transition from the enroute phase. In fact, LPV and ILS approaches have similar design criteria. Study the LPV and ILS approaches to Lancaster, Pennsylvania's Runway 8 on the charts shown above.

Overlapping design criteria often end at the runway. The missed approach segment can differ significantly in ways that really don't much matter to us here other than the ILS often requires more machinations



At roughly 2 inches high, Garmin sized its new budget GPS series to fit in place of traditional navcomms like the King KX155.

to get navigational guidance on the missed than any GPS approach. Note, though, that the missed approach design considerations for each can affect the minimums.

The bottom line, here, is that with 1549 Category I ILS approaches compared with 3998 RNAV (GPS) approaches with LPV minimums, and many more with higher minimums, there's little operational advantage to VHF nav, either enroute or on approach—so long as everything goes according to plan.

The main use today for VHF nav is as a backup to GPS. When GPS is unavailable or can't provide the needed precision, we've still got those VORs and ILSs. But, with the FAA planning on a GPS future both for our own navigation and for their surveillance, they're planning to decommission a great number of VORs and ILSs in the coming years, leaving us with the Minimum Operating Network capable of getting us safely on the ground, but not necessarily where we're going. So, while GPS is planned to become our near sole source of navigation, the opportunities to even efficiently use VHF nav as a backup will dwindle.

With that as an indictment of VHF nav, there remain a couple practical considerations. For arcane reasons, no GPS approach officially qualifies as a "precision" approach. Instead, at best their classification is an approach with vertical guidance. Today, only an ILS (or an LDA/GS, essentially the same thing) is considered a precision approach. This affects our choices when filing an IFR alternate.

Finally, there's one last consideration about VHF nav that few of us consider. Remember the old days when you often listened to FSS over a VOR frequency while transmitting on an unrelated frequency? Well, that's still possible, although the need (especially with cellphones) nearly—but not completely—disappeared.

I've flown into Allendale County Airport in South Carolina a few times. On the ground, I got very limited cellphone coverage and I couldn't raise ATC on any radio, in spite of a published frequency. The Chart Supplement tells me to contact Anderson Radio through their remote communications outlet on 122.1 while listening to the on-field VOR on 116.7. While this is unusual

SHOULD YOU BUY DUAL GPS?

Aside from the central issue of the VHF nav question, let's diverge for a moment to look at dual GPS. What good is it to have two? This

is kind of a pet peeve of mine, so forgive me if I rant for a moment, away from the main point.

Be honest: The main reason most of us have dual GPS is because of the mindset that we needed two VHF navs back in the day—and also because Garmin changed the face of the traditional navcomm with the all-in-one GNS 430/530. Buyers bought them in pairs and still do so today with the GTN series and also the Avidyne IFD units, shown here. The day of two VHF navs is long past, but is there anything you can do with two GPS boxes that you can't do with just one (aside from the added screen real estate)?



I'd submit that the answer is that having two is mostly pointless, other than redundancy and possibly using the second box to have

a different display, which actually might be better suited on an MFD anyway. But, having two GPS navigators behind those screens buys us nothing. (To be fair, there are some ways to use two GPS boxes, but

those are edge cases that escape the average Joe Pilot.)

So think about that the next time you're considering a panel upgrade and complaining about the cost. Consider dropping that second GPS/nav/comm in favor of ... what?

To answer that, consider what you use and need the most. We'll help you with your choices back in the main article.

—Frank Bowlin

today, it still remains a possibility that could leave you unable to contact FSS to reach ATC if you don't have VHF nav.

EQUIPPING TODAY

As interesting and engaging as this whole concept is in a theoretical sense, Garmin's introduction of essentially the same high-end GPS that they use in their flagship GTN navigators (with a couple feature differences), put in a smaller-box standalone (GPS 175), or paired with an ADS-B transponder (GNX 375) or with a comm (GNC 355)—but none with a VHF nav—has moved the discussion into the practical. If you're doing a panel upgrade now, what should you do?

The answer to that largely depends on your flying and the current state of your panel. There could also be

antenna considerations, and on some airframes VHF nav antenna work is expensive. We'd probably not replace a perfectly good existing radio with a VHF nav. It would be good to retain that VHF nav as the backup or for alternate planning as we discussed above. Beyond that, it all depends on your budget and on your use.

Surely, if you don't fly under IFR, you can safely skip VHF nav with little consequence. But, you probably already have working VHF nav, so it might make sense to just leave it.

Assuming you're considering your options because you don't even have GPS and haven't equipped yet with ADS-B, the GNX 375 GPS/ADS-B transponder (\$7995) might be a good choice to replace your existing transponder and add a state-of-the-art IFR GPS. Retaining your existing navcomm(s), assuming they're

working well, preserves all your options while adding ADS-B In and Out and a WAAS GPS.

Or, perhaps you've already got ADS-B Out, but you don't have WAAS GPS (except internal to the ADS-B box) and you want to be able to fly those GPS approaches. You could add the GPS-only Garmin GPS 175 (\$4995) and retain everything else.

Or, perhaps you've got ADS-B Out but want to simplify your panel while adding WAAS GPS. Add the GNC 355 GPS/comm, ripping out at least one of your existing nav-comms.

These, of course, are just hypotheticals. Note that this doesn't address interoperability. These new boxes do have good interface options. As we reported in the September 2019 *Aviation Consumer*, Garmin's new units work with a variety of third-party nav indicators and autopilots. Still, you should check to make sure that what you expect to retain will talk as needed to what you'll add.

Also note that other than the convenience and display sharing (for ADS-B In data), and unless you're really tight on panel space, there's little advantage of having a transponder in the same box as your GPS. But having a comm in the same box allows frequency selection right from the GPS database, which can be a big convenience.

Finally, you might note that a discussion of doing without VHF nav led us to various equipage options, many of which retained at least one existing navcomm. So even with these new options, you won't necessarily be completely without VHF nav capability. But the GNC 355 GPS/comm does have a frequency monitoring capability that lets you select a main frequency and monitor another. It's not quite like having two independent comms, but it's not a bad compromise if you really need to save space or money.

Bottom line is that in most cases you wouldn't be without VHF nav, but you could pretty safely choose to be.

Contributor Frank Bowlin is the Editor of sister publication IFR Magazine, where he noodles these kinds of buying decisions all the time.

AVIONICS BOOTCAMP



Sub-\$5K EFIS: Aspen, Garmin

Shopping the entry-level EFIS market for fitting a vintage Cessna shows you'll likely spend more for optional accessories for full compatibility.

by Larry Anglisano

The way we see it, the market has never been more competitive when it comes to budget glass and it's driving buyers to avionics shops like nobody's business. And with entry-level EFIS advertised at the \$5000 sweet spot thanks to more supportive FAA certification requirements (STC instead of TSO), for many it's finally time to upgrade.

"I've owned my 1962 Cessna Skylane since 1990 and the recent advances in tech, plus the FAA's attitude toward modernizing our fleet, has me moving toward upgrading to a totally electric panel," Chris Erkmann told us while he was planning the EFIS upgrade for his airplane.

Erkmann initially wanted us to backstop his planning to install a couple of Garmin G5 flight displays, but we helped kick the planning up a few notches by digging deeply into a couple of other interfaces he and others might get quotes for. We came up with three options (not in

any preferred order) worth fetching proposals for. What works for this 14-volt, round-gauge Cessna could easily work for a bunch of other airplanes, too. First let's look at mixing brands, and older avionics.

USE WHAT YOU HAVE

If it's compatible, we say keep it. Erkmann's Skylane has an existing Garmin GNS 430W, so it's already an instrument airplane that flies LPV and ILS approaches. And since the 430W is WAAS, it feeds data to an Appareo Stratus ADS-B transponder, so the airplane is set for the upcoming U.S. mandate. The 430W is backed up by a King KX155, driving a KI209 nav head. The audio panel is a King KMA24—hardly state of the art—but it's bulletproof. The autopilot is a single-axis, turn coordinator-driven S-TEC 40.

Since the primary goal is removing the vacuum system, let's look at sub-\$5000 EFIS and requirements.

DITCH THAT VACUUM SYSTEM



That's precisely what you can do when installing a pair of Garmin G5 instruments, far left in the images above, and Aspen's Evolution E5, pictured in the middle. That's because the STC for each of these systems allows it. The same is true for the G3X Touch and Dynon Certified SkyView. In a small Cessna or Piper, that could mean a significant weight savings when you factor the iron-gyro instruments, the vacuum pump and all of the lines and fittings. The photo to the far right is the plumbing removed from a Cessna 172. But the real advantage—aside from not having to worry about a pump and tumbling gyros—is it frees up space behind the panel. That makes the installation and upkeep easier.

GARMIN G5

When purchased as a pair, two Garmin G5 flight instruments (attitude indicator and electronic HSI) come with reversionary mode so if the G5 attitude display fails, the secondary G5 that's used for an EHSI reverts to attitude mode.

In the case of this Cessna, the idea is to remove the existing attitude indicator and the directional gyro and replace them with dual G5s. No metal-cutting required—the G5s will fit into the existing instrument cutouts. But because of the placement of the control column, the instruments will still be displaced to the left of the natural scan. Not the greatest.

The Garmin GNS 430W can connect directly to the G5 EHSI for displaying GPS course and VHF nav data, but the analog King KX155 nav cannot. That means the existing KI209 nav indicator needs to stay, making this a completely standalone system.

As for the autopilot interface, the G5 EHSI can connect with the S-TEC for heading and course command, but you have to buy the GAD 29B analog/digital converter unit. The package price for dual G5s, including the converter, is \$5324, not counting dealer discounts and not counting installation and removal of the vacuum system. Have your shop quote this

accurately, but out the door the project could approach \$9000.

ASPEN EVOLUTION E5

The model E5 is Aspen's sub-\$5000 EFIS and its STC also allows for removing the attitude indicator and the directional gyro. In this Cessna, the E5 slides into the existing AI and DG instrument holes without any cutting. The airspeed indicator, altimeter and turn coordinator (which drives the autopilot) need to stay.

But since the Aspen E5 only accommodates one GPS and one VHF nav input, the King KX155 has to remain as standalone and connected to the KI209 as it is now, and as it would be in a Garmin G5 interface.

Unless you install one, there's really no backup attitude data with this option should the E5 fail. Aspen said it got away with this simply because the unit doesn't have a TSO. We'd back it up with something, if it was our panel—maybe a Dynon D3 Pocket Panel—or a well-placed iPad with portable AHRS. The Appareo Stratus transponder in this airplane connects with the company's Stratus ADS-B In receiver as a semi-portable installation. That's a reasonable option for backup if you practice.

But to connect the autopilot, you need Aspen's optional (\$1000) ACU. Add that to the \$4995 E5 display—plus install labor—and the bottom-line price could be in the \$9000

ballpark. The Aspen requires an RSM (remote sensor module) on top of the aircraft. Like any magnetometer, done right that's a sizable effort.

WRAP IT UP

While you're getting proposals for these two sub-\$5000 EFIS options, it's worth having your shop price two others: Garmin's G3X Touch and Dynon's SkyView. Since space is limited in this panel, the only player is the 7-inch portrait G3X Touch installed in place of the mechanical AI and DG. The 7-inch G3X Touch is priced at \$7995, but the STC requires that it's connected to a Garmin G5 instrument for backup. Good idea, but that's another \$2249. Even with the G3X Touch you'll need the GAD autopilot adapter, plus the KX155 isn't compatible. I wouldn't expect to get out of this installation for under \$15,000. But compared to the other options you get SVX synthetic vision, Garmin's wireless Connex interface for tablet play with ForeFlight and Garmin Pilot and an option for displaying engine data.

There's also Dynon's 7-inch SkyView. With the backup D10A EFIS and major accessories it's \$7840, for an installed price that will flirt with roughly \$13,000, realistically.

My advice is to bring the airplane to three shops for comparable proposals on all before committing. While you're there, get a demo.



Beech Duke:

A pressurized cabin-class twin with timeless good looks and decent speed, but train for engine failures and save for real maintenance.

The Beech 60-series Duke is one of those airplanes that sometimes gets a bad reputation from folks who just don't understand it. Yes, it can be a real handful on the maintenance floor if the previous owner didn't give it the attention it demands. Yes, its turbocharged Lycoming TIO-541 engines are somewhat unusual and early variants had a short TBO, and even shorter in the hands of pilots who don't know how to treat them.

But the Dukes—especially later B60 models—can be good airplanes that serve serious owner-flown missions with a high level of styling, signature Beechcraft fit, finish and handling, plus decent performance. Still, like any high-end pressurized cabin-class piston twin, be prepared to write hefty checks when it comes to maintaining one, and bring your A-game when flying it.

HISTORY

With a 14-year production run, the Duke dates back to 1966 and generally competes with Piper's P-Navajo and of course the Cessna 414 and

421 pressurized twins. The Duke was advanced in its day thanks to manufacturing processes and materials, and that included skin bonding, honeycomb panels and chemical

The takeaway is to do your homework, buy a good Duke and stay away from the bargains.

milling, plus magnesium was used in the empennage. The landing gear is classic Beech, however, being essentially identical to the smaller Baron's.

Beech didn't change the Duke much over the years, although there were three models to include the straight 60 (sold in 1968 and 1969), the A60 (1970 to 1973) and the B60, introduced in late 1973 with airframe number 247. The fuel capacity was bumped up from 202 to 232 gallons in 1976. All told, 596 Dukes were built.

The model progression represents steady refinement, but the airplane's configuration remained basically unchanged. In 1971, the

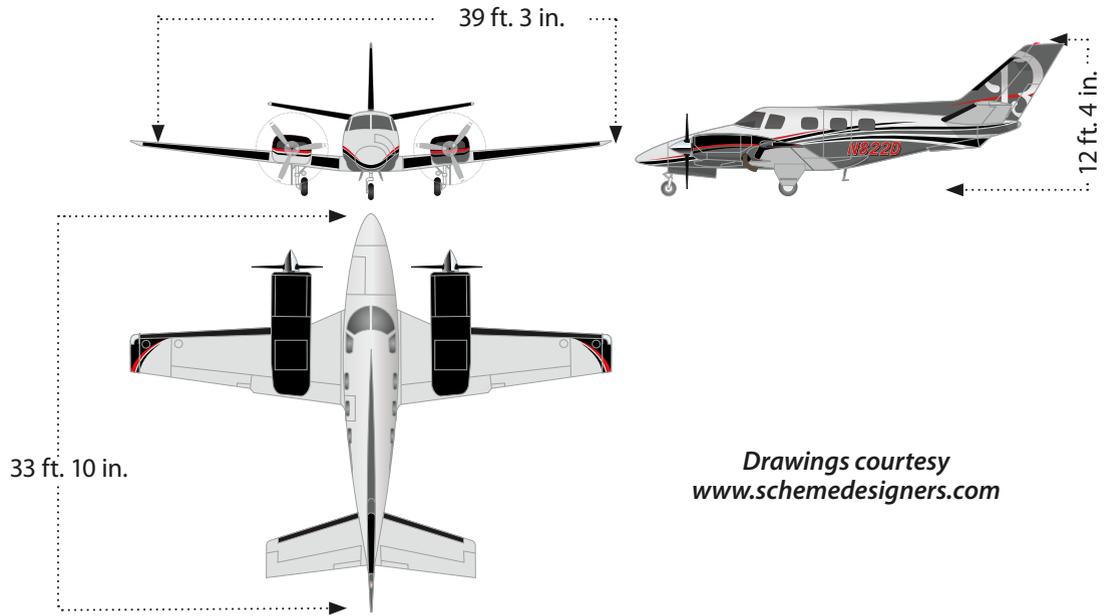
Model A60 was introduced with a modest increase in gross weight (up 50 pounds from 6725 to 6775), but useful load and performance dropped a bit. According to book figures, the straight 60 is a much better short-field performer than the A60. However, Duke owners tell us those early figures were extremely optimistic, and that the A60 is only slightly inferior in takeoff and landing performance to its predecessor.

One difference among the three models concerns the exhaust stacks. The original 60 had the shortest stacks, and suffered from flap corrosion due to the impingement of exhaust gases. The A60 had longer stacks, but corrosion was still a problem. The B60 has the longest.

All Dukes are powered by 380-

That's Dick Walen's well-cared-for 1977 B60 Duke in the lead photo. Aircraft Bluebook says the average retail is \$140,000, but ones like Walen's sell for more.

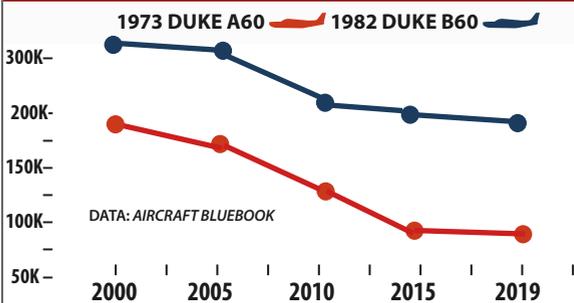
BEECH DUKE



SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL (GAL)	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1968-1969 DUKE 60	LYCOMING TIO-541-E1A4	1600	\$55,000	202	2200 LBS	246 KTS	±\$78,000
1970-1971 DUKE A60	LYCOMING TIO-541-E1A4	1600	\$55,000	202	2200 LBS	246 KTS	±\$89,000
1972-1973 DUKE A60	LYCOMING TIO-541-E1A4	1600	\$55,000	202	2200 LBS	246 KTS	±\$98,000
1974-1975 DUKE B60	LYCOMING TIO-541-E1A4	1600	\$55,000	202	2200 LBS	246 KTS	±\$107,000
1976-1977 DUKE B60	LYCOMING TIO-541-E1A4	1600	\$55,000	232	2000 LBS	246 KTS	±\$130,000
1978-1979 DUKE B60	LYCOMING TIO-541-E1A4	1600	\$55,000	232	2000 LBS	246 KTS	±\$165,000
1980-1981 DUKE B60	LYCOMING TIO-541-E1A4	1600	\$55,000	232	2000 LBS	246 KTS	±\$180,000
1982 DUKE B60	LYCOMING TIO-541-E1A4	1600	\$55,000	232	2000 LBS	246 KTS	±\$195,000

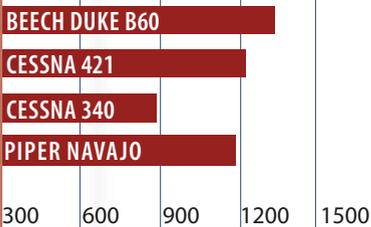
RESALE VALUES



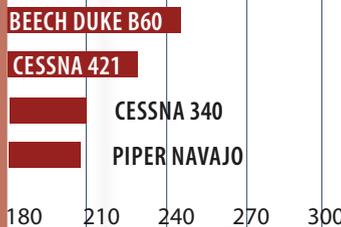
SELECT ADs

- AD 97-25-1** REPLACE OUTFLOW VALVES
- AD 95-22-3** KNOWN-ICING FLIGHT RESTRICTION
- AD 93-8-5** MODIFY AIR CONDITIONER
- AD 85-22-5** INSPECT WING ATTACH BOLTS
- AD 80-4-7** INSPECT WING OUTER ATTACH FITTINGS

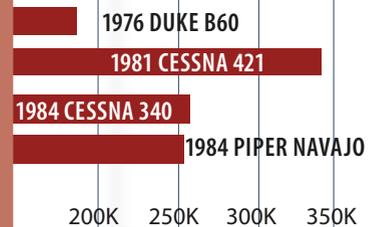
PAYLOAD/FULL FUEL



MAX CRUISE SPEED, KNOTS TRUE



PRICE COMPARISONS





There's lots of panel space in a Duke and owners take advantage of it. The one pictured at the top has Garmin GNS navigators, a Sandel EHSI and a full set of copilot instruments. The panel at the bottom has all-new Garmin glass and Electronics International engine monitors.



Duke owner told us he flight plans 52 gallons the first hour, 43 gallons for every hour thereafter and uses 68 percent power. In contrast, at 55 percent power, fuel consumption drops to

HP Lycoming TIO-541 engines. The slightly unusual powerplant has the turbocharger designed in as an integral component, rather than added on as an accessory. Early models installed on the 60 and A60 were maintenance headaches and had 1200-hour TBOs. But the engines have been upgraded over the years and now have a 1600-hour TBO; it's unlikely that many of the 1200-hour engines are still in service. Several Duke owners, in fact, tell us they've gone well past that figure by operating the engines properly and, in particular, ensuring that they are properly warmed up and cooled down to avoid shock cooling. It's advice worth taking, given the number of cylinder problems we've heard about.

PERFORMANCE

The Duke travels at a good clip but guzzles fuel. At 24,000 feet, max cruise is about 220 knots (250 MPH) at 65-70 percent power. Fuel consumption is about 40 GPH. One

about 30 GPH, but speed falls to about 185 knots.

The Duke edges out other pressurized twins in performance, with one exception, the pressurized Aerostars, which fly 10-15 knots faster on about 25 percent less fuel. Using high power settings for speed has a price, though: One owner called the cabin noise level "unbearable" at 75 percent power. Bring along your best ANR headsets, and consider modern interior upgrades.

Although the Duke's range is rather limited—its standard fuel tanks hold just 142 gallons—most have optional long-range fuel tanks that hold from 202 to 232 gallons, depending on the model. Top off the optional tanks and you can boost up the manifold pressure and make a four-hour, 900-NM trip with IFR reserves. At reduced power and full fuel, you can fly the Duke 1000 NM, which is average for its class.

The Duke wasn't designed for short runways. Most owners say

they won't even think about using anything with less than 3000 feet. One owner, though, says he regularly flies his Duke out of a 2650-foot runway in Pennsylvania.

This compels us to repeat an old but true story about how motorcycle daredevil Evel Knievel once ordered the pilot of his Duke to land on a drag strip. The Duke ended up with its snout through a truck trailer Knievel used as a dressing room. Another limitation of the Duke is that its initial climb on takeoff is rather lethargic until it reaches about 500 feet, according to some owners.

Climb performance is important for a pressurized airplane designed to cruise above 20,000 feet. Here, the Duke turns in respectable performance once it gets going. A climb to 24,000 feet, at full gross on a warm day, takes just 28 minutes, reports one corporate owner. Others say the airplane climbs 700 to 1000 FPM, depending on weight.

The addition of intercoolers improves climb performance and offers other benefits, though some say they think the benefits of intercoolers are dubious. At any rate, the Duke's climb performance (once it settles into the climb) is generally considered superior to any other owner-flown pressurized twin—except, again, for the pressurized Aerostars.

Single-engine performance is about average for this class of airplane. In other words, you'll be mumbling curses and prayers when an engine quits, even under ideal conditions. Expect a climb, at full gross weight and sea level, of 307 FPM (this assumes a perfectly running airplane flown with flawless technique).

Service ceiling with one dead

Passengers will like getting in and out of the Duke's cabin from the rear cabin door. Once inside, it's a corporate airplane experience with club seating and reasonably large windows.

engine is 15,100 feet. Some pilots say that intercoolers improve single-engine performance. The addition of vortex generators goes a long way toward improving single-engine performance. As always, we heartily recommend VGs on any twin. They're a simple mod that really works, in our opinion.

LOADING

As you might expect, the Duke is not a six-person airplane with full fuel, but it still beats anything in its class in terms of useful load and range. Late-model Dukes generally have a useful load of better than 2000 pounds, even when carrying full equipment. Earlier models, which tend to have less equipment and weigh several hundred pounds less, do even better: Some straight 60 and A60 models have useful loads approaching 2300 pounds. Such figures compare favorably with the cabin-class Cessna 421, which has seven seats to fill compared to the Duke's six.

One drawback is the Duke's healthy rate of fuel consumption, which translates into a smaller payload. Compared to other pressurized twins, the Duke uses a few hundred more pounds of fuel on a long trip. Still, the Duke shines in one respect: It can carry full fuel and two to four people. But there are variations in load-carrying capabilities.

One corporate owner of a lavishly equipped Duke reports that he makes three-hour, 600-mile trips with six people and 136 gallons of fuel. In contrast, a private owner, whose Duke has optional fuel tanks, says he's at gross with full fuel, 100 pounds of baggage and two people.

The Duke's single baggage compartment is located in the nose and can carry up to 500 pounds. According to one owner, this makes it easy to get the Duke out of its forward



CG limits but difficult to get out of its aft limits. Another says he finds the airplane's weight and balance characteristics benign—that is, hard to get out of CG in any manner.

COMFORT, HANDLING

Owners give the Duke decent marks for overall passenger comfort. Its cabin pressure differential is 4.7, so at 24,000 feet the Duke has a cabin altitude of 10,000 feet, which is superior to most six-seat pressurized twins. On the downside, the Duke is similar to Bonanzas and Barons in that it has a tapering cabin. Two adults in the back seats will travel elbow to elbow. In 1974, though, the B60 model's side panels and ducting were reworked to offer a bit more lateral cabin room. More recent models come with redesigned seats that increase the amount of aisle



space by a few inches.

If you're on the hefty side, it may be a tight squeeze entering the Duke's cockpit. As for the cockpit layout, it's user friendly: All the necessary controls, switches and avionics are within easy reach and view of the pilot, except for the circuit breakers. They're a far reach on

BEECH DUKE ACCIDENTS: ENGINES

After reviewing the 100 most recent Beech Model 60 accidents, we were impressed by the tiny number of runway loss of control (RLOC) accidents—three—puzzled by the number of fuel-related accidents—14—and concerned that the majority of accidents following an engine power loss involved a fatal loss of control.

The Beech Duke has, in our opinion, impeccable ground handling, as reflected by the miniscule number of RLOC accidents, but its single-engine handling requires pilots to bring their A-games. Unfortunately, our examination of accident reports reflected that a lot of pilots didn't give the airplane the respect it demands and several brought on an engine stoppage by failing to maintain their machines or buy fuel.

Of the 27 engine/mechanical accidents, lack of, or improper, maintenance accounted for over half. One owner put unapproved parts into both turbos, regularly subjected them to high turbine inlet temperatures and then had them both give up the ghost on the same flight.

When an engine does cease reciprocating, the Duke has the highest rudder force at Vmc, 150 pounds—the max allowed by the regs—of any piston twin. The high rate of loss of control accidents following engine stoppage causes us to strongly encourage owners to take regular recurrent training.

We also suggest carefully screening flight instructors. One fatal accident occurred because the instructor insisted on practicing stalls with a recovery technique involving differential power. The day before the fatal accident that technique caused the airplane to enter a spin, from which the new owner was able to recover. Not content, the next day's radar data indicate that the instructor did it to the owner again, at 1200 feet AGL.

Another CFI yanked a throttle to idle shortly after takeoff while the

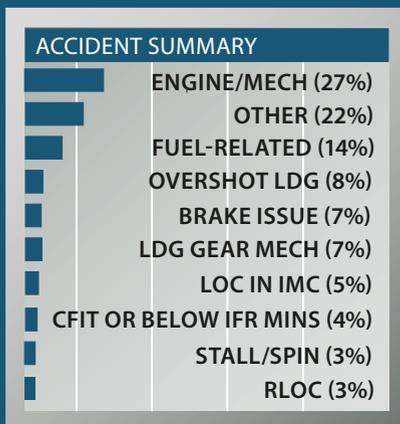
speed was below Vmc. The owner survived the crash. We can't help but wonder why he had lifted off below Vmc.

Lack of maintenance led to seven events in which the gear wouldn't extend as well as seven damaged airplanes because one or both brakes didn't work on rollout.

No one has ever accused the Duke of being a short-field airplane. Eight pilots went off the end of a runway, usually due to coming down final too hot and/or touching down well down the runway. Landing downwind wasn't the best decision one pilot ever made. He left skid marks from the displaced threshold to the end of the 2500-foot runway.

With both engines running, the Duke has a deserved reputation for excellent inflight handling. Only five pilots lost control in IMC, and it generally took thunderstorms to do it. One pilot lost it at FL270 in a boomer, recovered at 14,500 feet and landed with major structural damage. Another spun his iced-up Duke, recovered and landed, also with major structural damage.

We were stunned by the events starting with a shop removing a homemade autopilot system from a Duke during its annual. The owner then had work stopped before the shop could finish the annual, took the airplane to his hangar and reinstalled the autopilot. On the next takeoff the airplane rolled inverted at 50 feet and crashed.



the far right of the copilot's panel.

Cockpit visibility, though, is barely adequate. To see over the glareshield, a pilot of average height might be tempted to pull the seat forward; however, the seat will also automatically move up, which may put the pilot's head next to the headliner.

We like that the power controls and gear and flap levers have been placed in the standard order (they're reversed in earlier Barons). The flap system also is straightforward, with just three lever positions: up, approach and land. Maximum gear-extension speed is a phenomenal 175 knots. Also, dual control wheels are standard equipment, and the cowl flaps are electrically operated. A glance out the window will confirm whether they're working.

Owners report the ride will be comfortable and fairly quiet, except during climbs or power settings above 2500 RPM. While most concur that the cabin is noisy at cruise and takeoff power, one owner reports the rear cabin seats are about as quiet as a King Air's, but that the heater is inadequate in wintertime or at high altitudes, unless the cabin is filled with bodies.

In Beechcraft tradition, pilots compliment the Duke's handling characteristics. Its controls have a solid (some say heavy) yet responsive feel, which is not surprising, since the Duke is the heaviest of all six-passenger airplanes. One owner, praising the Duke as a rock-solid IFR platform, said, "ILS and LPV approaches are like a railroad track." Predictable and docile, the Duke trims up well and holds its airspeed, and pitch changes are minimal when the flaps or gear are extended.

One pilot, though, said the Duke's controls were too heavy for him, and that he prefers lighter and more responsive inputs. In turbulence, one pilot says the Duke is a "bear to fly" without a yaw damper, while another says adroit footwork can be substituted for a yaw damper.

FEEDING IT

It should be no surprise that pressurized twins with amenities such as air conditioning typically cost a small fortune to maintain, but the Duke seems to be in a class of its



We think it's a good idea to source and maintain a Duke from a place that knows the airplane well and sees a lot of them. As obvious by the photo here, Royal Air in Louisiana dedicates its entire maintenance operation to Dukes.

own. Over the years we've heard Duke owners complain about mechanics automatically jacking up their prices for a Duke because it's a Beechcraft at the top of the food chain.

While maintenance shops won't feel sorry for you when you roll up to the hangar in a Duke, most satisfied owners correctly point out that the key to keeping bills down, and ensuring that the Duke's engines reach TBO, is to properly operate and maintain the airplane. And woe to those who got a "good buy" on a used Duke that was not properly operated or maintained. It can be an expensive mistake.

To help reduce such costs, though, many owners stress that it's important to find a shop that is familiar with the Duke, rather than letting a mechanic who has never worked on the airplane learn at your expense.

The Duke Flyers Association, which was formed in 1988, can help in this area. On a brighter side, buyers will be glad to know that parts availability has not been a problem.

Don't even consider a pre-1976 Duke unless you're sure its 380-HP Lycoming TIO-541 engines have received the appropriate upkeep. A pair costs some \$110,000 to overhaul, which underscores the need

for prudence in this area. As for other engine problems, here are some major ones that we've identified through owner complaints and service reports over the years:

- **Cylinders and pistons.** Until 1974, the TBO of the TIO-541 was only 1200 hours, primarily because of cylinder woes, with cracking around the exhaust ports the major problem. Since then, engines built or overhauled with improved pistons and cylinders have had a TBO of 1600 hours. One factor in cylinder failures was improper pilot technique in warming up and cooling down the engines; if temperature changes were too abrupt, cylinder stress would result. (Incidentally, a check of SDRs revealed numerous cylinder problems.) Still, Dukes built in 1976 and later (serial number 804 and up) have the upgraded engines. They have a 1600-hour TBO, and owners report operating them for 1600 and even 2000 hours.

- **Turbochargers.** The 60, A60 and 1974 B60 models had cast-iron turbo housings that tended to crack from the heat. This was no small problem in flight, since a turbocharger failure in a pressurized airplane can lead to partial or total cabin depressurization. However, the cracking problems stopped in 1974, when stainless steel blowers

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That's a Royal Turbine Duke in the top photo, courtesy of Nick Dean, with BLR Aerospace winglets.

were fitted. By now, almost all cast-iron turbo housings have been replaced with the stainless steel ones; however, a few old ones remain, so be sure you're not getting one of them—especially when sourcing the airplane outside of the U.S. If you are, make sure you get a price reduction.

During a demonstration ride, be sure to check for manifold pressure drift. Mixture control cables also have had their share of problems. Be sure to see that you're getting the upgraded versions, since replacing mixture control cables costs several thousand dollars.

- **Crankcases.** Through 1977, Dukes had a high incidence of crankcase cracks (which goes to show, at least, that Continental isn't the only company to have crankcase cracking problems). The Duke's crankcases were beefed up in 1988,

starting with engine serial number 78.

OTHER SERVICE ITEMS

Dukes came with jet-style nickel cadmium (nicad) batteries. You'd think that this would give a high degree of dependability and wear. But the battery is improperly cooled, and it can be destroyed by a slight improper adjustment of the voltage

regulator. Average life is just two years or less. That may seem like a decent enough battery life, but not when the battery costs thousands. Fortunately, later model Dukes have lead-acid batteries. Beech has stopped offering lead-acid conversion kits, but you could probably have a Beech dealer install one. Our suggestion is that you try and buy a Duke with lead-acid batteries.

The Duke's heated windshield drew various complaints: delamination and static discharges that pitted the plastic. We've heard of delamination problems on earlier Dukes but not later models. Some speculate that St. Elmo's fire might be caused by not having the static discharge lines attached to the ailerons. (Incidentally, we didn't find any SDRs pertaining to windshields.)

Other reports point to various problems with the exhaust. The Model 60, in particular, had short exhaust stacks that lead to flap corrosion. The condition of the exhaust pipes also should be checked at the rear by the slip joints; they came off

and triggered a fire in one case.

Various magneto, landing gear, drive train and wheel problems also were mentioned in SDRs and owners' reports, so make sure these items receive a thorough going over on a prepurchase inspection. After receiving two reports of partial outboard elevator separations in Dukes, Beech issued mandatory service bulletins in 1989 to check the airplanes' horizontal stabilizers and elevator hinge attachment areas. The bulletin affects certain Duke 60, A60 and B60 series models. Beech said an inspection should take two techs 12 hours to perform. Inspections were to be performed as soon as possible, but no later than the next 50 hours.

The Duke is subject to relatively few ADs, considering the complexity of the aircraft. The various spar cracking ADs that have affected Bonanzas and Barons in recent years don't apply to the Duke, fortunately. Aside from various shotgun ADs, the only really important ones in the past 20-odd years have been 85-22-5, which dealt with Inconel bolts in the wing attach fittings, and 80-4-7, which called for inspections of the wing outer attach fittings.

MAJOR MODS

When searching the market you'll find the Rocket Engineering Royal Turbine mod, which is a B60 converted with two PT6A-35 engines rated at 525 HP each. Max cruise is 290 knots at FL270. With a 45-minute reserve up high, range is about 1000 miles and endurance about 3.5 hours. Gross weight is 7050 pounds, max landing weight is 6775 pounds and the published empty weight is 4650 pounds. With a total of 260 gallons aboard, 658 pounds can be carried in the cabin. While a well-cared-for late-model piston Duke with low-time engines might sell for \$250,000, we spotted a couple of turbine Dukes in the \$700,000 range. There aren't many conversions out there—under 25 as far as we know.

There are plenty (207) of "Grand Dukes" modded with BLR Aerospace (www.blraerospace.com) winglets and over 160 with aft body strakes. The company also has a VG kit—a popular mod for the Duke. The winglets are compatible with

aircraft serial numbers P-247 and on. The early 60 and A60 models have different tips that aren't compatible.

The VG kit is \$3950 and install time is eight hours. Aft body strakes are \$5750 and take 16 hours (plus paint work) to install. The winglets are \$17,950, plus 30 hours of installation for dry tips and 40 hours for wet tips. BLR's Nick Dean said all Dukes up to serial number P-364 were 202-gallon aircraft; P-365 and on are all 232-gallon Dukes, although you will find a few earlier ones that were either retrofitted with the later Beech wet tips or that have an STC that BLR did for wet tips. The company made 30 ship sets of these back in the 1990s and sold all of them.

A Grand Duke fully modded has lower stall speeds—78 knots compared to 82 knots on a stock airplane in the clean configuration, and 70 knots compared to 76 knots on a stock airplane in the dirty configuration. The short-field approach speed is drastically lowered to 77 knots with a BLR-modded Duke, compared to 99 knots for a stock airplane, according to the BLR. You'll see better climb, too, when equipped—nearly 350 FPM better when both engines are making best power. The new gross takeoff weight of a fully equipped Grand Duke is 7000 pounds, compared to 6775 on a stock airplane.

To help with slam-dunk descents while still being kind to those finicky Lycoming engines, PowerPac Spoilers (www.powerpacspoilers.com) offers aftermarket "jet type" hydraulic spoiler kits for the Duke. The kit is \$7495 and the idea is to deploy them at any speed (up to Vne) for rapid descent rates without the need to pull the power off.

PRO FEEDBACK

The Duke is not only the sexiest plane on the ramp, it is also a true thoroughbred. The airframe is as solid and sturdy as they come and the engines can be remarkably reliable if operated and cared for properly. After 20 years of working on nothing but Dukes, it's rare to see engines removed at TBO. The norm for us and the industry is more like 1900 to 2000 hours, and they are usually still running strong. If not



for a self-inflicted lifter issue that has been solved by an aftermarket carbide lifter STC, this engine is bulletproof. I once ran across a Duke owner who had 3200 hours on his engines and was still running them. As for the airframe, one of our customers lost control at 28,000 feet in his turbine Duke. ATC had him clocked in a 6000 FPM descent and he managed to recover from a spin at 10,000 feet and landed the plane. It was bent, but intact. The FAA told him if he had been in anything but a Beechcraft he would be dead. The owner repaired the plane and it is still flying today.

After buying my first Duke in 2000 and getting involved with the Duke Flyers Association (www.dukeflyers.org, 419-755-1223 or 419-529-3822), I quickly learned that the largest disparity to Duke ownership is the ability to find a qualified shop to maintain it. So in 2001 Royal Air started an aircraft maintenance operation that centered around Duke maintenance to provide maintenance for our Part 135 charter operation. A few years later we opened our doors to the public. After many years and many annuals the typical cost to annual a Duke that is flown regularly at our shop runs between \$6000 and \$12,000. When we are not performing annuals for others we will take an airframe and refurbish it to like-new condition.

The Duke is the ultimate pilot's aircraft. Upgrading to a Duke is like trading in your Buick for a Porsche. It has a solid feel, but is also nimble

With a sleek pointy snout, there's plenty of ramp appeal that tags along with the Duke.

and maneuverable with excellent slow-flight characteristics. With the Boundary Layer VG kit, the VMC is reduced to essentially the stall speed, dramatically increasing safety margins during engine-out scenarios, or to aid in getting in and out of short fields. Yes—I said it—in and out of short fields. The biggest myth I hear is that the Duke is a runway hog.

I have known people over the years who have flown their Dukes in and out of fields as short as 2500 feet. My first instructor, and Duke expert, was a man named Dale Lockhart. Dale knew the Duke backward and forward and he provided training for all our pilots for many years. After listening to runway hog accusations by new recruits, Dale would bet them lunch that he could demonstrate a 500-foot takeoff and landing. He never lost that bet.

If one gets proper training and has a capable shop to service the plane I can just about guarantee a pleasurable experience owning and flying a Duke. Many of our customers are longtime owners, and 15 to 30 years is not uncommon. These owners will tell a completely different story from the one passed around mostly by people who have never owned a Duke.

As I learned more and more about this aircraft a disparity emerged. My initial reaction after buying my

Beech Duke

(continued from page 31)

first Duke was that it was the best-kept secret in aviation. Much of the public's perception was quite different. It was important for me to understand why and do my part to rectify this. I learned everything I could about this aircraft. To me it is a superbly engineered and constructed airplane that pushes the boundaries of performance, safety and comfort. It is, after all, a Beechcraft. The Duke was spawned from 1960s technology and as of today there has not been another production piston twin that can do what the Duke does well. So, after buying or selling over 60 of these planes and listening to hundreds of prospective customers I feel I can at least talk intelligently about some of the sources of the disparity.

I know of hundreds of longtime Duke owners who will tell you wonderful things about their experiences (if asked). Unfortunately there are quite a number of unhappy Duke owners who gladly tell anyone and everyone who will listen about their negative experiences.

The tragedy comes in when you understand that it is not the aircraft's fault so much as it is pilot error, in that a good aircraft becomes a bad aircraft when it is neglected, mistreated or owned by someone who really can't afford the plane. Eventually this becomes a problem aircraft only to get sold under market price to someone who did not know what he was getting into. As a result, this problem Duke keeps getting passed around

from person to person with stories abounding from the bad experiences.

I liken the Duke to a vintage Porsche. To fly one is like trading in your Buick for a sporty hot rod. A vintage Porsche should be maintained by a seasoned Porsche mechanic, but is truly a joy to own and drive if it is within your budget. A problem Porsche offered at an attractive price does no service to the unsuspecting buyer who always wanted to own one but never thought he could afford to buy one. The takeaway is to do your homework, buy a good Duke and steer clear of the "bargains." The Duke Flyers Association is a great resource to anyone looking to learn more about this aircraft.

I have heard many nightmare stories, but I have also owned and flown one specific Duke for 15 years. It was literally one of the most reliable Dukes I have ever owned. I attribute this to buying a good one and flying the plane regularly and correctly. We have many customers who will tell a similar story about their experiences. The typical Duke flies an average of only 40 hours per year (that's an average of once per month). That makes it hard to keep "sit-itis" from taking its toll. The planes that we see that are in the best shape are the ones that are flown regularly and log more than 150 hours per year.

Beechcraft chose to make Duke tails out of magnesium to save weight. Over the years it has become obvious that aluminum would have been a better choice. If not treated correctly by the paint shop, filiform corrosion will start, in time requiring

DIAMOND DA40



It's time to take a look at the used Diamond DA40 market for the *Aviation Consumer* Used Aircraft Guide. We want to know what it's like to own these composite singles, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your Diamond 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 Diamond by December 10, 2019, to:

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an eventual repaint of the tail. On average, we see from five to 15 years for this corrosion to germinate and surface. It is a slow-moving corrosion and would only render the tail unrepairable if allowed to expand untreated for many years.

Throughout my flying career I have flown several Beech products up to and including the King Air 200, which is an excellent choice if your budget permits. But after years of flying both the King Air and the Duke I can still say without any doubt that nothing can touch the Duke dollar-for-dollar or pound-for-pound in the overall value of what you get for your money. That's why I fly Dukes. You can contact us at www.royalairinc.com for advice about owning this awesome aircraft.

Glenn Adams
via email