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VOLUME 23 NUMBER 12

Garmin Autoland

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Twin & Turbine (ISSN 1945-6514), USPS 24432 is published monthly by Village Press, Inc. with advertising offices located at 2779 Aero Park Drive, Traverse City, Michigan 49686. Telephone (231) 946-3712. Printed in the United States of America. Periodical Postage Paid at Traverse City, MI.

SUBSCRIPTIONS: *Twin & Turbine* is distributed at no charge to all registered owners of cabin-class aircraft. The mailing list is updated monthly. All others may subscribe by writing to: *Twin & Turbine,* P.O. Box 968, Traverse City, MI 49685, or by calling 1-800-447-7367. Rates for the United States and its possessions follow: one year $15.00; two years $29.00. Canadian subscriptions are one year $24.00; two years $46.00, including GST tax. Overseas subscriptions are one year $52.00; two years $99.00, U.S. funds. Single copies $6.50.

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POSTMASTER: Send address changes and inquiries to Twin & Turbine, Village Press, Inc., P.O. Box 968, Traverse City, MI 49685.

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DECEMBER2019 • **VOL. 23, NO. 12**

COVER PHOTO:
Garmin Autoland/Piper M600 SLS
Photo Courtesy of Piper Aircraft

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Editor's Briefing

by **Rebecca Groom Jacobs**

In Honor of Dr. Dan

It has been difficult for me to sit down and write this month's briefing, as I know typing these words will ultimately make everything more real. But I feel compelled to share a reality my husband and I recently experienced in the hope it will impact our readers in a positive way.

This past October, surgeon, pilot, and our friend, Dr. Daniel Greenwald crashed and perished in a Piper Aerostar shortly after takeoff in Kokomo, Indiana. He was the sole occupant on board. The suspected cause of the crash? Misfueling. The piston-powered Aerostar was mistakenly filled with Jet A.

My husband Jared and I met Dan nearly a year ago when we traveled to Tampa upon his invitation to provide Jared (a professional pilot) with a lesson in upset recovery and aerobatics. Though a full-time surgeon, Dan was also an active Unlimited Aerobatic Flight Instructor and former FAA Designated Pilot Examiner, with more than 10,000 hours of flight time. He provided instruction through his business Angle of Attack Experience using his personal L-39 Albatros and Extra 330.

Dan's passion and knowledge for flying was absolutely undeniable, and we had a blast spending an entire day among him and his local aviation community. The trip ultimately led to three Twin & Turbine articles, including the February cover story (L-39 Albatros) and a two-part series written by Jared on his flying experience (June and September issue). It was clear when we departed Tampa that we had made a new friend, and we continued to stay in touch with Dan over the following months.

Jared Jacobs and Dr. Dan Greenwald.

The news of Dan's accident and the supposed cause remains shocking. It is a first for Jared and me to lose someone we know to an aircraft accident, and it's amazing the effect it has had on us despite only knowing Dan for a short period. It feels especially unfair that someone with such admirable aviation experience and flying skills lost his life to a preventable mistake. Since this tragedy, I've spent some time digging into and researching misfuelings, an issue that has been battled for decades.

Over the years, the industry has taken various steps to confront the problem including airworthiness directives to restrict the tank port size, producing color-coded decals to place next to the fuel ports, releasing service bulletins and offering free fuel-tank port restrictors. The National Air Transportation Association (NATA) has also made eliminating misfueling accidents a top priority and urges all FBOs to access NATA's free Misfueling Prevention Program *(www.preventmisfueling.com)*. The site offers beneficial information and resources for line service professionals, customer service representatives, FBO managers and pilots.

If I can suggest a call to action – talk to your local FBOs and airport managers. See what their training protocol is to promote a safety-focused culture. One example of a safety-forward culture is Banyan Air Services out of Ft Lauderdale Executive in Florida. They have a list of 30 simple safety reminders – they send one daily to all line service and CSR staff, which they review as a team. Simple things, like "Do not step over it, pick it up," and "If you do not remember how to do a task, stop and ask for help." But as we've seen, simple things gone wrong can go terribly wrong. We'll be sharing their safety reminders on our website where the December issue can be found. Share the link or print it out for your airfield.

While it certainly would have been easier to address another, more positive topic this month, I felt pulled to write these words. Hopefully, shining light on one tragedy can prevent others – and I feel Dan, who dedicated his life to serving others, would encourage the effort.

I will now turn it over to Jared, who was fortunate to share a cockpit with Dr. Dan. He wishes to add some words of remembrance as well.

I guess you could say that I was one of the lucky ones. After 11 years as an active member of the aviation community, I had never lost a friend to an aviation-related accident. Sadly, that changed recently when I learned of the passing of Dr. Daniel Greenwald. The shocking loss came only a month after the conclusion of a two-part story I wrote regarding my training with Dan last January.

Dan, an accomplished aerobatic pilot (among many other things), shared with me his love for aviation, specifically for teaching people how to safely explore the edges of the flight envelope. In a single day,

through oral lessons and hands-on experiences, I learned more about aerodynamics than in any other training event before. Dan had a spark in him when it came to teaching these topics. He had a way of enthusiastically explaining his lessons, questioning for retention, and then expanding the topic to connect with others. His depth of knowledge, much like his skills in acrobatic flying, seemed to know no limits.

Dan's zeal was infectious, so it is no surprise that his influence spread to many like-minded individuals in the Tampa Bay and Lakeland area. So proud of his aviation community, he even generously organized a BBQ for Rebecca and me at the Lakeland airport during our visit. While there, I heard stories from multiple pilots how Dan was the source of their aviation bug, or about the hours of instruction he provided, or the unforgettable trips they had been on together. I know that Dan's aviation legacy will live on through this tightknit network of friends. And after becoming fast friends with Dan myself, I too have stories that I will be telling of my time with him for the rest of my life.

I started this segment by saying I was one of the lucky to have never lost a friend in an aviation accident. Though I can no longer say those words, I can say that I was one of the lucky ones to have been friends with Dr. Daniel Greenwald.

Blue skies and tailwinds, Dr. Dan. You are missed. T&T

A Calling to Make Aviation Safer

A conversation with Garmin's Phil Straub

On Oct. 30, 2019, Garmin stunned the aviation industry with the announcement of Autoland, an autonomous technology that lands an aircraft without any human intervention. The revelation may result in a major reset in the expected standard for safety equipment in future general aviation aircraft.

In late August, prior to the public announcement, I sat down with Phil Straub, Garmin's executive vice president and managing director of aviation, to discuss how the technology came about and why this may be the most important development the company has ever brought to market.

T&T: Why was this such an important project for Garmin to undertake?

Straub: It became a calling for us. When you hear about those accidents where the airplane is perfectly operational, but the pilot is possibly incapacitated, it is such a helpless feeling. There have been a couple in the last few years and those sealed the deal for me. We can make a difference here, and I view it as our obligation to make a difference.

T&T: What was the certification process like considering how many areas of flight operations that Autoland touches?

Straub: This isn't just about certifying a single airplane. Autoland crosses over into the flight standards side through the human factors aspects and air traffic control side because we are broadcasting in the blind and squawking an emergency code. Thus, we were coordinating three branches of the FAA. It was a big certification undertaking and required monumental coordination. In addition, the Boeing 737 Max issue has taken up FAA resources, and that has a trickle-down effect to the rest of the industry.

T&T: It's easy for companies that dominate a specific market to become complacent and cease to innovate. What is Garmin's long-term strategy to push the technology envelope and stay out in front?

Straub: The story I like to tell is that Gary Burrell and Min Kao (Garmin's founders) saw an opportunity, which led them to found the company back in 1989. Although they had a few

GPS panel-mount products developed, the Bendix/King KLN90 was still the dominant product at the time. It wasn't until the GNS430 came along that Garmin really competed and began to make inroads.

For me it's a matter of keeping that culture and remember why we exist. I think the best example is to look at the homebuilt/amateur market. While it takes a lot of resources to serve that market, they buy our product, put their trust and faith in us, and are entitled to great service. If we don't serve them well, we give others the opportunity to serve a need where we are not. We never want to take our success for granted.

But on the flipside, we are a small player in the overall aerospace market. So, we have to be very scrappy and innovative, and never let the foot off the gas.

T&T: Where does Autoland technology go from here?

Straub: It needs to go in smaller airplanes, but it also needs to go in bigger airplanes. When you think about the building blocks that allows this to happen – the autopilot, autothrottle, navigation, communications – these are in most airplanes, or they can be in most airplanes. With the right hardware, there is nothing preventing it to being applied in a smaller aircraft.

But I still maintain that when I get on an airliner, I think I have the right to have an airplane equipped with this technology. We are not talking a Category III Autoland system. But in emergency scenarios, this system could be available and activated. We are seeing some interest among larger-cabin Part 25 OEMs.

T&T: Will the industry continue to see investment in new safety products from Garmin?

Straub: We are committed to developing advanced technologies and we can make a difference here. We hold the bar very high and we recognize that we have a responsibility to bring these types of technologies to the market that protect the lives of our customers, our children, family and friends. Autoland started as a vision many years ago and as it developed, we kept pushing to make it better – not to just save the lives of the people inside the airplane, but to preserve the airplane itself. That's the kind of place that makes you excited to come to work every day. T&T

Dianne White *is the executive director of MMOPA and editor of MMOPA Magazine. For a total of 14 years, she was editor of Twin & Turbine and has worked in the business aviation industry for nearly 30 years. She also serves on the board of directors for Angel Flight Central. An active multi-engine, instrument-rated pilot, Dianne lives in the Kansas City area and can be reached at* **editor@diannewhite.com.**

Top Turboprop Series

Pre-Owned Meridian and JetPROP

by **Joe Casey**

PHOTO COURTESY OF MACH POINT ONE AVIATION

Which is better, the JetPROP or the Piper Meridian? As an active instructor in the PA46 world, this proves to be one of the most debatable topics and one of the questions I hear most often.

I'll first relate that they are singularly outstanding airplanes, and I really appreciate attributes in both. But there are also key differences, and a prudent buyer should be aware of those differences before making a purchase.

The Similarities

Let's review the similarities first. Both airplanes offer the same size cabin, cruise at about 260 KTAS, achieve a range of around 750 nm, and climb to FL270 from a sea-level airport in about 20 minutes. Both have a "bulletproof" engine and see a similar acquisition cost for an equivalently equipped model. They are special airplanes well-matched for the owner who wants turbine reliability and power, pressurization and a great platform for true IFR flying. The differences between the two airplanes center around three things: engine, baggage space and operational costs.

The Differences

The JetPROP was introduced in the late 1990s and was a huge hit from the beginning. It is a Supplemental Type Certificate (STC) that is applied to a piston PA46 (usually a Mirage). The piston engine is removed, along with nearly everything firewall-forward, and a Pratt & Whitney Canada PT6 is installed (usually a PT6-35). The result is a phenomenal increase in climb rate and speed. Where the Mirage can have trouble climbing at 600 fpm (depending upon the density altitude and weight), the JetPROP can climb around 1,800 fpm, sometimes more. The average Mirage cruise speed is usually about 200 KTAS, but the JetPROP cruise can reach 260 KTAS easily. The marketplace took notice of the stellar performance of the JetPROP, and there are now more than 330 JetPROP conversions. It is easily one of the most trusted and popular conversions in the market.

When the JetPROP was introduced, Piper Aircraft also took notice. They were already eying the potential of a turbine PA46, but when the JetPROP released, Piper really amped up the research and development to create the Meridian. The Meridian has since evolved into a fabulous platform for the owner-pilot who wants a from-the-factory airplane.

Comparing the Systems

Since the JetPROP is a conversion, some systems heavily depend upon the systems that were original in the piston PA46 – systems that can sometimes be complex and require a pilot who is knowledgeable of their intricacies. For instance, the JetPROP has a complex fuel system that requires the pilot to change the fuel lever to level the fuel from right

to left. Also, the heating system has four separate heat controls and the intake system has an ice door that must be managed. The systems are not hard to operate once trained, but they cannot be mismanaged or trouble awaits.

With the Meridian, Piper wanted to make a turbine that is easy for the pilot to manage, with systems requiring little or no management at all. As a comparison, the Meridian fuel system is ridiculously simple and requires no pilot input for the whole flight. There is no ice door to manage, and the cabin heating is a rheostat that simply requires turning to adjust the temperature. I'd attest that Piper did a great job of reviewing every system to make operations as pilot-friendly and straightforward as possible.

I also think the Meridian offers better safety systems as compared to the JetPROP. The wing deice boots are much larger and more effective, the cabin altitude warning system is far more robust, and there's not a prop lever to manage.

Other Considerations

But while simplicity and safety abound in the Meridian, it comes at a cost. Because there is no ice door, effectively the ice protection is always "ON." So, the Meridian burns more fuel in climb and cruise. It even burns more fuel just sitting on the ground idling. A Meridian will burn more than 20 gph just sitting at idle on the ground. It has a bigger engine and bigger costs more.

The PT6-42A bolted on the Meridian is what I call the "big block" PT6. In fact, the -42A engine is the smallest of the big-block PT6s, and the -35 is the biggest of the small block PT6s. The -35 actually produces more power (560 hp) than the -42A (500 hp), but the -42A will produce 500 horsepower up to a higher altitude, and the JetPROP loses power as altitude is increased. This translates to an engine that is never ITT limited at altitude, so the pilot need only manage the torque as a climb progresses. In the JetPROP, the pilot will manage both torque and ITT as the climb progresses.

To me, one of the biggest advantages of the JetPROP is the nose baggage compartment. The Mirage has a nice baggage area that remains in a JetPROP, whereas the Meridian offers no nose baggage area at all. I normally don't put very much in the nose baggage, but it is nice to have

a place to put smaller items that may be less-than-comfortable to put into the cabin such as fuel strainers, rags to check oil and various cleaners.

The Decision

So, which P46T should you purchase? There are two distinct buyers for each. First, if you are a from-the-factory kind of pilot, preferring an airplane not modified by a large STC, then the Meridian is for you. But, if you are driven by efficiency and don't mind an STC-airplane, then the JetPROP is a consideration. JetPROP owners tend to be pilots who revel in having the most efficient airplane. A -35 JetPROP will cruise with a fuel burn of about 32 gph, while a Meridian is going to burn 39 gph for the same speed.

Answer this question: Would you rather own a showroom-condition, numbers-correct, low-mileage, stunning 1963 Corvette Stingray Split-Window Coupe; or a brand-new, decked-out, gorgeous 2020 Corvette? Both will cost you about the same to buy in like-new condition, but they will drive completely different. The 1963 Corvette will have a small block V8, standard-shift transmission, timeless good looks and it'll probably appreciate as the years progress. Whereas, the 2020 Corvette will have the best-of-the-best electronics, incredible creature comforts, automatic transmission and the biggest engine Chevy could find.

If you are leaning toward the 1963 Corvette, then chances are you would want a JetPROP. You'll say that changing fuel tanks, turning the ice door on and off and pushing buttons to adjust the heat is no problem for the acquisition and fuel to be gained. Driving a standard transmission is not harder than an automatic transmission once you know what you are doing. Plus, the standard gives the driver driving options, right?

Or, if you like the sounds of the 2020 Corvette then you are probably a Meridian buyer. To know you have improved safety gadgets, advanced avionics and a newer airplane that is likely to have smaller maintenance costs trumps any efficiency issues that may arise in your mind.

The cool part to me is that I like both a 1963 and a 2020 Corvette. And I like both the JetPROP and the Meridian. Piper has sold nearly 600 Meridian/M500 airframes, so they've clearly got a good product. And the JetPROP continues to sell strongly with JetPROP owners as some of the most fanatical about their steeds, often owning their airplane for decades, not years.

Whichever you choose, you cannot go wrong. They are both fabulous platforms and great cross-country performers. I'm excited every time I get the chance to fly one, and I fly one or both nearly every day. The P46T, whether a JetPROP or a Meridian, is simply a great airplane. T&T

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Garmin Autoland

An inside look at general aviation's latest revolutionary, break-through safety technology

by **Dianne White**

PHOTOS COURTESY OF PIPER AIRCRAFT/GARMIN

It's the scenario no pilot wants to imagine: A medical emergency that renders him or her incapacitated, leaving passengers helpless, panicked and facing an unthinkable outcome. But Garmin has changed the calculus on such an event. With its revolutionary Autoland system, the aircraft will navigate to the closest, suitable airport, select the most appropriate runway in regard to winds and weather, and safely land and stop the aircraft on the runway. This happens with a simple push of a prominent red button on the flight deck.

Publicly announced in late October, Autoland is scheduled to first be certified on the Piper M600SLS, Piper's flagship single-engine turboprop, by the end of the year. It is also scheduled to be certified on the Cirrus SF50 Vision Jet by yearend.

Autoland in Action

In August, Garmin invited me to test out the Autoland feature at its flight test headquarters at New Century Air Center (KIXD) onboard its M600 testbed. After a thorough brief and review of the system, we climbed aboard the M600 for a demo flight. With flight test pilot Erik Sargent in the left seat, I settled into the right seat, putting myself in the position of a passenger.

After departing Runway 18, we climbed northwest of the airport to an altitude of 4,000 feet. With the aircraft on autopilot, Sargent invited me to lift the clear plastic guard and activate the Autoland button. Immediately the familiar G3000 displays were replaced with clear communications that "Autoland is Active." At the same time, the airplane had activated the GPS LNAV approach for Runway 18 and made a 180-degree toward KEZNU, the final approach fix. The autothrottles slowed the aircraft as it descended, and as the aircraft turned onto the final approach course, the gear and approach flaps extended and the aircraft settled into a stabilized, 110-kt descent to the runway. Meanwhile, the displays and aural instructions provided continual updates and guidance on ensuring seatbelts are buckled and loose items are stowed. On the final approach segment, the MFD displayed the message, "Approaching Destination Airport. Prepare to Land."

This is where things get interesting, especially for a pilot accustomed to disconnecting the autopilot at decision height or on short final. Sargent assured me that it wouldn't be necessary today. As we crossed the threshold, the autothrottles retarded power and the plane gently began to pitch up for the flare. Touching down firmly on the mains, the aircraft tracked perfectly down the runway as it brought the nose down and braked aggressively. Once at a complete stop, Autoland normally would initiate engine shutdown, but on this demo, it was prevented from performing that function.

Although it landed slightly left the painted centerline, just as other aviation journalists have reported, the airplane was dead center on the synthetic vision GPS waypoint. (The paint stripes are not perfectly aligned with the GPS runway center point).

Throughout the demo, the automated announcements provided reassuring updates of the aircraft's progress toward its destination and even provided helpful pre- and post-landing instructions.

"Well, what do you think?" Sargent asked.

I could only conjure up one word: "Amazing."

Deep-Dive into Development Background

Garmin first began imagining an Autoland system in the early 2000s and began working on it in earnest in 2010 using a Columbia single-engine aircraft as its test platform. The goal at first was to simply get the aircraft on the ground to save the lives of those onboard. As development continued, the goal changed to not only save lives but to preserve the integrity of the aircraft itself.

Development was divided between three main groups within the company: the flight controls group, which was responsible for autothrottle, auto-braking, auto-steering and other mechanical automation aspects; the display software team, which developed the algorithms for the system's decision-making, routing and the most difficult part: the landing; and finally, the certification arm of Garmin worked in concert with Piper and Cirrus to make the entire system on the M600 and Vision Jet a certified reality.

On the Columbia, Garmin further refined its 3-axis autopilot, then delved into developing an

autothrottle by developing a servo that could manipulate the throttle to control speed.

"From an autopilot perspective, we spent a lot of time on the basics of the 200 feet down to the runway surface: the flare, the low-speed ground effect, the landing. Then we tackled the last piece, which was the ground control, the aircraft's braking and steering," said Ben Patel, the team leader for Garmin's flight controls group.

To test and perfect the landing sequence, engineers modified the aircraft's airport database by devising a series of virtual runways at 5,000 feet above the Kansas eastern plains. Then they "landed" the aircraft hundreds of times on those simulated runways.

"It's similar to how a ski jumper will practice landing in a pool before actually landing on the actual ski slope. We landed at these virtual airports so we could practice the flare maneuvers and make sure the algorithms worked in different crosswind conditions," Patel added.

At first Garmin tried using GPS alone as its guidance source for the short-final to landing sequence. The results were mixed depending on how good the GPS signal was that day. Although Garmin believed the algorithms worked reliably to account for the GPS error, engineers knew it could be further perfected with the addition of radar altimeter, so that instrument was integrated. In February 2016, Garmin successfully completed its first real runway landing at KIXD. By the spring of 2019, Garmin had completed 800 flights and many, many more landings in the Piper M600SLS.

How Autoland Chooses Its Destination

On the software side, Garmin's engineers worked on figuring out how to take all the discreet decisions a pilot makes and create a system of prioritization for different combinations of circumstances and conditions. For example, the algorithm considers and then assigns a weight to a whole host of criteria, such as

Always on Watch: Autoland Keeps Tabs on Itself

Garmin not only imagined all that the Autoland can do, it was mindful of what it can and can't do if part of the system is inoperable.

When the pilot powers up G3000 for a flight, the system runs through a normal avionics pre-flight test in which the Autoland components are checked. If an anomaly or failure is detected, a CAS message is posted to inform the pilot. If Autoland or one of the components that it uses is detected to be nonfunctional, the pilot would then have the choice of whether to dispatch on that flight with all or part of Autoland inoperative. If Autoland itself is flagged during the pre-flight test, it's important to note that the autopilot will continue to function even if Autoland is inoperative.

Where Garmin could partition the functionality and isolate components, such as a brake servo or radar altimeter, they have done so. Thus, if a brake servo fails the self-test, it won't completely disable the entire Autoland system. However, there are a few essential components that Autoland must have, such as the autothrottle and the pitch servo.

In flight, Autoland is constantly monitoring the health of all its key components required for its function. In the improbable event that the radar altimeter or a brake servo were to fail inflight while Autoland is activated, Autoland will continue with the landing with the capabilities it still has. In this example, it will use GPS for altitude sensing or land without activating brakes.

"We've made the system so flexible for OEMs that we haven't even begun to use all ways it might be configured. While it is fully autonomous, but it could potentially be configured to have a passenger intervene or perform a task if necessary. For example, the system could provide step-by-step instructions to the passenger, even show a picture that says, 'move this knob or lever and make it look like this'," said Bailey Scheel, Garmin's senior programs manager and systems engineer. "That might be a feature made available in a smaller aircraft installation that has less functionality or automation, but still get the benefit out of the technology."

An example of Autoland's vast configurability is seen in the Piper M600SLS Halo that incorporates Autoland. If a passenger's hands or feet touch the controls while Autoland is active and the system senses the controls being moved and posts a message stating, "Keep your hands and feet away from the controls."

Autoland is part of Piper's newly announced Halo system that bundles safety equipment including autothrottle, electronic stability and underspeed protection, emergency descent mode, level mode, SurfaceWatch and SafeTaxi. At present, autothrottle is only functional for Autoland, but the company plans to offer a fully functional autothrottle by year-end. The M600SLS – the nomenclature stands for safety, luxury and service – also incorporates an updated interior and Piper's Ultimate Care Program, covering scheduled maintenance and hourly/calendar-based inspections for 5 years.

fuel on board, runway length, airspace, real-time weather, terrain, controlled vs uncontrolled airports. It then ranks the choices and selects the most suitable one for landing.

It does all that in .8 of a second or less.

Garmin leaned on its flight test pilots to vet the cascade of decisions and criteria weighting that leads it to the best airport and runway selection. They knew they had it right when the pilots looked at Autoland's decision and said, "Yeah, that's the decision I would make."

According to Eric Tran, senior software engineer who led the design of the routing algorithm, explained that ultimately the individual aircraft manufacturer determines the weighting system, as each airframe has different capabilities and tolerances for weather conditions or runway lengths. For example, a more capable aircraft might be willing to fly through green precipitation returns to reach the most suitable runway, while a light aircraft might fly around them or land somewhere else. The system is also smart enough to realize that if it is currently flying in a precipitation area that is higher than the base tolerance, such as a yellow return, it relaxes that tolerance (since it's already in it) and continues on, but continues to navigate around yellow or red returns ahead.

Preferred runway length for Autoland is something that is driven by the manufacturers of different aircraft platforms. For the M600SLS, Piper stipulated that 5,000 feet was the ideal minimum runway length, with 4,500 being acceptable if given no other choice. Garmin analysis showed that about 75 percent of U.S. airports equipped with GPS LPV or LNAV/VNAV approaches also have runways that are at least 4,500 feet long.

How Autoland Chooses

After the passenger pushes the Autoland button, the system evaluates all airports around it and determines its route and ultimate destination. It looks to avoid selecting Class B anchor airports, which typically have busy, congested airspace, unless that is the only suitable choice available. It uses all the available weather sources on board, including SiriusXM, FIS-B and/or Iridium datalink weather (but not onboard radar), to help it decide which is most suitable route and landing site. It also considers runway length required, fuel on board, terrain and obstacles, and the availability of a GPS approach with lateral and vertical guidance.

Further, if the aircraft is outside a 20-minute radius of its landing point, it will calculate a forecast based on what it already knows about the weather. For example, if a cell is moving in and forecasted to be on top of the airport, it is capable of predicting that and either choosing a new destination or entering a hold until the cell clears. Throughout Autoland sequence, it will continue to evaluate the weather to reaffirm its runway choice or change based on changing conditions. However, once the aircraft is at the final approach fix, it's locked in and will continue to a landing. For baro setting, it uses the GPS estimate, and as it gets closer it will use a setting that matches landing pressure altitude, which would be particularly critical in a mountainous area or a location with obstacles. For the M600SLS, the de-ice system is activated and remains on when it detects an OAT below 5 degrees Celsius. It also flies the holding pattern and approach slightly above book speeds because of the unknowns, such as potential airframe ice or wind shear. It does not utilize the onboard radar because of the manipulation of the beam required relative to aircraft altitude and attitude to get the best picture of precipitation ahead.

Likewise, if the system determines the aircraft is too high to begin the approach sequence, it will enter a standard hold to lose altitude and then execute the approach.

During the approach phase, it flies the glidepath using GPS just like the autopilot normally would. On very short final, it blends radar altimeter inputs to decide when to deviate from the glidepath go into vertical speed mode. Garmin tested it in a variety

of runway settings such as a sloping runway in Price, Utah, which has a 1.8-degree downslope on Runway 19. It also tested it up to the M600's demonstrated crosswind to ensure it could crab appropriately and then transition to a smooth and accurate flare-to-touchdown.

After landing, it has a "course" anti-skid function for aircraft installations that have differential braking capability using servos located in the aircraft's braking system. "We blend the rudder and brake pedals as we slow the aircraft down to help steer it and keep it on the centerline. So, the system differentially applies the brakes and relieve pressure if it feels it slipping. Its only goal is to relieve enough pressure to maintain directional control," Patel said.

To test the braking capability in the most challenging conditions, Garmin requested airport authorities not to plow the runway or apply de-icing after a major Kansas snowstorm so that they could test the braking system in poor traction conditions. In every instance, Autoland kept the aircraft tracking down the centerline of the runway. After coming to a stop, the system shuts down the engine allowing passengers to make a safe exit.

Human Factors Drive Passenger Interface

One of the most fascinating and well-executed aspects of Autoland is its passenger interface, which the company spent considerable effort to get right. Once Autoland is activated, the normal G3000 displays are replaced with simple visuals accompanied by verbal communications of what is happening and what passengers can expect. The flight displays show the aircraft location along with destination airport, estimated time of arrival, distance to destination airport and fuel remaining. Basic flight information such as airspeed, altitude and heading are labeled in an easy-to-understand format. If passengers wish to communicate with ATC, instructions are provided with the touchscreen interface now functioning as a

press-to-talk button. The display helpfully suggests, "speak clearly and slowly" and shows the aircraft's N-number for reference. Garmin tested every aspect with nonpilots within its human resources team as well as others. They tweaked everything from the calming voice of the verbal instructions to explicit instructions on preparing for landing, and how and when to open the door.

Meanwhile, Autoland squawks 7700 and broadcasts automated announcements on 121.5 as well as tower frequency or CTAF advising that the aircraft is declaring an emergency and executing an Autoland at the selected airport. The system even listens first to ensure it does not step on other transmissions before it broadcasts.

A push of the red button isn't the only way Autoland can be activated. If the pilot loses consciousness and stops responding to G3000 prompts, the system will execute an emergency descent and prompt the pilot again. If they do respond, Autoland is not activated. If they don't, Autoland takes over. At any time Autoland can be disarmed by pressing the autopilot disconnect button on the yoke.

According to Bailey Scheel, Garmin's senior programs manager and systems engineer who led the certification program effort, the program was offered to several aircraft manufacturers, with Piper and Cirrus being the first adopters. At this time, Autoland works with the G3000 NX, Garmin's current advanced flight deck, with legacy G1000 systems lacking the computing power and capability of supporting Autoland.

The Autoland feature set can be adopted and customized to individual aircraft capabilities and needs. Garmin can foresee a more limited Autoland system for a light piston single. It has said there has been interest up-market in Part 25 aircraft.

"When we started this project, Garmin already had all the pieces – the autopilot, navigation, communication – we just needed to develop a system to have them all work together along with autothrottle and auto-braking," concluded Carl Wolf, Garmin vice president aviation sales and marketing. "Garmin devoted hundreds of engineers and years of development to make it a reality because we felt it was our mission to save lives. While we hope it is never needed, if it saves one aircraft and its passengers, it will all have been worth it." T&T

Dianne White *is the executive director of MMOPA and editor of MMOPA Magazine. For a total of 14 years, she was editor of Twin & Turbine and has worked in the business aviation industry for nearly 30 years. She also serves on the board of directors for Angel Flight Central. An active multi-engine, instrument-rated pilot, Dianne lives in the Kansas City area and can be reached at* **editor@diannewhite.com.**

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Five on the Fly

by **Dianne White**

WHO:
Bailey Scheel

COMPANY:
Garmin International

POSITION:
Senior Programs Manager & Systems Engineer, Aviation Systems & Programs

HOME BASE:
Olathe, KS

RATINGS:
Private Pilot

1) What led you to pursue a career in engineering in the aviation sector?

I grew up flying with my grandfather in the backcountry of Idaho, Washington and Oregon in his Cessna 180 – I remember being really excited when I could finally reach the rudder pedals! As soon as it was legal for me to do so, I began taking lessons to learn to fly. Despite not having a driver's license yet, I earned my private pilot certificate when I was 17. I received a scholarship from a local air museum for a portion of my flight training costs, and I worked manual labor in the summers to pay for the remainder. My family was very supportive of me learning to fly. We even had a system where I would call the family phone on my way back from a cross-country so my mom would know when to pick me up from the airport. All they would hear is engine noise, but she knew what it meant.

So, with one grandfather an airline pilot and one grandfather an engineer, my interest in both led me to study mechanical engineering with the hope to one day work with airplanes. My engineering grandfather taught me about working hard for something that helps people and that you believe in. And when I was 8 or 9, my pilot grandfather raved to me about how awesome this new company "Garmin" was to work with when he installed a new radio in his airplane. His description of the product, safety benefits, customer service, etc. really struck a chord. I wanted to work for a company I believed in and that pilots loved. Who would have thought my grandpa's first Garmin product would go on to make such an impact!

2) Describe your role at Garmin and what a typical day looks like.

At its simplest, my job is to help aircraft manufacturers certify and use Garmin avionics in their aircraft. Every day is different! There is a great deal of communication required to keep everyone aligned and ensure expectations are met. Throughout the lifecycle of a project, I may work on wiring diagrams,

system descriptions, designing new products or features, scoping efforts, creating and following schedules, reviewing system safety, answering questions from customers in the field, and a bunch of other things. It's probably no surprise that with a project like Autoland, my typical day varies greatly and can prove to be challenging, interesting and exciting to say the least.

3) Developing Autoland, Garmin's revolutionary flight deck safety feature, has been a huge partof your life for the past few years. How does it feel to see it finally certified and in the marketplace?

It's so rewarding and exciting to see Autoland certified. I get to finally tell my grandfather about it – he keeps asking what I'm working on and I haven't been able to tell him! I have never worked on something I care about so much with such amazing, passionate people. Honestly, I wish I was able to work on something like Autoland forever – it's been challenging, exhausting and so much fun.

4) Garmin is among the most innovative companies in general aviation. How does the company's culture help drive that innovation and desire to offer the best solutions for pilots?

I think if you ask anyone at Garmin, they will likely say the people are what make Garmin great. Garmin seeks out and hires passionate people who want to make an impact. Garmin invests a lot in R&D and encourages engineers to become pilots and fly regularly, even flying engineers to AirVenture every year to see our products in action and meet pilots. With so many engineers who are pilots or friends/spouses of pilots, it brings home who you are making these products and features for.

5) As a successful female in a STEM field, what would you say to other young women considering a career in engineering within the aviation field?

I have found mentors and friendships to be very helpful in navigating jobs, difficult situations and tough days. Friends and mentors are especially great to celebrate with, too. Some of the best advice my mentors gave me is to continually push yourself out of your comfort zone but remember to take care of yourself and your other interests as well. T&T

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TOTAL MARKET COVERAGE

Jets – 15,414

Chief Pilots & Owners

Count	Aircraft
55	AIRBUS ACJ319
26	ASTRA 1125
30	ASTRA 1125SP
49	ASTRA 1125SPX
33	BEECHJET 400
226	BEECHJET 400A
117	BOEING BBJ
371	CHALLENGER 300
53	CHALLENGER 600
31	CHALLENGER 601-1A
108	CHALLENGER 601-3A
49	CHALLENGER 601-3R
286	CHALLENGER 604
9	CHALLENGER 800
163	CITATION 500
279	CITATION 525
261	CITATION BRAVO
150	CITATION CJ1
82	CITATION CJ1+
188	CITATION CJ2
170	CITATION CJ2+
364	CITATION CJ3
123	CITATION CJ3+
273	CITATION CJ4
151	CITATION ENCORE
55	CITATION ENCORE+
305	CITATION EXCEL
18	CITATION I
248	CITATION I/SP
437	CITATION II
57	CITATION II/SP
154	CITATION III
86	CITATION LATITUDE
191	CITATION M2
377	CITATION MUSTANG
123	CITATION S/II
256	CITATION SOVEREIGN
76	CITATION SOVEREIGN+
234	CITATION ULTRA
232	CITATION V
27	CITATION VI
97	CITATION VII
249	CITATION X
29	CITATION X+
208	CITATION XLS
229	CITATION XLS+
1	DIAMOND I
38	DIAMOND IA
5	DORNIER ENVOY 3
227	ECLIPSE EA500
59	EMBRAER LEGACY 500
141	EMBRAER LEGACY 600
67	EMBRAER LEGACY 650
221	EMBRAER PHENOM 100
264	EMBRAER PHENOM 300
73	FALCON 10
20	FALCON 100
19	FALCON 200
196	FALCON 2000
22	FALCON 2000EX
56	FALCON 20C
14	FALCON 20C-5
21	FALCON 20D
2	FALCON 20D-5
31	FALCON 20E
9	FALCON 20E-5
65	FALCON 20F
58	FALCON 20F-5
178	FALCON 50
7	FALCON 50-40
93	FALCON 50EX
152	FALCON 900
24	FALCON 900C
104	FALCON 900EX
176	GLOBAL 5000
128	GLOBAL EXPRESS
19	GULFSTREAM G-100
202	GULFSTREAM G-200
9	GULFSTREAM G-300
22	GULFSTREAM G-400
288	GULFSTREAM G-450
8	GULFSTREAM G-500
500	GULFSTREAM G-550
54	GULFSTREAM G-II
21	GULFSTREAM G-IIB
120	GULFSTREAM G-III
165	GULFSTREAM G-IV
283	GULFSTREAM G-IVSP
170	GULFSTREAM G-V
33	HAWKER 1000A
5	HAWKER 125-1A
6	HAWKER 125-1AS
4	HAWKER 125-3A/RA
11	HAWKER 125-400A
13	HAWKER 125-400AS
12	HAWKER 125-400B
9	HAWKER 125-600A
3	HAWKER 125-600AS
95	HAWKER 125-700A
59	HAWKER 4000
184	HAWKER 400XP
34	HAWKER 750
170	HAWKER 800A
33	HAWKER 800B
336	HAWKER 800XP
39	HAWKER 800XPI
83	HAWKER 850XP
158	HAWKER 900XP
6	JET COMMANDER 1121
3	JET COMMANDER 1121B
8	LEARJET 23
15	LEARJET 24
1	LEARJET 24A
11	LEARJET 24B
28	LEARJET 24D
11	LEARJET 24E
7	LEARJET 24F
10	LEARJET 25
35	LEARJET 25B
8	LEARJET 25C
85	LEARJET 25D
4	LEARJET 28
26	LEARJET 31
161	LEARJET 31A
30	LEARJET 35
350	LEARJET 35A
13	LEARJET 36
32	LEARJET 36A
29	LEARJET 40
186	LEARJET 45
166	LEARJET 45XR
92	LEARJET 55
4	LEARJET 55B
12	LEARJET 55C
253	LEARJET 60
462	PILATUS PC-12/45
108	PREMIER I
6	SABRELINER 40
17	SABRELINER 40A
3	SABRELINER 40EL
1	SABRELINER 40R
21	SABRELINER 60
17	SABRELINER 60ELXM
2	SABRELINER 60EX
58	SABRELINER 65
13	SABRELINER 80
6	SABRELINER 80SC
66	WESTWIND 1
4	WESTWIND 1123
27	WESTWIND 1124
63	WESTWIND 2

Turboprops – 11,605

Chief Pilots & Owners

Count	Aircraft
369	CARAVAN 208
1208	CARAVAN 208B
32	CHEYENNE 400
131	CHEYENNE I
13	CHEYENNE IA
251	CHEYENNE II
56	CHEYENNE III
37	CHEYENNE IIIA
51	CHEYENNE IIXL
23	CHEYENNE IV

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253	CONQUEST II
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57	JETSTREAM 32
60	JETSTREAM 41
25	KING AIR 100
484	KING AIR 200
21	KING AIR 200C
17	KING AIR 200T
197	KING AIR 250
173	KING AIR 300
9	KING AIR 300LW
554	KING AIR 350
64	KING AIR 350C
354	KING AIR 350I
16	KING AIR 90
10	KING AIR A/B90
63	KING AIR A100
209	KING AIR A200
48	KING AIR A90
104	KING AIR A90-1
93	KING AIR B100
854	KING AIR B200
99	KING AIR B200C
8	KING AIR B200CT
91	KING AIR B200GT
4	KING AIR B200SE
21	KING AIR B200T
77	KING AIR B90
329	KING AIR C90
34	KING AIR C90-1
191	KING AIR C90A
351	KING AIR C90B
80	KING AIR C90GT
89	KING AIR C90GTI
150	KING AIR C90GTX
12	KING AIR C90SE
242	KING AIR E90
156	KING AIR F90
25	KING AIR F90-1
61	MITSUBISHI MARQUISE
1	MITSUBISHI MU-2D
22	MITSUBISHI MU-2F
16	MITSUBISHI MU-2J
33	MITSUBISHI MU-2K
10	MITSUBISHI MU-2L
18	MITSUBISHI MU-2M
17	MITSUBISHI MU-2N
24	MITSUBISHI MU-2P
36	MITSUBISHI SOLITAIRE
616	PILATUS PC-12 NG
146	PILATUS PC-12/47
215	PIPER JETPROP
68	PIPER M500
79	PIPER M600
794	PIPER MERIDIAN
201	QUEST KODIAK 100
2	ROCKWELL 680T TURBO
5	ROCKWELL 680V TURBO II
5	ROCKWELL 680W TURBO II
4	ROCKWELL 681 HAWK
96	SOCATA TBM-700A
68	SOCATA TBM-700B
283	SOCATA TBM-850
100	SOCATA TBM-900
33	SOCATA TBM910
111	SOCATA TBM930
5	STARSHIP 2000A
68	TURBO COMMANDER 1000
30	TURBO COMMANDER 690
132	TURBO COMMANDER 690A
136	TURBO COMMANDER 690B
81	TURBO COMMANDER 840
24	TURBO COMMANDER 900
52	TURBO COMMANDER 980

Twin Piston – 6,320 Owners

Count	Aircraft
34	BARON 56 TC
1412	BARON 58
2	BARON 58 PA
339	BARON 58P
108	BARON 58TC
3	BARON A56TC
332	BARON G58
186	BEECH DUKE B60
163	CESSNA 340
507	CESSNA 340A
58	CESSNA 402B BUSINESS LINER
130	CESSNA 402C
24	CESSNA 404 TITAN
244	CESSNA 414
352	CESSNA 414A CHANCELLOR
39	CESSNA 421
34	CESSNA 421A
319	CESSNA 421B
596	CESSNA 421C
50	CESSNA T303
110	DIAMOND D42
108	PIPER 601P AEROSTAR
24	PIPER 602P AEROSTAR
515	PIPER CHIEFTAIN
25	PIPER MOJAVE
308	PIPER NAVAJO
208	PIPER SENECA
12	ROCKWELL 520 COMMANDER
4	ROCKWELL 560 COMMANDER
11	ROCKWELL 560A COMMANDER
8	ROCKWELL 560E COMMANDER
7	ROCKWELL 560F COMMANDER
13	ROCKWELL 680 SUPER
3	ROCKWELL 680E
15	ROCKWELL 680F COMMANDER
12	ROCKWELL 680FL GRAND COMMANDER
5	ROCKWELL 680FLP GRAND LINER

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Count	Aircraft
219	BEECH BONANZA
438	CESSNA 182
56	CESSNA 206
389	CESSNA P210N
21	CESSNA P210R
54	CESSNA T182
818	CIRRUS SR20
2991	CIRRUS SR22
28	MOONEY ACCLAIM ULTRA
10	MOONEY OVATION ULTRA
238	PIPER MALIBU
104	PIPER MATRIX
441	PIPER MIRAGE

39,146 TOTAL AIRCRAFT

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Cirrus Safe Return

Cirrus to follow Piper as first to implement Garmin Autoland

by **Rich Pickett**

PHOTOS COURTESY OF CIRRUS AIRCRAFT

The recent announcement by Garmin regarding their revolutionary automatic land capability is excellent news for the industry. And Cirrus Aircraft joins Piper Aircraft as the first of the general aviation manufacturers to introduce the system in a production airplane. The company will implement its Safe Return Emergency Autoland System in the 2020 Vision Jet. The automatic landing technology will act as an additional safety system to the Cirrus Airframe Parachute System (CAPS).

Careful consideration was given to where to place the activation button for the Safe Return. Since single-pilot operation is common in the

Vision Jet, Cirrus elected to place the button just aft of the CAPS and oxygen overhead console. The placement makes the function easily accessible by anyone in the aircraft. Safe Return is also automatically activated after 60 seconds in Auto-Level mode as well as Emergency Descend Mode upon reaching 15,000 feet.

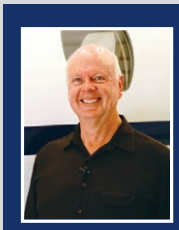
Communication with ATC uses both COM radios, one for 121.5 MHz and the other for the nearest appropriate ATC facility, as well as setting an emergency transponder squawk. That solution takes into account the present 3D location, along with potential landing facilities and weather, including possible icing, terrain and remaining fuel. If icing is predicted, the Vision Jet's TKS, engine inlet heat and pneumatic boots are activated. A unique feature of the Cirrus implementation is that if a safe solution is not obtainable due to remaining fuel, terrain (including water) and other conditions, Safe

Return will advise the passengers. In this situation, a message will appear on the MFD advising the passengers to activate CAPS. This information is also included in the passenger briefing on the checklist.

If the conditions allow, and the pilot does not cancel Safe Return, the system will descend the aircraft and proceed with the appropriate approach through the use of a control stick switch. Configuration of the aircraft with gear and flaps is automatic. Since the flight will transition between different ATC sectors, the system will change to the appropriate frequency, whether that is approach control, control tower or even CTAF. Emergency services will also be called while simultaneously transmitting the same information on 121.5 Mhz.

On the approach, Safe Return also utilizes a new radar altimeter for a more precise glide path and landing. Once on the ground, using GPS-based speed sensors on the brakes, Safe Return will progressively apply pressure to the brake master cylinder until a complete stop and set a parking brake. With the engine tail-mounted, it is not a safety issue so it will continue running in case a pilot needs to taxi the plane off the runway.

When thinking about the two emergency safety systems, Safe Return is primarily meant for pilot incapacitation, while CAPS is in case of an aircraft emergency that cannot be controlled or resolved. Cirrus will include Safe Return as standard equipment in their 2020 Vision Jet models starting in January. The new feature is expected to add $100,000 to the base price. T&T



With 11,000+ hours of piloting more than 100 aircraft models **Rich Pickett** *still has a passion for flying. Rich holds an ATP, CFII SME, SES, glider licenses, and type ratings in the L29, L39, Citation 500/510s/525s, Eclipse 500S and DA10. His company, Personal Wings, provides training, mentoring and aircraft services. You can contact Rich at* **rich@personal-wings.com**.

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Learning the Differences

by **Kevin Ware**

The challenge is figuring what is unique or different about a new-to-you airplane, then applying that information in some practical fashion."

One of the companies I fly for recently acquired a Gulfstream 150, and over the past several months, our pilot group (mostly accustomed to flying lighter Learjets and Citations) has been getting checked out in the new machine. Two in the group spent a couple of weeks and $40,000 each completing the full simulator training course. The rest of us took the ground school course the aircraft management company put on, then completed flight training in the airplane itself – leading to a 61.55 check ride and a second in command rating. I have been through this process several times over the years, and starting to get the ritual down pretty well.

You would think the main challenge in approaching a new or different airplane would be the "flying" part. Perhaps crosswind landings, V_1 cuts or other such maneuvers. But at least for me, that is not the case. This is probably because with time, you come to realize that all airplanes are similar in the way the controls work, and they also have a lot of operational limitations in common. For example, just about all small corporate type jets have an engine starting wind limitation of 10 knots if the engine's intakes are facing downwind. Another example is the operation of windshield heat is usually prohibited while on the ground. The challenge is figuring what is unique or different about a new-to-you airplane, then applying that information in some practical fashion.

Recognizing this is where the challenge lies, the ground school emphasized to us the differences in a G150 – and there are quite a few of them. Most may seem relatively minor or petty in the large scheme of things, but they are nevertheless important from a practical point of view. For example, somewhat surprisingly, the first and most important thing for any experienced professional corporate pilot to master is the the cabin door. If the passengers see the pilot stumbling over the everyday act of opening or closing the door, they automatically assume his or her piloting skills must lack, and everything else that subsequently occurs during the flight will be interpreted through that negative lens. And the G150 has a couple of real "gotchas" when it comes to the door.

The G150 nose wheel steering system has a pin that is pulled when parked and must be re-inserted before taxi, a task that is sometimes easier said than done.


Key pilot memory item: don't forget to retrieve the wood block that keeps the door from overextending during passenger boarding.

First, the door is big and heavy, hinging onto the bottom of the fuselage. There is a flush-mounted handle at about eye level that operates a lever that turns and pulls all the locking pins holding the door. Once unlocked, a pretty hefty tug makes it start to drop down, and the tendency is to try and cushion its descent with your hand because you are standing right under it. But, it turns out the door has hydraulic cylinders that limit the

rate of descent, and if you are pushing against them, the door simply won't drop down. The act can leave you standing there holding the door up and looking like an idiot in front of the passengers. So, the drill is to pull the handle, give the door a good yank, then get out of the way while it descends all by itself.

The door stops its automatic descent when it is about 6 inches from the ground and hangs there while a rubber-tipped foot drops down to the ground to support the door while passengers ascend the stairs. The problem is if the airplane is light, say with half tanks or less, it sits higher on the landing gear and the rubber-tipped foot does not touch the ground. Consequently, if a heavyset passenger puts all their weight on the first step, the door can overextend the hinge attached to the fuselage, bending the metal and effectively grounding the airplane on the spot.

To prevent this disaster caused by "pilot oversight," a 4-by-4-inch block of scrap wood is kept near the door entry. It is the pilots' job to make sure that piece of wood is placed under the rubber stop before anyone is allowed to board. Upon departure, the pilot (in addition to dealing with IFR clearances, fuel and baggage loading) must also remember to retrieve that piece of scrap wood before the door is closed. If forgotten, it can cause all kinds of turmoil at the next stop. It is indeed peculiar that a piece of scrap wood is an operational necessity in an airplane costing $14 million, but it is a difference that must be learned and demonstrated before a new pilot checkout.

Once you master the door, it is time to move on to other things. On nearly all small jets, the batteries are typically disconnected from the aircraft before it is parked because there are hot battery bus items that can discharge them overnight. But on the G150, they are in the back of the airplane and inaccessible to the pilot during preflight. So, after opening the door, the pilot's next job is to turn on the master switch and see how much power remains in the batteries. It must be 24 volts or better, but don't sit and stare at the display too long after turning the master on. The batteries will deplete and you won't be able to start the APU, effectively grounding the airplane unless ground power is available.

Starting the APU has its own ritual. First, you must check the unit's fire suppression system by pressing the half-inch square arm or test switch on the center of the instrument panel, all the while taking great care to keep your other finger off the discharge switch of the same size immediately next to it. If you accidentally push that switch, the bottle will discharge and ground the airplane until the mess can be cleaned up and the fire bottle re-charged. Then comes a test for fuel availability to the APU, which comes from the right engine supply. If this is good to go, the APU itself can finally be started with the push of a button. The little jet engine starts almost right away. With a lot of small jet APUs, there is a required delay of a couple of minutes to allow the engine to warm up before the generator and ECS (environment control system) is switched on. But on the G150, while there is a two-minute delay only on the ECS, the generator can come on right away. All kinds of funny little differences to remember that have very little to do with actually flying the aircraft.

Now with the little jet engine roaring away in the back and the ECS warming the cabin, it is time to actually do the walk around part of the preflight. This involves the usual steps like making sure the tires are inflated, but there are also a couple of peculiar exceptions that must be dealt with – one of which is the nose wheel steering system. The nose wheel has a pin that must be pulled when the airplane is parked, completely disconnecting the wheel from its control linkage. It must then be re-connected before any attempt (other than a very embarrassing one) is made to taxi the aircraft. Re-inserting the pin, however, turns out to be best completed by both pilots

as the dual nose wheels often need to be moved slightly for the pin's holes to line up. This requires grabbing the tires with both hands and twisting them slightly in order for the pin to line up correctly. But with both hands busy, it makes placing the pin nearly impossible if a pilot is doing the preflight by himself. So, it is not uncommon to see two G150 pilots getting their pants dirty while crawling under the airplane near the nose wheel. Learjets don't share this issue, which is one reason we had to pay special attention to it during the G150 checkout.

After ensuring all the sneaky preflight items are completed, it is time to board and start the engines. However, before actually pushing the "start" buttons, you must first work your way through a 45-item checklist, including everything from the coffeemaker to the fire extinguishing system. Once that is complete, starting the engines just requires the push of a single button once the power levers are placed in the idle position. With the engines running, there are 17 more items to check and you are finally ready to taxi. But, don't be too quick about releasing the brakes. The rudder pedals only control the first 3 degrees of nose wheel movement. The remaining 60 degrees of turn is managed by a small steering wheel on the left side of the cockpit (similar to most airline aircraft). The steering wheel itself has an on/off switch, so make sure that switch is on before advancing power. With only 3 degrees of movement via the pedals, you will almost certainly hit the hangar door even with your foot on the rudder buried right to the stop.

After successfully taxiing out, we run a series of other checklist items fairly common to small jets (such as cycling the spoilers) and get to the lineup portion and takeoff briefing. The main difference here is only the pilot in the left seat of the G150 has good directional control of the aircraft during the initial portion of the takeoff roll – and he does this using his left hand on the small steering wheel and right hand on the throttles. So, if the left seat pilot is the one flying, the control wheel must be properly positioned and held for the wind conditions by the pilot in the right seat until sufficient speed is reached (usually about 80 knots). At that point, the left seat pilot releases the small steering wheel with his left hand, places it on the control column and announces "my wheel." Shortly after that, V_1 is called by the monitoring pilot and the pilot flying releases the throttles and places both hands on the control column. This is a common practice in airline aircraft, but not required in lighter jets like Lears. The process takes a few takeoffs to get the teamwork down but comes fairly quickly when briefed in advance.

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Once V_1 is reached, the G150 landing gear requires a fairly heavy pull on the control column to get the nose wheel off the ground and the aircraft pitched up. Shortly after, the back pressure must be released or the nose will point toward the heavens with the climb rate going to 4,000 fpm. Despite being briefed on this detail, I take way too long to release the back pressure to get the nose down on my first takeoff. In Learjets, if you lower the nose too much, you will almost certainly get an over-speed warning as you blast through 250 knots. Yet another slight but significant difference to remember.

Once airborne, we perform a series of maneuvers then return to do some landings. With a trailing beam gear, a very gentle landing in the G150 is certainly possible. But, this is to be avoided if the runway is on the shorter end because the spoiler deployment system will not be activated until weight on the wheels is fully established. So, the idea is to "put it firmly on the ground" unless you have a couple of miles of runway. Then, as the landing roll slows down, make sure to remember the nose wheel control is again switched to the left seat pilot, who then taxis the airplane back to the ramp while the right seat pilot runs the after landing checklist. Ah, more differences.

When I was in my 20s and a new flight instructor, I routinely told new students, "All airplanes basically fly the same, and the bigger they are, the easier it is." And, in a certain way, I still believe that to be true. But on the other hand, 11,000 flight hours and multiple type ratings have taught me that it is true only if the word "fly" is narrowly defined. Although all airplanes essentially fly the same, their operational complexity increases almost directly with the maximum takeoff weight. Plus, all have design differences peculiar to the manufacturer that sometimes leave you wondering, "What were they thinking?"

It is the differences that you have to pay attention to. T&T

Kevin Ware *is an ATP who also holds CFI, MEII and helicopter ratings, has more than 10,000 hours and is typed in several different business jets. He has been flying for a living on and off since he was 20, and currently works as a contract pilot for various corporations in the Seattle area. When not working as a pilot he is employed part time as an emergency and urgent care physician. He can be reached at* **kevin.ware2@aol.com**.

En Route

Epic Aircraft's E1000 Completes Certification by Rich Pickett


PHOTO COURTESY OF EPIC AIRCRAFT


PHOTO BY AUTHOR

What started out as an innovative experimental single-engine turboprop in 2005 is now the newest certified turboprop, the Epic Aircraft E1000. After a seven-year effort to certify their aircraft, Epic has achieved a great milestone. Epic CEO Doug King stated they wanted to achieve a high-performance turboprop without compromises, and is proud of their achievement.

The E1000 makes extensive use of composites, featuring an all carbon fiber design. The plane is powered by a Pratt & Whitney Canada PT6A-67A and boasts a maximum cruise speed of 325 KTAS, an economy cruise of 285 KTAS and a maximum operating ceiling of 34,000 feet. The E1000 features a maximum cruise range of 1,385 nm, and after a power reduction to economy cruise, results in an impressive increase to 1,650 nm.

I've spent some time in the E1000 mockup and it offers a comfortable passenger cabin, with six seats and a full fuel payload of 1,100 pounds. This payload offers great mission flexibility, with the ability to carry an impressive load of passengers and baggage over long distances at high altitude. The cockpit, featuring the Garmin G1000 NXi avionics suite, is well designed, with a curved lower panel. To improve passenger comfort, the Epic E1000 also provides a relatively high pressurization differential of 6.6 pounds per square inch (PSID).

With an initial order book of 80 E1000s, Epic Aircraft is in the process of completing the first seven production aircraft. In order to accommodate the demand, they have doubled their composite fabrication capacity. With more than 300 full-time employees staffing two production shifts, they are planning to start deliveries before the end of this year. Epic Aircraft expects to have its production certificate in hand during the first quarter of 2020. T&T

En Route

Pilatus Unveils the PC-12 NGX

by Rich Pickett


PHOTOS COURTESY OF PILATUS AIRCRAFT

Standing next to an airplane shrouded in black fabric, we eagerly await to see what hides underneath the cloth. Editor Rebecca Groom Jacobs and I are attending the debut of the newest Pilatus at Henderson Executive Airport during NBAA in Las Vegas.

Markus Bucher, CEO of Pilatus Aircraft, stands at the podium, extolling the virtues of the new aircraft and detailing the lineage of the PC-12 and PC-24. With 1,700 PC-12s now in the market, a fleet that has amassed more than 7 million flight hours, Pilatus partnered with suppliers like Pratt & Whitney Canada and Honeywell to advance its PC-12 turboprop further. The result of this development: the PC-12 NGX.

Engine

The PC-12 NGX is probably the most extensive update of the venerable PC-12 aircraft since they started building the aircraft. As Bucher mentioned, Pilatus Aircraft was determined to improve the safety, performance and cabin experience with the NGX. One of the first features highlighted was the new Pratt & Whitney Canada (PWC) PT6 E-Series engine – the PT6E-67XP. Maria Della Posta, president of Pratt & Whitney Canada, also took the podium and was aptly proud of this new engine.

It is the first production turboprop engine with a dual-channel EPEC (Electronic Propeller and Engine Control) that controls both the engine and the propeller. This affords the pilot a single power control lever (PCL) that is now electronic, servo-controlled rather than mechanical. The pilot now has three detents – Idle, Maximum Continuous Power (MCP) for cruise and Takeoff (T/O). It is another feature that reduces pilot workload but still offers full control when necessary.

With optimum control of the engine and propeller for all phases of flight, the engine can be optimized to operate at even higher recommended ITT temperatures. This can result in a faster climb to altitude, greater speed and a 10 percent increase in power (at sea level compared with the PT6A-67P). Another unique feature of this new engine is the ability to operate in quiet mode. By simply pushing the Prop Low Speed button, the EPEC can operate the propeller at 1550 RPM rather than 1700 RPM. The quiet mode is even available for takeoff with available runway length. The EPEC optimization of the propeller, through an electronic governor, should also help reduce maintenance on this component.

An additional benefit of the new engine installation is a reduction in maintenance costs. The new Data Acquisition Unit collects over 100 data signals for trend monitoring. This information should prove invaluable to operators and maintenance personnel. If the owner is enrolled in PWC's engine maintenance plan (ESP), it can also be sent wirelessly to PWC for trend monitoring. The existing 300-hour maintenance schedule has increased to 600 hours, and the TBO interval increases from 3,500 to 5,000 hours with the new E-Series engine.

Autothrottle

The NGX incorporates not only a new engine but also an autothrottle. This feature involved an extensive development effort between Pilatus Aircraft, PWC and Honeywell.

With the new servo-controlled PCL, the pilot can set a speed and the system maintains it. It is another feature that reduces workload – especially when ATC requests a specific speed, or you are flying a speed-restricted departure or arrival procedure.

Avionics

I spoke with Steven Slijepcevic, president of Honeywell's Electronic Solutions, and Jason Bialek, director of EPIC Cockpit Systems, regarding the new Honeywell suite in the NGX. In addition to Honeywell's contribution to the autothrottle, the avionics and systems upgrades are so extensive that Pilatus Aircraft renamed the upgraded cockpit the Advanced Cockpit Environment (ACE). In addition to the autothrottle, Honeywell updated the avionics suite to incorporate the features in their Epic 2.0 platform. The upgrade is significant and includes more powerful processors, updated synthetic vision, Emergency Descent Mode (EDM) and the Crew Alerting System (CAS). It can also call up the associated electronic checklist on the MFD when a condition occurs.

I was able to explore the new avionics with Anthony Vallon, a test pilot for Pilatus Aircraft. Vallon, who flew the airplane from the factory in Switzerland, was understandably excited about the NGX. A pilot with substantial experience in all Pilatus aircraft, as well as his own RV-8, he took me through various profiles with the new suite. The new system incorporates advanced features that have been implemented in Honeywell's other platforms, such as the intuitive touch controller. This controller can control a number of functions, including quick COM and NAV tuning, environment control, weather display and datalink.

The upgraded avionics also incorporates Honeywell's SmartLanding and SmartRunway awareness and advisory system. This system offers several unique features like advising the pilot if they are lined up on a different runway from the approach they have loaded into the FMS.

Cabin

The third major area of improvement that Bucher highlighted was the cabin experience. Pilatus took the already-large cabin windows of the PC-12 and made them 10 percent larger. To the passengers, it provides a substantial change in their outside view. Pilatus also improved passenger and crew comfort by improving the air conditioning and interior. The company worked with BMW Designworks on six different interior options and now offers passengers seats with full recline, taller seatbacks and more headroom. It is clear that their experience with the PC-24 has had a synergistic impact on the PC-12 as well.

As someone who flies the PC-12 regularly, I am thoroughly impressed by the advancements Pilatus has incorporated into their latest turboprop – one that is sure to raise the bar for other manufacturers. Stay tuned for a PC-12 NGX flight review in an upcoming issue. T&T

New Online Garmin GTN 650/750 Course

King Schools has released a new interactive online course dedicated to "Flying the Garmin GTN 650/750." The course is meant for pilots who are new to the GTN navigators or in need of a refresher. The course features both VFR and IFR teachings, with more than six hours of video that can be taken either online or offline using a free iPhone/iPad app.

"The advanced touch screen technology of the Garmin GTN navigators is an absolute dream when you know how to use it," said King Schools Co-Chairman, Martha King. "This course is much more than a manual or simple how-to video. The on-screen graphics demonstrating the operations are easy to follow and will have you up to speed quickly and efficiently. The videos use vivid real-life scenarios with clear instructions that prepare you so well that when you get in the airplane, your hands and eyes will automatically go to the right place."

This course is available at *KingSchools.com/GarminGTN* at the retail price of $179.

SRS Introduces Onboard Coffee Brewer

During NBAA in October, SRS Aviation displayed its new onboard coffee maker, Jet Java. The product was recently TSO-certified for all fixed-wing aircraft and is approved for either a cabin or galley install.

"This is a new product to the market and new technology," said Dave Laurin, president of SRS Aviation. "We're the only TSO certified pod brewer on the market."

The brewer comes with four interchangeable trays to accommodate various beverage options including coffee beans, tea bags and beverage pods. It is not hooked to a potable water source and operates on 4 amp 110VAC or 12 amp 28VDC. More information can be found at *www.srsaviation.com*.

Twelve Days of Christmas

Review these 2019 articles if you dare

Theologians posit that the classic song by Frederic Austin was written to help Christians learn and pass on the tenets of their faith while avoiding persecution. We can all recite the lyrics from twelve down, but notice how difficult it becomes when reading from the bottom up: a partridge in a pear tree, two turtle doves, three French hens, four calling birds, five golden rings, etc.

In order to pass on the tenants of this writer's 2019 articles without persecution (and for those who asked), here is an abbreviated version of this year's stories. I hope that you find them joyful to remember – in any order.

JANUARY: Debrief that Partridge

"Errors of Omission and Commission: Remembering Lessons Learned"

An error of omission is not doing something that we should have done: forgetting to put the gear down, not feathering a prop during an engine failure, or neglecting to load an arrival/approach into the FMS. An error of commission is the mistake of doing a thing, but doing it wrong: extending the gear but while too fast, feathering the wrong prop during an engine failure, or loading the FMS with the wrong arrival/approach. Making an error of omission or commission is frustrating, and you're not the only one that does it. Despite several dozen memory mnemonics, litanies and checklists, we make errors of omission and commission. Most of our mistakes are small and of little consequence, but the potential for a serious blunder looms large. By reviewing significant events from our flights, we can reduce both types of errors. The tool that helps us to avoid repeating the bad is called a debrief – write lessons learned in a diary or logbook.

FEBRUARY: Gettin' Hitched – To Your Airplane, Not the Two Turtle Doves

"Saying 'I Do' to DIY Aircraft Towing"

Airspeed and money make airplanes fly. But that cliché and our clinical persona may deprive us of something more. What if we allow the right side of our brain to have a seat in the towing vehicle before we slide into the left seat of the airplane? The functional elegance of towing is often lost on us pilots, overshadowed by the left-brain efficiency, ease and convenience of a professionally prepositioned aircraft. Towing your own airplane will take some skill, so get some dual with your own tug, tow bar and airplane before you go solo. And if you will accept the challenge of towing, I will abandon the challenge of writing poetry about towing. (This was a reference to my poem titled "How Do I Tow Thee").

MARCH: Enfoque No Autorizado – Not Three French Hens in Spanish

"Trees, TERPS and Bilingual Lingo"

The plethora of scattered notes and cautions in our instrument procedures can make it seem as if they're written in a foreign language. But notes appear after something malo

(bad) happened to someone. Usually by someone not paying attention or not thinking lo suficientemente por delante (far enough ahead). Procedural cautions and notes can prevent something bad from happening to our sensitive body parts (lindas nalgas). Not only do rules, restrictions and notes keep us safe from obstacles, but following them makes our actions efficient and predictable. With tens of thousands of instrument procedures around the world being flown by tens of thousands of pilots, we must all agree to update our pubs on schedule and before we fly them to review each for applicability, authorizations, restrictions and changes. If we miss a critical note, or we fly a procedure that is not authorized, the Feds may take a razor strap to our nalgas.

APRIL: The Tempestuous Troposphere – The Four Calling Birds Should Stay on the Ground

"Turbulence Facts, Fiction and Fairy Tales"

Many nursery rhymes express fear, suffering and disaster. Perhaps for us valiant aviators, this was a childhood primer to the potentially traumatic and unforgiving effects of weather. The list of atmospheric monsters has lengthened since we were kids, and pilots can't outgrow or ignore them. No longer a fairy tale, turbulence demons live in the heart of our flying territory. From our pilot perspective, few things are as impressive as a 200-knot jet stream, a fire and brimstone producing thunderstorm, the kidney-rupturing lenticular clouds over a mountain range, or the roll cloud in front of a microburst – if we're on the ground looking up, that is. When airborne near these turbulence-producing phenomena, stay far away, radar on, eyes wide open and your tail tucked between your legs. It will likely add a couple of minutes to your ETA but may save you from a fairy-tale-like demon.

MAY: Max Mania – Not Five Golden Rings for Anybody

"B-737 Decisions, Disasters and Disclosures"

The Boeing 737 Max crashes garnered worldwide attention not only because of their commonality, the perceived culpability of the manufacturer and implied pilot training deficiencies, but because aviation crashes remain the modern-day version of a train-wreck. Passengers are at the mercy of the 10 million manufacturing and design decisions that were made years before they ever boarded the plane. Those that pilot the 737 and its variants have been peppered with questions from inquiring minds that want to know, "What do you think happened? Why didn't they turn off the system? Would you feel safe flying the Max?" The executive summary is this: Engineers created a "background" system using a marginally reliable, non-redundant probe/sensor. The crews didn't recognize the failure mode. And yes, I would still fly the airplane. By the time you read this, we will have some answers and a solution will be in place. Probably new software, additional AOA sensor input, system activation annunciation and additional aircrew training. However it unfolds, when any failure rears its head in the airplane, it will be your training, experience, determination and judgment that will prevail as you demonstrate some of that pilot-stuff.

June: Come Help Me – Six Geese are A-Laying!

"Mayday, Mayday, Mayday"

Misbehaving AOA sensors have now invaded GA and precipitated the grounding of yet another fleet – the Cirrus Vision Jet. May's MCAS article seems to have prophetically provided a plausible prologue for a story about requesting traffic priority if our own plane presents us with a pickle of a problem. "Mayday, mayday, mayday" is itself an alliteration-like-three-peat and thus perfectly personifies the preparatory paragraph. We practice hair-raising scenarios in the simulator not only to rehearse the procedures but to help override our human nature to be afraid, to fight or flee, and also to negate the perception of time compression. Hopefully, this story desensitized you to the use of the repetitive mayday, mayday, mayday radio call, which can add adrenaline and make it seem as though we are overreacting and overstating the seriousness of our problem. Your cool, calm use of the mayday, mayday, mayday call will certainly carry, carry, – the, the, – day, day. Is there an echo in here?

July: Say What! Seven Swans Never Drink Alone

"Aviation Memories: Poignant and Playful. (And Sometimes Rated "M" for Mature)"

Aviation humor is a dialectal minefield for a writer and can easily poke an eye out if misused. But a tactful, tastefully presented and good-spirited bit of humor (or sarcasm) can help information and lessons stick in our memory better than IMSAFE, GUMP or Identify, Verify and Feather. It can also counterbalance the effects of the life-sucking, joy robbing ordeal of Part 121 aircrew scheduling in a thunderstorm infested, 737 MAX grounding, post 9-11 era. Mature metaphor alert: children look away.

Stories such as this one with grown-up humor, even when honest and sensitive, are an opportunity for fallout, and I'm thinkin' this story may need to be stashed in the unmentionable drawer with grandma's bloomers. But like that morning flight with the "stiff-one" offer, I hope my use of humor to make pilot-y points will help you to remember what are often painful lessons for some other schmuck – even the pilot-y points that were rated PG.

August: Year of The Fighter – Milking Fun from OSH Without Eight Maids

"There are Only Two Types of Aircraft: Fighters and Targets"

In 1972, my hair was shoulder-length, shoes were platform, pants were bell-bottom, and I did not yet have 100 hours flying time. I ventured to Oshkosh that year with six

flight instructors by resting my scrawny, 110-pound physique in the seventh (jump) seat of a Seneca I. Back then, Vans Aircraft was a year old and the convention's Wisconsin venue was only two years into its 50-year reign. Burt's VariViggen was brand new and the VariEze didn't yet exist. You could buy red 80 octane fuel everywhere, get a ride in a Breezy and Bob Hoover was the star of the airshow. Now the largest annual fly-in in the world, it's much more than a fly-in; it's a family reunion complete with a flood of memories. I still feel like that long-haired, 110-pound, student-pilot-hippie when at Oshkosh, but now that I'm a balding, professional pilot and writer, I have an image to uphold – right? A special thanks to the spirit-filled lady that was yodeling in her best Julia Child voice "hellooooo" from a tent somewhere. It made me want to break into my Steve Martin, Wild and Crazy Guy imitation with both hands alternately pointing skyward. Oshkosh can do that.

SEPTEMBER: Participation Trophy – Nine Ladies Dancing with Earbuds

"No Such Thing as Bad Student, Only Bad Teacher. Teacher Say, Student Do."

– Mr. Miyagi (Pat Morita-The Karate Kid, 1984)

The year that I started high school, a brand-new C-172 was $33,950 and they built 750 of them. The favorite flavor of flight school fuel was red 80 octane, and a third-class physical was completed as if you were applying to be a Mercury astronaut. It was a time when you needed a restricted radiotelephone operator permit to use the airplane radio. and your flight instructor chastised you for not only piloting errors but for improper use of the radio. After soloing in GA, your shirttail was ceremoniously and publicly cut off, potentially exposing non-pierced nipples and navels. At the majors, most FO's flew for 12 to 18 years with old-school captains before they upgraded to the left seat. And while the captains and FOs flying today may have 45 to 70 years of combined flying experience, the flying time of a new captain and a new FO's added together will soon not be as much as one retiring captain. But despite these differences in generational characteristics and experience levels, the pilot partition of Gen Y and Z continues to show impressive skill and intelligence. Their level of adaptability noticeably exceeds previous generations, and not just in their ability to use Bluetooth electronics and essential oils. So, we may not be doomed after all.

October: True Confessions – Lords Don't Leap, Even if There are Ten of Them

"Telling Passengers the Inconvenient Truth"

I'm not a fan of the grisly facets of All Hallows' Eve. But the ghoulish holiday presents a timely pretext to discuss what we tell our passengers before things turn dangerous or disastrous. No matter from which side of the cockpit door you toil, we all do our part in dealing with passengers. Telling them in frustration, as the flight attendant did in our

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story, that they and their little dog Toto will die in a huge ball of fire, is not the best option. The non-pilot public absorbs information more readily when delivered by the PIC. And the recent Citation runway accidents (Citation Excel at OVE – 6,020 ft. runway, and a Citation Latitude at 0A9 – 4,529 ft. runway) highlight the need to talk to our passengers just like we do at the airlines about emergency exits and following the instructions of crewmembers. Though sometimes frightening, passengers want the truth. But try not to scare the crap out of them. Or their dog.

November: All the Leaves Are Brown – Eleven Pipers, None of Them Named After Indians

"Flying with a Summer Brain and an Autumn Body"

This year I drew a New Mexico hunting permit in an area in which the elevation ranges from 8,000 feet to over 12,000 feet. Since my office for 85 hours each month is at about an 8,000-foot cabin altitude, I figured a high altitude, wilderness hunt on horseback would be doable for this 63-year-old, soft-skin, flat-land Gringo. I'm a healthy airline pilot; how hard could it be?

Next September marks 30 years since I last flew the F-16. That day, on my 34th birthday, I remember wondering if I had squeezed every bit of training and fun out of my flights. I felt the same emotions when asked how I felt about delivering an MD-80 to Roswell. After 57 years in airplanes, four engine failures and a plethora of system problems, you gain a perspective on the metaphysical magic of the machine. As you age, evaluate and monitor your own flying ability and proficiency, and don't let time slip you by. And after your next flight when no one is looking, let a little California Dreamin' into your heart and give the airplane a kiss on the nose. You will be glad you did when all your leaves are brown.

December: Twelve Days of Christmas – Drumming Along Like a Wright R-3350

There you have it. Feel free to email me if you would like a PDF of any articles, and we'll talk again in 2020. Merry Christmas, my friends.

Kevin Dingman *has been flying for more than 40 years. He's an ATP typed in the B737 and DC9 with 23,000 hours in his logbook. A retired Air Force major, he flew the F-16 and later performed as an USAF Civil Air Patrol Liaison Officer. He flies volunteer missions for the Christian organiz tion Wings of Mercy, is employed by a major airline, and owns and operates a Beechcraft Duke.Contact Kevin at* **dinger10d@gmail.com**.

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Irrational Behavior

I believe I am stricken with a virus known in medical circles as "irrationalis behaviorus." It is characterized by expressions of emotions such as crying hysterically and maintaining unrealistic expectations. The most severe cases of the virus are found in aircraft owners.

Or, in my case, former aircraft owners.

You may recall that I sold my second Citation Mustang earlier this year. Awesome airplanes and the best bang for the buck ever made by Cessna/Textron. But, I finally came to the conclusion that I could no longer afford the operational costs of a jet. And combined with not having a business to take advantage of the tax benefits, I decided that my time was up.

That decision lasted about six months.

In the interim, friend Larry King generously offered to let me lease his fine M2. However, he promptly departed for 70 days on an around the world adventure in his airplane.

Have you ever been without an airplane for months?

I began to softly cry myself to sleep each night. I dreamt about loading Garmin software, filling tires with nitrogen and wiping bugs off windshields. Upon returning from his journey, I confided to Larry about my strange behavior.

"Can't you take medication for that?" he asked.

"Larry, I am already reading old copies of *Twin & Turbine* out loud in the middle of the night in my bathroom," I responded. "Patty says either buy another plane or chew some of Peaches' CBD dog treats."

I still can't afford a jet. But then, I couldn't afford to own one before. Indeed, this lack of reasoning is a symptom of the virus. I visited my internist, who verified my diagnosis and told me that there is currently no known cure. It seems all the government funding for the malady has been diverted to build the southern border wall.

In order to find a cure, I first had to admit my addiction to turbines. And, a strong preference for one on each wing. I know all the arguments of single versus twin, but in the end, the twin will likely get you at least a little closer to your destination after an engine failure.

I began to "irrationalize" perhaps owning a King Air. Surely this would be cheaper than a jet. My capital investment would be less. No monthly engine reserve deposit. Parts prices are cheaper. My internal temperature began to rise. I think this is called a fever.

I consulted the internet, a place always full of excellent factual data. There were many King Airs available and well within my price range. I spent hours looking at pictures taken in the best light possible. I fell in love with one loaded with avionics and engines and propellers. Patty and I went to take a look.

Its gleaming paint sparkled under the high-intensity lights in the hangar, but something wasn't quite right. I couldn't put my finger on it. Perhaps it was the age. The airplane's logbooks had years of handwritten entries. It was older than my son – and he's over 40. So, I passed.

I soon realized that buying a well-used airplane is full of pitfalls. I needed professional help.

Stay with me.

Fly safe. T&T

David Miller *has owned and flown a variety of aircraft from turboprops to midsize jets for more than 50 years. With 6,000-plus hours in his logbook, David is a member of the Citation Jet Pilots Safety Committee and writes and speaks on aviation topics. You can contact David at* **davidmiller1@sbcglobal.net.**

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Since its introduction in 1989, the Pilatus PC-12 has become the best-selling single engine turboprop. It has a reputation for reliability, operational flexibility, and performance. Pilatus continued to improve on its original design by increasing the useful load, engine performance, and even adding an integrated avionics package.

After analyzing the PC-12's stock cowling, the engineers at American Aviation, Inc. identified areas that could be improved—specifically the ram air inlet and internal ducting. This analysis led to the design and manufacture of Speed Cowl. The cutting-edge design combines a cowl inlet which maximizes the recovery of high-velocity ram air and internal ducting that is aerodynamic minimizing air separation and flow losses of the high-velocity air to the engine's plenum. This results in higher available torque at the same ITT settings, which significantly improves the performance of the Pratt & Whitney PT6A-67 turbine engine.

Speed Cowl has been flight tested in multiple flight configurations—climb, cruise at various altitudes, descent, with the inertial separator door open and closed—all at varied torque and ITT settings. During flight tests, the cruise true airspeed was shown to increase by up to 18 knots at FL280. Also, time to climb above FL180 was noticeably reduced due to the available torque increase. Performance improvements will depend on altitude, outside air temperature, and ITT settings.

For more information about Speed Cowl, please visit info.edmo.com/speedcowl.