MyGoFlight Cockpit Tech / Autothrottle PC-12/KingAir / Understanding the Rudder

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VOLUME 25 NUMBER 2

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Editor's Briefing

by **Rebecca Groom Jacobs**

New Year, New Search

My husband Jared and I have been pleasantly surprised and encouraged by the number of readers who have reached out to provide well wishes, personal experiences and advice since we announced the search for our first aircraft this past September. Following our most recent update after a failed offer on a Mooney (see "Almost First Time Owners," T&T November 2020), some of you have emailed me curious about the status of our hunt.

In a nutshell, the search went into hibernation mode over the last few months. However, the pause ended up being a blessing in disguise as it allowed time for a huge, game-changing development…I will turn it over to Jared to recap the latest.

Jared Jacobs: After I realized that a deal on the Mooney was not going to happen, I needed some time to unwind and reset. Plus, it seemed to me that the market was just too hot! Any reasonably equipped/priced aircraft I came across online would be under contract in what seemed like hours. And those that remained available were usually some combination of overpriced, in need of serious upgrades, or had a storied past. With demand for personal aircraft skyrocketing due to the pandemic, I talked to several aircraft dealers and brokers who saw shattered sales records in 2020. While we would like an aircraft sooner rather than later, there is no pressing need.

So, with these things in mind, I told myself that I could stand to sit on the sidelines and continue to observe for a few months to see if anything changed. Well, things did indeed change, though not necessarily on the market side, but on the personal side…we now have a partner.

During my recent King Air recurrent training at FlightSafety, I mentioned in passing to a coworker that Rebecca and I were conducting an aircraft search. With little downtime between me stepping out of the simulator and him stepping in, I hardly noticed this comment register with him as we quickly checked off a few more pleasantries then went on our separate ways. But later that night, I answered an unexpected phone call from the same coworker.

"Jared, I'd like to talk to you about your aircraft search."

He explained that he had owned two aircraft in the past and had decided to sell his most recent airplane because he simply wasn't flying it enough on his own. But he missed owning an airplane, and with the addition of a partner, he thought this could be an ideal setup to reduce costs and increase utilization. My mind immediately raced with the possibilities.

It was a quick conversation to pitch the idea, and we agreed to take time to think it over and discuss it with our wives. But before we exchanged goodbyes, he added, "I'm very serious about this."

He need say no more. After pouring over the numbers, I knew that sole ownership had major financial drawbacks. In fact, a number of T&T readers we heard from attested to the value of finding a quality partner. And that is exactly who I unwittingly stumbled upon – a trusted friend, top-notch aviator and experienced owner. This was a gamechanger.

Following our short phone conversation, I wanted to lay it all out on the table to ensure we both wanted the same things. So, I composed an email detailing our must-haves, deal-breakers, budget and scheduling requirements (including links to the previous T&T articles, of course). As it turns out, we are a great match.

Thanks to a hectic December work schedule, this back and forth took up the remainder of 2020. So now we find ourselves in a new year with essentially a new search. In discussing the ideal aircraft for both of us, we have narrowed it down to either a straight tail Bonanza (likely an early F33A) or a well-maintained and upgraded late-model Debonair. The market appears to have cooled slightly, but aircraft are still going quick. Jointly, we do not feel an urgency to purchase an airplane right away and are holding out hope that we will stumble onto the right airplane through a connection rather than the battlefield that is online aircraft listings.

But, as the warmer months approach, I imagine our urgency will grow, and the search will intensify. So, keep your eyes out – with any luck, there will be more exciting details in Editor's Briefings to come!

rebecca@twinandturbine.com

Airmail

In Response to Kevin Ware's "Under Pressure" (November)

I enjoyed your article this month on pressurization. I just bought my first pressurized aircraft, a P337H Skymaster. I found your comment humorous, "I am routinely told flying piston twins without full pressurization is somewhat common in the industry" – as all I've ever flown for 25 years (besides airliners) is unpressurized twins!

You can fly a Turbo Skymaster (non-pressurized version) legally to FL300 while wearing an oxygen mask, but my pressurized edition with the same engines and very similar weight may only be legally flown to FL200 while pressurized. The cabin is at 10k when the aircraft is at FL200. I've read reports of owners flying as high as FL240 without issues, but I would imagine Cessna was trying to protect the pressure vessel when they limited it to FL200.

The Skymaster was the only twin ever built at Cessna's Pawnee factory and one of only two pressurized aircraft built there – the P337 and the P210. So not a lot of pressurization experience at the plant. That said, I love the concept of being pressurized. On the inaugural flight home, I flew VFR at 17.5, and she maintained the max cabin differential the whole flight. From CO to TX, we averaged 210 knots and 24 gph total.

I appreciate you pointing out the deficiencies in the design, i.e., the inspection plate. So many times I've asked myself, "Why did they build it this way???" I know the day will come when I'll be hunting down leaks in my bird, so I wish you the best with yours! May your leaks be sealed!

Mark Shackelford

Enjoyed your article on the pressurization issue. I have a 1976 414 and every year mine gets a little worse. I have had mechanics chase this for several years without much benefit and a lot of money. My annual has just started, and I am interested in pursuing the cause during the inspection. My mechanic admits he comes short when it comes to the pressurization system but is willing to have me help him. Did you use the vacuum process and did you find your main leak? I have replaced many seals and boots over the years. On the ground, do you pull the gear breaker to bypass the squat switch that would open the dump valve? Any information would be greatly appreciated.

Bryan Browne

MYGOFLIGHT
Cockpit Mounts and Accessories

by **Rich Pickett**


MYGOFLIGHT Sport Mount

During the November 2010 AOPA Conference in Long Beach, California, you may have seen three guys roaming the convention center by the Internet kiosks or vendor booths. If they saw you holding an iPad, they likely approached to showcase their single product – an aluminum iPad case. If there was interest, they led you to the Internet kiosk area, brought up a website storefront and sold you one on the spot! With 150 cases, it was first come, first served.

The three guys – Charlie Schneider, Dominic (Nick) Martinez, and Brian Domareck – are the founders of MYGOFLIGHT. Since their first experience at the AOPA event, they have grown tremendously, building a strong online presence and showcasing their expanding product line across several aviation events. Recently, we visited their offices in Denver, Colorado, to learn more about the company and the latest products.

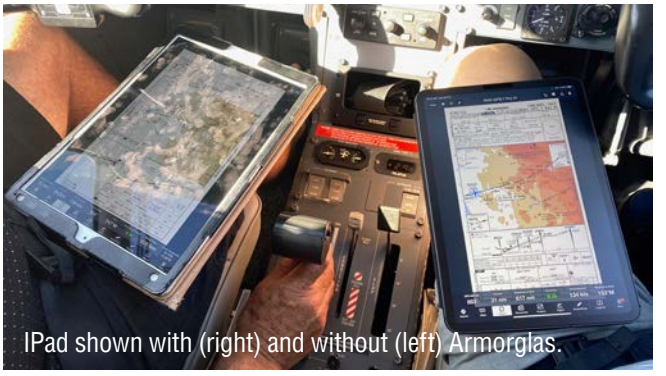
Background

Charlie started flying so he and Brian could efficiently visit clients of their company, Builder Sourcing. Many clients were in smaller cities with local or regional airports, none easily accessible by the airlines. So, Charlie purchased a Cirrus SR22 in 2007 to learn to fly (and still has that plane today). Charlie quickly found he did not like to deal with paper in the cockpit, so he purchased an Apple iPad. Of course, once you have a tablet, you have to find a way to keep it handy and secure. Hence the impetus for their first iPad case.

MYGOFLIGHT has since expanded rapidly to a full set of innovative and flexible mounting devices for a variety of aircraft environments. Their quick-connect mounts, which I've used for years, enable pilots to quickly change devices or mounts as needs change. While initially focused on products for pilots, their mounts work equally well for other modes of transportation such as boats.

Tablet Products

Once you fly with a tablet in bright sunlight, you immediately learn how difficult it is to view the display in those conditions. I'm always moving my iPad to just the right position to see the display. To solve that particular problem, MYGOFLIGHT developed a no-glare glass overlay for tablets and smartphones called Armorglas. I use one on my iPad and the difference in bright sun is amazing. I've found that the glass improves visibility during a wide range of lighting conditions. It even reduces fingerprints, keeping your electronic devices much cleaner and easier to read.


IPad shown with (right) and without (left) Armorglas.

How many pilots have experienced the dreaded tablet shutdown from overheating in our cockpits? Of course, it usually happens at the most inopportune times, like during an approach. Your only option is to hold it up to the air vent and hope that the incoming air will cool it down before you have to intercept the glideslope, which doesn't always happen. As technology improves, so do the cooling requirements of the processors, which only exacerbates the problem.

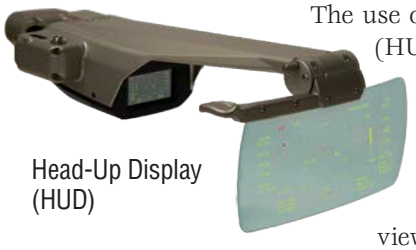
The folks at MYGOFLIGHT have come up with an innovated iPad case with a small, intelligent cooling fan system. I tested out their prototype and it would be great not only for airborne use but any time you might experience excessive heat. The units are now available for the iPad, and I suspect they might even expand the line to accommodate other devices in the future.

Storage Solutions

MYGOFLIGHT developed a line of cases, backpacks and luggage specifically designed for pilots and other sports enthusiasts. The backpack offers unique pockets to make it easier for pilots to carry a wide variety of devices, flashlights, standby radios, and almost anything else you need.

Extending on these products, they recently designed and added a set of luggage, custom-made to their specifications. Recognizing it can be easy to load up your plane beyond its useful load, they even sell a very handy digital scale that is easy to use.

Next Breakthrough



Head-Up Display (HUD)

The use of a Head-Up Display (HUD) is shown to positively impact aviation safety, providing critical flight information directly in front of the pilot's view during certain phases of flight. The Flight Safety Foundation confirmed that conclusion in two studies, one in 1990 and subsequently in 2009. Based on their research, the use of HUDs might have prevented, or at least resulted in a better outcome, between 31 and 38 percent of accidents.

The folks at MYGOFLIGHT also believe in its effectiveness and have developed a HUD for general aviation – the SKYDISPLAY HUD. Of course, they used Charlie's Cirrus SR22 as the development platform, flying countless tests. Their HUD has now been approved by the FAA and can be installed in a number of Part 23 aircraft, including several turboprops and turbines. Recognizing the significance of their new product line, MYGOFLIGHT formed a new division named SKYDISPLAYHUD (*www.skydisplayhud.com*).

The team also decided to integrate a MaxVis Enhanced Vision System (EVS) with their HUD, further enhancing the utility. Imagine flying at night, in low visibility, and having an infrared image of the airport environment projected directly in front of you – along with the other critical information. Another great example of its usefulness is firefighting, allowing pilots to spot fires, follow the appropriate FPV, and see through the smoke – further enhancing flight safety. For aircraft with an existing MaxVis EVS (or installed at the time of the HUD), no additional approval is necessary.

MYGOFLIGHT expects FAA approval in January, with initial installations available on aircraft with Avidyne, Garmin G500/G600 (TXi) and Aspen avionics. The HUD sells for $29,500 and installation costs vary.

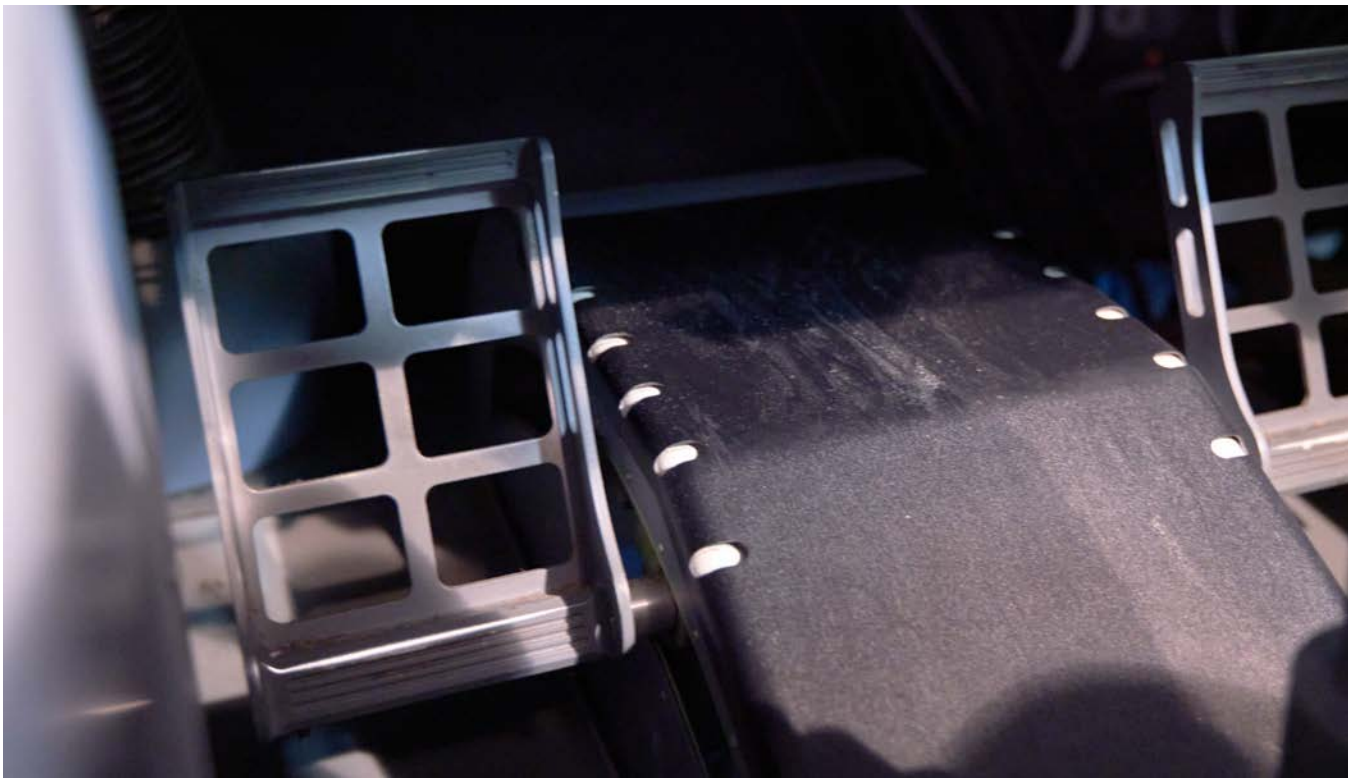
In Conclusion

It is inspiring to explore aviation technology with such innovative individuals like the team at MYGOFLIGHT. Over the last 10 years they have proven the value of their products, and the passion they have for aviation is evident. Stay tuned for more product reviews in the future. 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, Beechcraft Premier and DA10. His company, Personal Wings, provides training, mentoring and aircraft services. He is also a proud owner of an Eclipse and Cirrus SR22. You can contact Rich at* **rich@personalwings.com**.

Dangerous Rudder

by **Stan Dunn**



Traditional oral exams begin with a cavalcade of numbers. The multitude of airspeeds, weights and operating restrictions that are regurgitated inevitably succumb to mist within a week (humans are horrible at remembering arbitrary numbers). Fortunately, most of the important stuff is depicted by color-coding on gauges. Everyone knows that red represents a restriction, yellow indicates caution, and green means go. Glass cockpits with integrated electronics have further reduced the burden of memorization – computers can deal with the details while humans manage the big picture.

The first airline that I worked for (now defunct) demanded an unholy amount of memorization. We had to recount every limitation on the aircraft, as well as 80 steps split between two dozen different procedures (we had five different go-around profiles and befuddlingly had to memorize how to enter a stall). Faithfully recalling two pages worth of memory items was improbable during live-fire training and impossible during an actual emergency. We were at the tail-end of the industry transition away from memorization. Quick reference checklists are much more reliable.

An engine fire (as an extreme example) does not require an immediate response. Flames in flight are scary, but firewalls protect the occupants for a period of time – at least long enough to ensure aircraft control prior to running the appropriate procedure. Obviously, a fire is a condition that must be addressed, but it is all too easy to "do the wrong thing rapidly" in a rushed response to a high priority item. More than a few crashes have resulted from scurrying pilots shutting down the good engine.

Pilots should restrict memory items to issues that immediately affect the stability of flight. This does not mean that a pilot should not "fix the obvious" (if you switch fuel tanks and the engine begins to run rough, for example), but that deliberation is often the better solution to in-flight disturbances.

Flight Controls

Numerous studies indicate that stick-and-rudder skills are also enhanced when they are a part of a deliberative process. All too often pilots react impulsively in response to relatively benign disturbances. There are many accidents resulting from

confused pilots reacting without thinking, inputting control forces that ultimately doomed the aircraft.

The failure to fly deliberately has produced a history of inappropriate inputs in all three axes of flight, but the worst offender has been the rudder. It is one of the most confounding devices on an aircraft. The controls are buried beneath the pilot's feet, so it can be difficult for an observer to determine how a pilot is manipulating the pedals. This reduces the ability for instructors (or more experienced copilots) to pass along corrections for ineffective rudder technique. Sometimes pilots are released into the wild sans a substantial idea of how to use one of the biggest control surfaces on an aircraft.

Over time we develop some ideas about the rudder. Pilots of taildraggers cannot stop yapping about it (it is hard to forget the experience of a ground-loop). It is used in props to counteract p-factor and as an aerodynamic cudgel to eliminate excess energy on final. In aircraft from LSAs to A380s, it is the means to maintain directional control in crosswind conditions. The rudder is alternately the most demanding and the most dangerous device aboard an aircraft.

V_a is the maximum speed at which full deflection of the flight controls can be commanded without undue risk of structural failure. It is an arbitrary number that should be memorized. As important as it is, V_a comes with a rather important caveat: Flight controls are only protected when inputs are initiated from the neutral position. Alternating deflections (stomping on the right rudder and then stomping on the left) can result in structural failure – even at speeds well below V_a. Although this caveat technically applies to the elevator and ailerons as well, it is the rudder that is most at risk in the event of oscillatory inputs.

Enhancing the danger is the fact that the rudder is one of the least predictable devices on an aircraft. Both the ailerons and elevator are fairly linear – a given control force will result in a fairly predictable rate of roll or pitch. The rudder is quite a bit more finicky. If the aircraft is in a slip, rudder towards the side of the slip will have to overcome the aerodynamic forces already acting against the vertical stabilizer, and a little bit of rudder will have little effect. If rudder is opposite the direction of the slip, the aerodynamic force of the rudder and vertical stabilizer will sum into a large rate of yaw. Thus the same amount of pressure on a rudder pedal can produce significantly different results (a notable percentage of pilots reported experiencing "unexpected rudder characteristics" in an FAA survey).

"The failure to fly deliberately has produced a history of inappropriate inputs in all three axes of flight, but the worst offender has been the rudder. It is one of the most confounding devices on an aircraft.

This ambiguity greatly increases the probability that a pilot will fall into the trap of divergent oscillation, cycling from left to right rudder at an increasingly dangerous rate. The yaw generated from an engine failure on a multi-engine aircraft, for example, can create a startle response inappropriate for the situation. Kicking the rudder in alternating directions can place massive forces on the vertical stabilizer risking structural failure. The scale of those forces is insidious due to the fact that pilots often have no kinesthetic notion that they are occurring (a rudder may experience thousands of pounds of force, while the rotational acceleration felt by the pilot is relatively minor).

FAA Technical Report

The issue of rudder usage was central to an FAA report released in October of 2010. The survey focused on transport category aircraft but is applicable to high-performance passenger aircraft as well. The survey focused on unusual attitudes, with 914 pilots relating various experiences encountered over the course of their career.

Nearly two-thirds of pilots reported unusual attitudes during low-level flight associated with takeoff, landing and initial climb. The vast majority were attributed to wake vortex encounters (62 percent) and atmospheric disturbances (21 percent). It is important to note that nearly all respondents flew aircraft that weighed in excess of 100,000 pounds. Wake turbulence is not a problem for only small aircraft.

With wake turbulence making up the majority of disclosures, it was unsurprising that roll upsets were predominantly described. Interestingly, 56 percent of pilots reported using the rudder in response to these roll events. This almost exactly matches the number of pilots who indicated that they had received aerobatic training at some point in their life. Aerobatic flight demands a substantial amount of rudder coordination, sometimes applied quite aggressively. The law of primacy in training is apparent here as pilots routinely transfer techniques learned in earlier flying experiences to aircraft for which they may be inappropriate and sometimes dangerous.

In many cases, the respondents described using rudder in a manner inconsistent with industry and manufacturer guidance. The final report also noted that pilots tend to consider an aircraft "upset" based on motion

Propellers have not changed much over time – feathering can be a matter of life or death.

(g-forces) as opposed to pitch or bank angles. Pilots perceived the immediate need to intervene at pitch and bank angles substantially less than the "unusual attitude" definition of 25-degrees nose up, 10-degrees nose down, or 45-degrees of bank.

While preventative awareness of pitch and bank is commendable, aggressive reactions are generally unnecessary. A benign atmospheric force (or wake turbulence) often disturbs a flight only momentarily. Passenger aircraft are almost uniformly designed to be stable so that a disturbance will automatically result in a restorative force. Sudden g-forces can create the dreaded startle response, which routinely produces inappropriate reactions to otherwise mild upsets. One-sixth of pilots admitted to inappropriately over-controlling or making inputs in the wrong direction in response to sudden stimuli. Pitch excursions based on improper pilot input were rare (likely due to the kinesthetic of g-force feedback). Inappropriate roll commands were more likely. The rudder was the greatest offender.

Troublingly, many of the erroneous rudder inputs were calculated to have exceeded certification criteria. While none of them exceeded the ultimate structural load limits, they nonetheless transgressed the margin of safety built into the certification process. The reality of this was reinforced by a companion simulator study that revealed the tendency for pilots to over-control the rudder (exposing the vertical stabilizer to large g-forces) with the ham-fisted application of rudder inputs. Each type of aircraft is unique, and it is incumbent on pilots (and training programs) to develop type-specific techniques appropriate for the particular airframe. In general, modern swept-wing aircraft (those with active yaw dampers) do not require much rudder input outside of asymmetric thrust or crosswind conditions.

"Between 1994 and 2003 there were [multiple aircraft] accidents across the globe which resulted in more than 2,100 fatalities – all the result of aircraft upsets." – FAA "Perspectives of Directional Control Events"

From the NTSB Database

Overusing the rudder can have devastating consequences, yet it is also dangerous to ignore it. The rudder conveys important information to a pilot, and proficiency in interpreting that information can be indispensable to successfully resolving an in-flight disturbance. An overemphasis on rudder use is uncalled for, but the failure to develop proficiency on it can be reckless.

The crash of a Cessna 414A in picturesque Kahului, Hawaii, had (as most accidents do) many factors. The Part 91 aircraft was carrying three occupants, all of whom died. The left engine failed for undetermined reasons while the aircraft was preparing for landing. The recovered aircraft was configured with the flaps fully extended and the gear down. Both propellers were found in a low pitch (not feathered) setting. The crash occurred 0.6 miles west of the approach end of the runway.

Very few multi-engine aircraft can maintain altitude with an engine inoperative, gear down and flaps fully extended. Feathering the propeller on the inoperative engine is also paramount to aircraft performance on a propeller-driven aircraft. In the mental fog that accompanied the mechanical malfunction, the pilot failed to account for the drag that the aircraft was encountering as a result of its configuration. Controls in the aircraft allowed a quick remedy for gear, flaps and propeller settings – and would have substantially increased performance, allowing the remaining 310-horsepower engine to complete the emergency landing.

As airspeed decayed below V_{mc}, a pronounced roll into the failed engine would have inevitably developed. The ailerons do not have the control authority to manage this at slow airspeeds, requiring an increasing amount of rudder to counter the roll. The rudder shouts at the pilot to lower the nose, reconfigure and climb away – or lower the nose and crash right-side-up if no better option is available. Yet all too often, the pilot, oblivious to the information being conveyed by the rudder, keeps increasing the elevator until the roll becomes a V_{mc} spin. Too many pilots have succumbed to V_{mc} rolls throughout the history of multi-engine flight. The results are nearly always fatal.

The rudder can be confounding and is likely the most overlooked device on an airframe. Its importance is integral to pilot proficiency, but it is also in danger of being overstated. In one of those little contradictions common to life, the proper approach is to know your rudder well – just try not to use it too much. T&T

Stan Dunn *is an airline captain and check airman. He has 7,000 hours in turbine powered aircraft, with type ratings in the BE-1900, EMB-120, EMB-145, ERJ-170, and ERJ-190. Stan has been a professional pilot for 14 years, and has been flying for two decades. You can contact Stan at* **Stan@flyingformoney.com.**

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ELECTRIC FUTURE

CLEAN, QUIET & POWERFUL PROPULSION

by **Grant Boyd**

Ampaire

While we typically look to our favorite longtime OEMs and service organizations for the latest and greatest in new aircraft and STC's, other notable happenings are percolating in aircraft development that can easily be overlooked. Among these game-changing developments are electric propulsion systems. Many companies are currently working on designing, manufacturing and implementing hybrid electric, and ultimately all-electric aircraft, from trainers to regional passenger-carrying aircraft and everything in between. We turned to three of those companies – Ampaire, magniX and Bye Aerospace – to learn the latest.

Ampaire

Brice Nzeukou, product manager for Ampaire, explains why the aviation industry is seeing more of a shift toward electric propulsion: "There are many benefits that come with an all-electric aircraft. Some of the most tangible benefits are energy and maintenance cost savings, zero tailpipe emissions and lower noise emissions. Some of the higher-level benefits include lower airfare for passengers and increased accessibility to smaller airports."

Ampaire, based in Hawthorne, California, is focused on bringing electric powertrain technology to regional aircraft of 19 seats or less. Founded in 2016, the company currently uses a Cessna 337 Skymaster called The Electric EEL in its flight test program. This hybrid-electric test platform, which utilizes both electric and traditional powertrains (a 160-kW electric power unit up front and a 300-horsepower Continental IO-550 in the back), had its first flight in September of 2020. The aircraft's milestone was preceded by a previous prototype outfitted with a conventional engine in front and an electric power unit in the rear, which first took to the skies in 2019.


Ampaire Electric EEL

Nzeukou stated, "Our retrofit [of existing aircraft] approach is much more involved than just developing the powertrain; it requires a deep analysis of the aircraft performance and integration approach, with special attention paid to safety considerations. This also supports our growing expertise in working with regulatory bodies to certify the modifications."

Results from the company's flight-testing program have been beneficial for the team in their continued development of the product, as well as proof of concept for existing and future customers – a list headlined by Mokulele Airlines. The Electric EEL is currently going through the paces in Hawaii, demonstrating the value of electric aviation in a location with challenging geography. The "island-hopping" flights that the airline makes in Caravans are ones that the company sees much potential to electrify due to the reduced costs and other direct benefits (such as lower emissions).

In the future, Ampaire also intends to partner with OEMs to replace conventional engines with zero-emission or low-emission technologies. "By pairing our innovative technology with proven airframe designs [rather than creating a clean sheet aircraft model], we reduce risks and maximize benefits for our customers," said Nzeukou.

To this point, the company is currently working on a low-emission, hybrid electric variant of the DHC-6 Twin Otter. The team expects an operating cost reduction of approximately 30 percent in this configuration and is currently being tested in conjunction with NASA in a FAA Part 23 capacity.

magniX

magniX, based near Seattle, began as a General Electric motor R&D company in 2009 and transitioned exclusively to aerospace in 2017 after the team identified a strong opportunity with its technology. The research team found that its low RPM, high-quality, redundant motor with a high-power-to-weight ratio and advanced power electronics was ideal for aircraft.

Among the company's current Electric Propulsion Unit (EPU) offerings are the magni250 (375 horsepower/280 kW) and magni500 (751 horsepower/560 kW). The magni250 is suitable as a standalone propulsion system for smaller aircraft or a distributed propulsion system on a larger aircraft. The magni500 is built for "middle mile" aircraft like Caravans and King Airs. The company is currently expecting FAA Part 33 Certification on the products in the first half of 2022.

The company's two EPUs are "direct to propeller," meaning they are designed to provide the required torque and power turning at only 1900 RPM, the same speed as the propeller. This eliminates the need for heavy maintenance-prone gearboxes. Another EPU benefit is that it's sealed from both ends with an advanced air filter, which reduces FOD and other contaminants from entering. It also contains a proprietary closed-loop liquid cooling system that allows for full performance no matter the environmental conditions and full torque availability, even when operating at very low RPM. The EPU provides the same levels of torque and power no matter the altitude or temperature as it is not impacted by air density.

magniX's design and testing program was highlighted in 2019 with the flight of the world's first all-electric commercial aircraft, a DH2 Beaver operated by Harbour Air of British Columbia Canada. Another milestone was achieved in 2020 with

magniX eCaravan

the first flight of the company's 208B Cessna Grand Caravan outfitted with a magni500 propulsion system. This feat marked the aptly named eCaravan the "world's largest commercial electric aircraft."

Of course, some obstacles have hindered all-electric powerplants in the past, most notably the batteries. While still a challenge actively being navigated by all in the space, magniX estimates the current 100-nm range of their eBeaver and eCaravan will triple in a decade; a conservative estimate based upon current trends in battery technology improvements and the team's efforts. There are also players within the battery industry working on newer battery types, such as aluminum-air and lithium-ion, that could make a 300-nm mission a quicker reality.

magniX CEO Roei Ganzarski noted these improvements are important in reaching the goal of creating the electric commercial aviation future. He also warned OEMs and others to be careful not to become the Kodak of the aviation industry. "Kodak was in a position to lead with the new digital technology that was taking hold of photography culture, but they couldn't keep up once they finally accepted its importance and decided to pivot."

Ganzarski anticipates the industry to be solidified in this new electric future in about a decade or so, a period where we will see existing OEMs either unveil their own electric aircraft, partner with (or acquire) startups, or ultimately begin a gradual decline if they don't ride the waves of change.

Bye Aerospace

Bye Aerospace, based in Denver, is headed by George E. Bye, who has led various aircraft design and certification programs over the course of several decades. The company is firmly planted on the trainer market side with its eFlyer 2 – a two-seat aircraft propelled by an ENGINeUS 150 horsepower (110 kW) powerplant produced by Safran.

Bye Aerospace eFlyer 2

Seeking to largely reduce the operating costs of flight training, the company currently has deposits for a little over 700 models of its eFlyer 2 and four-seat eFlyer 4. "There is a large demand so far. Certainly here in North America, but also Europe and Asia, which you wouldn't think at first," said Bye.

Much of the demand is undoubtedly related to the company's history in the all-electric space as well as being the first FAA type certificate applicant of its kind. Bye explains that FAA certification, while delayed to COVID-19's effects, is going smoothly, and the company expects its eFlyer 2 aircraft to enter into service by Q4 of 2022.

In working towards that goal, the eFlyer 2 developmental prototype test team conducted 111 test events and 47 test flights over the last two years, which demonstrated "remarkable flight efficiency." At 9,000 feet density altitude, the aircraft had a 640-fpm climb at 68 kW (92 hp) and 120 KTAS cruise using only 45 kW (60 hp). With the eFlyer 2 critical design phase complete, the focus now shifts to the assembly of the first three conformed production aircraft that will be used by the company and the FAA to complete certification.

Bye Aerospace also seeks to take a bite of the market for aircraft with more seats and increased range. The company is developing a lightly pressurized six-seater called the eFlyer X. The eFlyer X will be a step up from the company's eFlyer 4 and is powered by a 200 kW (270 HP) all-electric powerplant. This model is followed by the Envoy, a twin version of the eFlyer X that is set to boast nine seats and fly 300 knots with a 500-nm range. The company anticipates a strong demand for these two products due to the high operating costs associated with aircraft today, many of which have been in service for multiple decades. Certification for the eFlyer 4 is currently expected in 2023, with the eFlyer X and Envoy entering into service the subsequent two years.

When asked why a lot of the industry buzz of electric powerplants is seemingly coming from startups and relatively small companies, Bye said that he is not surprised. "Large manufacturers such as General Motors did not lead the electric car revolution; Tesla did."

While not wanting to speculate on large OEMs' plans, Bye added that this technology will be disruptive, and its current state is already shaking up the industry.

Summary

Little is known regarding existing aircraft manufacturers and their intentions to compete in the electric future. What is known is that the above companies and others have made great strides in recent years. All-electric, commercially viable aircraft are not the far-away possibility that they once seemed to be, and future operators will undoubtedly appreciate the resulting cost savings, reduced noise and lower emissions that correlate with electric powerplants. T&T

Grant Boyd *is a recent MBA graduate of Wichita State University. A private pilot, Boyd is currently working toward his instrument rating, with the ultimate goal of combining his love of business and aviation with a career at a general aviation manufacturer. You can contact Grant at* **grantboyd2015@gmail.com**

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JETS - 17,806

CHIEF PILOTS & OWNERS

COUNT	AIRCRAFT
36	AIRBUS ACJ319
30	ASTRA 1125
32	ASTRA 1125SP
57	ASTRA 1125SPX
29	BEECHJET 400
266	BEECHJET 400A
195	BOEING BBJ
503	CHALLENGER 300
40	CHALLENGER 600
26	CHALLENGER 601-1A
121	CHALLENGER 601-3A
54	CHALLENGER 601-3R
325	CHALLENGER 604
7	CHALLENGER 800
148	CITATION 500
340	CITATION 525
318	CITATION BRAVO
187	CITATION CJ1
96	CITATION CJ1+
240	CITATION CJ2
225	CITATION CJ2+
476	CITATION CJ3
174	CITATION CJ3+
368	CITATION CJ4
189	CITATION ENCORE
74	CITATION ENCORE+
392	CITATION EXCEL
14	CITATION I
280	CITATION I/SP
445	CITATION II
54	CITATION II/SP
155	CITATION III
124	CITATION LATITUDE
247	CITATION M2
467	CITATION MUSTANG
130	CITATION S/II
323	CITATION SOVEREIGN
105	CITATION SOVEREIGN+
310	CITATION ULTRA
285	CITATION V
31	CITATION VI
122	CITATION VII
329	CITATION X
38	CITATION X+
253	CITATION XLS
301	CITATION XLS+
1	DIAMOND I
32	DIAMOND IA
16	DORNIER ENVOY 3
304	ECLIPSE EA500
75	EMBRAER LEGACY 500
100	EMBRAER LEGACY 600
53	EMBRAER LEGACY 650
247	EMBRAER PHENOM 100
328	EMBRAER PHENOM 300
80	FALCON 10
22	FALCON 100
16	FALCON 200
242	FALCON 2000
27	FALCON 2000EX
34	FALCON 20C
15	FALCON 20C-5
17	FALCON 20D
1	FALCON 20D-5
10	FALCON 20E
49	FALCON 20F
75	FALCON 20F-5
197	FALCON 50
8	FALCON 50-40
118	FALCON 50EX
178	FALCON 900
24	FALCON 900C
116	FALCON 900EX
156	GLOBAL 5000
123	GLOBAL EXPRESS
25	GULFSTREAM G-100
239	GULFSTREAM G-200
14	GULFSTREAM G-300
24	GULFSTREAM G-400
313	GULFSTREAM G-450
11	GULFSTREAM G-500
602	GULFSTREAM G-550
27	GULFSTREAM G-II
12	GULFSTREAM G-IIB
111	GULFSTREAM G-III
175	GULFSTREAM G-IV
338	GULFSTREAM G-IVSP
204	GULFSTREAM G-V
38	HAWKER 1000A
2	HAWKER 125-1A
2	HAWKER 125-1AS
12	HAWKER 125-400AS
2	HAWKER 125-600A
1	HAWKER 125-600AS
61	HAWKER 125-700A
72	HAWKER 4000
223	HAWKER 400XP
44	HAWKER 750
153	HAWKER 800A
14	HAWKER 800B
398	HAWKER 800XP
42	HAWKER 800XPI
88	HAWKER 850XP
187	HAWKER 900XP
2	JET COMMANDER 1121
2	JET COMMANDER 1121B
2	JETSTAR 731
4	LEARJET 23
12	LEARJET 24
2	LEARJET 24A
7	LEARJET 24B
20	LEARJET 24D
8	LEARJET 24E
6	LEARJET 24F
4	LEARJET 25
19	LEARJET 25B
4	LEARJET 25C
45	LEARJET 25D
4	LEARJET 28
32	LEARJET 31
182	LEARJET 31A
26	LEARJET 35
398	LEARJET 35A
21	LEARJET 36
33	LEARJET 36A
32	LEARJET 40
243	LEARJET 45
225	LEARJET 45XR
92	LEARJET 55
6	LEARJET 55B
8	LEARJET 55C
307	LEARJET 60
623	PILATUS PC-12/45
149	PREMIER I
1	SABRELINER 40
7	SABRELINER 40A
2	SABRELINER 40EL
2	SABRELINER 40R
4	SABRELINER 60
5	SABRELINER 60ELXM
68	SABRELINER 65
7	SABRELINER 80
1	SABRELINER 80SC
67	WESTWIND 1
1	WESTWIND 1123
14	WESTWIND 1124
50	WESTWIND 2

TURBOPROPS - 12,801

CHIEF PILOTS & OWNERS

COUNT	AIRCRAFT
403	CARAVAN 208
1,523	CARAVAN 208B
155	CHEYENNE I
16	CHEYENNE IA
206	CHEYENNE II
56	CHEYENNE III
38	CHEYENNE IIIA
57	CHEYENNE IIXL
35	CHEYENNE IV
235	CONQUEST I
291	CONQUEST II
38	JETSTREAM 31
63	JETSTREAM 32
52	JETSTREAM 41
37	KING AIR 100
450	KING AIR 200
17	KING AIR 200C

PHOTO BY JESSICA AMBATS

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617	KING AIR 350
62	KING AIR 350C
8	KING AIR 350ER
387	KING AIR 350I
4	KING AIR 350IER
8	KING AIR 90
6	KING AIR A/B90
76	KING AIR A100
184	KING AIR A200
34	KING AIR A90
197	KING AIR A90-1
105	KING AIR B100
1,038	KING AIR B200
107	KING AIR B200C
99	KING AIR B200GT
5	KING AIR B200SE
8	KING AIR B200T
47	KING AIR B90
302	KING AIR C90
38	KING AIR C90-1
186	KING AIR C90A
378	KING AIR C90B
76	KING AIR C90GT
88	KING AIR C90GTI
150	KING AIR C90GTX
13	KING AIR C90SE
258	KING AIR E90
173	KING AIR F90
28	KING AIR F90-1
5	MERLIN 300
13	MERLIN IIB
8	MERLIN III
22	MERLIN IIIA
44	MERLIN IIIB
14	MERLIN IIIC
3	MERLIN IV
11	MERLIN IV-A
101	MITSUBISHI MARQUISE
18	MITSUBISHI MU-2F
1	MITSUBISHI MU-2G
15	MITSUBISHI MU-2J
37	MITSUBISHI MU-2K
12	MITSUBISHI MU-2L
25	MITSUBISHI MU-2M
24	MITSUBISHI MU-2N
29	MITSUBISHI MU-2P
47	MITSUBISHI SOLITAIRE
796	PILATUS PC-12 NG
197	PILATUS PC-12/47
296	PIPER JETPROP
74	PIPER M500
92	PIPER M600
602	PIPER MERIDIAN
198	QUEST KODIAK 100
2	ROCKWELL 680T TURBO
5	ROCKWELL 680V TURBO II
4	ROCKWELL 680W TURBO II
4	ROCKWELL 681 HAWK
85	SOCATA TBM-700A
90	SOCATA TBM-700B
381	SOCATA TBM-850
121	SOCATA TBM-900
38	SOCATA TBM910
136	SOCATA TBM930
6	STARSHIP 2000A
50	TURBO COMMANDER 1000
22	TURBO COMMANDER 690
131	TURBO COMMANDER 690A
135	TURBO COMMANDER 690B
73	TURBO COMMANDER 840
20	TURBO COMMANDER 900
19	TURBO COMMANDER 980

TWIN PISTON - 6,872 OWNERS

COUNT	AIRCRAFT
35	BARON 56 TC
1,566	BARON 58
446	BARON 58P
118	BARON 58TC
3	BARON A56TC
335	BARON G58
158	BEECH DUKE B60
150	CESSNA 340
480	CESSNA 340A
49	CESSNA 402B BUSINESS LINER
110	CESSNA 402C
20	CESSNA 404 TITAN
312	CESSNA 414
430	CESSNA 414A CHANCELLOR
36	CESSNA 421
30	CESSNA 421A
335	CESSNA 421B
713	CESSNA 421C
38	CESSNA T303
100	DIAMOND D42
65	PIPER 600 AEROSTAR
3	PIPER 600A AEROSTAR
44	PIPER 601 AEROSTAR
4	PIPER 601B AEROSTAR
182	PIPER 601P AEROSTAR
21	PIPER 602P AEROSTAR
509	PIPER CHIEFTAIN
20	PIPER MOJAVE
280	PIPER NAVAJO
196	PIPER SENECA
13	ROCKWELL 520 COMMANDER
3	ROCKWELL 560 COMMANDER
11	ROCKWELL 560A COMMANDER
7	ROCKWELL 560E COMMANDER
6	ROCKWELL 560F COMMANDER
12	ROCKWELL 680 SUPER
3	ROCKWELL 680E
14	ROCKWELL 680F COMMANDER
11	ROCKWELL 680FL GRAND COMMANDER
4	ROCKWELL 680FLP GRAND LINER

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COUNT	AIRCRAFT
200	BEECH BONANZA
435	CESSNA 182
52	CESSNA 206
373	CESSNA P210N
21	CESSNA P210R
54	CESSNA T182
790	CIRRUS SR20
2,875	CIRRUS SR22
26	MOONEY ACCLAIM ULTRA
11	MOONEY OVATION ULTRA
271	PIPER MALIBU
93	PIPER MATRIX
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IS&S Autothrottle System for PC-12s and King Airs

by **Dale Smith**

Okay, so you've lined your twin up for takeoff, advance the throttles, V_1, V_2, rotate, and just after you've stowed the gear, the left engine gives up. As you try to "rub your head and pat your tummy," you reactively do your best to control the airplane and keep it flying. But, in your attempt to maintain altitude, the airspeed drops off and suddenly you're on the wrong side of right-side-up.

Of course, this is the classic VMCa stall situation. As you'll recall from your training days, VMCa stands for Velocity-Minimum Control (airspeed). That happens when a multi-engine aircraft suffers the failure of one engine. While trying to maintain altitude, the pilot pulls back on the yoke, dropping the airspeed to the point where they lose control of the aircraft.

In fact, when it comes to VMCa situations, it can be easier to keep a piston twin right side up than a twin turboprop. Why? When you lose an engine on a piston twin, you pretty much are committed to an emergency landing.

But, with the turboprop's added power is a temptation to keep flying. So, when you lose power on one side and still have all that added horsepower lifting the opposing side, the asymmetric thrust makes the airplane that much more unstable in the roll axis. Even the best of us can easily get way behind the airplane in that situation.

Less Power to You

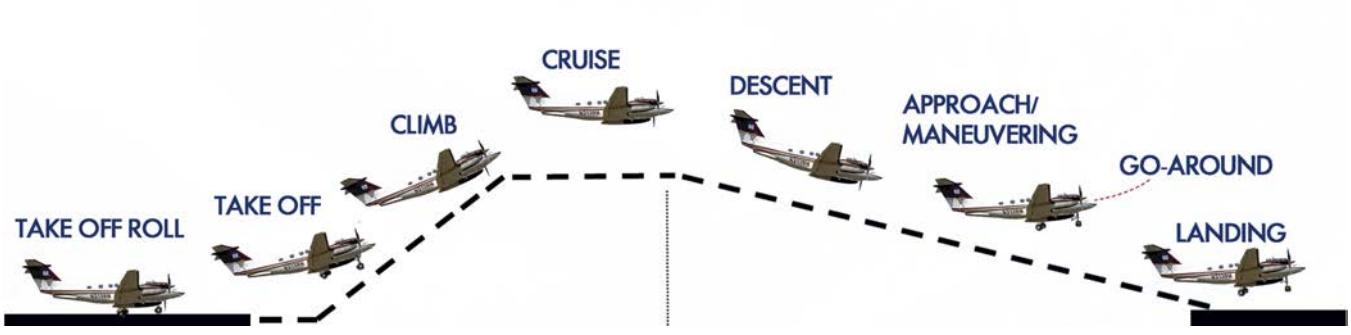
And if it's a problem with a pair of 650 shp turboprops, it must be a huge issue with much more powerful aircraft. And it would be if not for dynamic engine control technologies.

"I was an aerodynamicist on the F-14 Tomcat program for Grumman, which was one of the first aircraft to have dynamic VMCa protection," explained Tom Grunbeck, director of autothrottle programs for Innovative Solutions & Support (IS&S). "If you lose an engine on takeoff, the 'good' engine will maintain a fixed limited power of approximately 25 percent of thrust so the pilot can maintain directional control."

"Our new ThrustSense Autothrottle system is the only full-regime system available with dynamic VMCa protection," he continued. "ThrustSense for the King Air features our patented LifeGuard Protection system that dynamically adjusts the power settings on the 'good' engine based on the aircraft's airspeed to help the pilot maintain directional control."

As Grunbeck explained it, the ThrustSense Autothrottle controller collects all the aircraft's current flight data, then automatically calculates airspeed, engine power and rudder-effectiveness during single-engine operations, and it can make its throttle adjustments. And it does it at up to five-knots-per-second intervals.

"Our real-time analysis of loss of control due to asymmetric thrust and sudden loss of airspeed showed that by modulating the remaining engine's available thrust, all the pilot has to do is put their foot on the rudder on the side of the failed engine and the airplane will stay straight," added IS&S Chairman and CEO, Geoffrey Hedrick. "No matter how slow you go, the airplane will go straight and level to the stall. Of course, our ThrustSense Autothrottle will sense the loss of airspeed and



IS&S ThrustSense Autothrottle – modes of operation.

automatically advance power on the good engine to help prevent the stall. It keeps the pilot in control and the airplane right side up."

Easier Said Than Done

As you may well expect, developing a system as sophisticated as ThrustSense didn't come easy. Even to a company with "Innovative Solutions" in its name.

"Right after we got a Pilatus, I decided then to develop the autothrottle system, but it was a lot easier said than done," Hedrick said. "For the next 15 years, we worked on it until we came up with a very simple, retrofittable actuator that is truly failsafe. We put it on our airplane, and it works perfectly."

"We developed our first ThrustSense Autothrottle system for our PC-12, but the team saw more potential, so IS&S purchased a King Air to use for the twin-engine program," Grunbeck said. "With the King Air, we had two main hurdles from the retrofit standpoint: system size and cost. There were already autothrottle systems available, but they are very expensive and add too much weight."

"We overcame both hurdles through a combination of developing our own proprietary actuators and doing something I think is incredibly innovative: Our engineers built the autothrottle's controlling computer into our integrated standby unit (ISU)," he continued. "So, the retrofit installation requires replacing the legacy standby unit with our ISU and adding the actuators into the existing throttle quadrant. That greatly simplifies the installation."

Grunbeck said that the new IS&S actuators are very light, small, and extremely reliable. And the entire system weighs in at only 5 pounds – about one-sixth of other autothrottle systems.

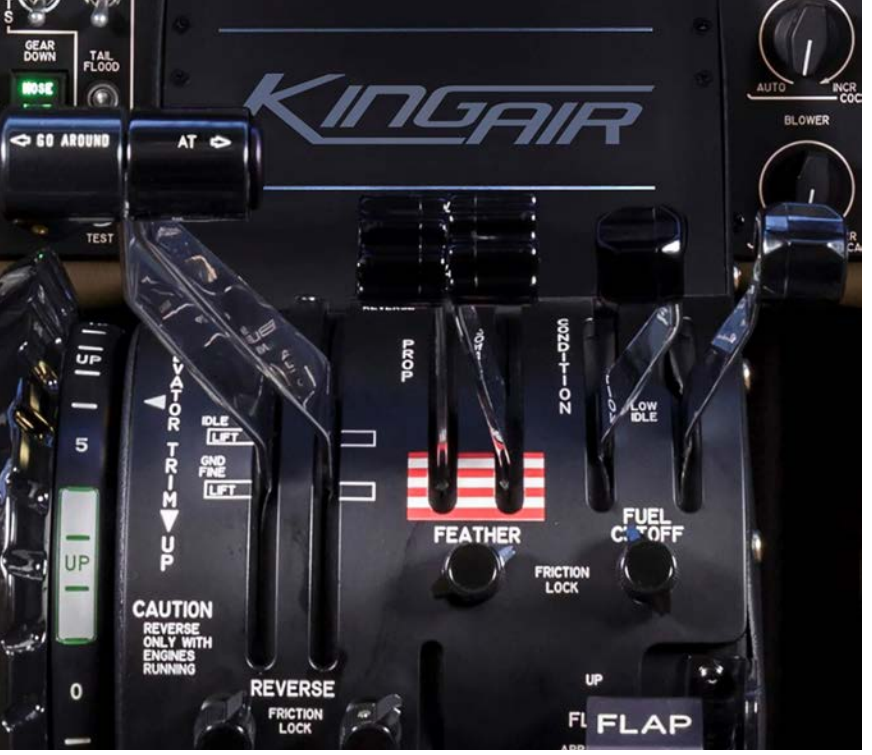
"Our actuators are extremely sensitive and accurate. They can actually move the power levers the width of a human hair," he said. "There's no hunting power at cruise to maintain airspeed. The system does it all."

Full-Regime Benefits

"ThrustSense is the only full-regime autothrottle available for retrofit on the PC-12 and Collins Pro Line 21 and Fusion-equipped King Air family," Grunbeck said. "Some other production autothrottles are engaged in climb and not on takeoff. The benefits of full-regime operation are an extremely important differentiator for us."

According to Grunbeck, the patented ThrustSense full-regime autothrottle provides automatic power management from takeoff to touchdown, including go-arounds. In addition, the system protects the engine against operator-induced speed exceedances, engine over-torque, and under-temp – all of which greatly enhance the safety and operational value of the aircraft.

"We pride ourselves in delivering truly innovative and unique solutions to problems. For example, the autothrottles feature our patented



▲ Installation in Pilatus PC-12 legacy and NG.

◀ Existing King Air throttle quadrant with IS&S actuator installed.

"Guard Mode" that lets you manage the power manually, but the system will automatically keep the engine where it needs to be for that phase of flight," Hedrick added. "If you advance the throttle to a point where it will over-temp or over-torque, the system will automatically push the power to a safe zone."

"It gives you feedback in the throttle's feel. If you are approaching the engine's limits, it will actually push back on the power so you don't overstress the engines. A lot of pilots are asking for that feature," he said. "It's the same if you're on approach and slow the airplane down too much. It will automatically sense the loss of airspeed and advance the throttles to maintain a safe maneuvering speed."

While the IS&S ThrustSense Autothrottle system is extremely capable, as Grunbeck explained, it's simple to use.

"Once you're lined-up for takeoff, you just push the go-around (GA) button, and that engages the autothrottle system. In takeoff mode it lets the engines spool up and deliver maximum torque and temperature limits for that density altitude. It also automatically corrects for any engine surges that may occur as the power is advanced," he said. "After takeoff, there are modes to optimize every phase of flight."

- **Takeoff Mode:** ThrustSense compensates for environmental conditions and mitigates engine surges during power-up. Takeoff Mode is active until the system transitions into Climb Mode.
- **Climb Mode:** The throttles are automatically reduced to maximum continuous climb or torque schedule as a function of the altitude.
- **Airspeed Mode:** Controls airspeed to a command value through a manually-selected speed change. The autothrottles maintain a constant mach airspeed, as commanded by the FMS or, pilot's IS&S Integrated Standby Unit (ISU).
- **Protection Modes:** Continually monitor the aircraft and engine performance. The engines are kept within safe torque and temperature limits, per the aircraft's POH.
- **VMCa Mitigation:** ThrustSense A utothrottle will apply appropriate maximum safe power that precludes any adverse yaw and catastrophic upset. The autothrottle's One Engine Inoperative (OEI) mode is active during engine loss when ThrustSense is engaged for takeoff, climb, or go-around.
- **Go-Around Mode:** ThrustSense automatically sets maximum safe power while providing full engine protection.

No matter what mode you are in, automatic engine management and protection is a key benefit that ThrustSense brings to both the Pilatus PC-12 and King Air series. But, while it provides "automatic" protection, it still permits pilots to hand fly the throttles if they want.

"In some systems, we can also integrate our new ThrustSense Autothrottle to have full 4D navigation capabilities," Hedrick added. "Vertical and lateral navigation, RNP (required navigation performance), LPV (localizer performance with vertical guidance), as well as the required time-of-arrival. It's quite a valuable and safety-enhancing upgrade for these aircraft."

While that's certainly an impressive array of workload-reducing features, the company recently announced some significant additions, including Torque Matching, Power Lever Detents and an Electronically Controlled Throttle Handle Brake. As you may guess, the King Air ThrustSense will offer all those with the addition of the new Asymmetrical Beta Mode Protection capability.

Affordability of Autothrottle Enhancements

"Sure, I want one," you say. "But what's it cost?"

As of this writing, Grunbeck said that if you're flying a Pilatus PC-12

(legacy or NG-series), the system MSRP is just under $55,000. For a Collins Pro Line 21-equipped 200- and 300-series King Airs, the system lists for $68,000. If your King Air has Collins Fusion integrated avionics, the ThrustSense kit retails for $76,550. The higher cost is due to the Fusion system requiring a second remote unit. And, yes, prices are subject to change.

The MSRP is for the complete installation kit including the STC and a new IS&S Integrated Standby Unit (ISU), but does not cover the labor for the installation. As you can guess, that depends on the particular aircraft's equipage and panel configuration.

As for who can do the installation, Grunbeck said that any authorized Pilatus Service Center can install the IS&S system. On the King Air side, along with the Textron Aviation Service Centers, IS&S has established relationships with a number of leading MROs to do the work.

Of course, if you're fortunate enough to be taking delivery of a factory-new King Air 260 or 360, IS&S's ThrustSense Autothrottle with LifeGuard protection and dynamic VMCa mitigation is standard equipment.

"Textron Aviation has shown great initiative and trust by certifying our ThrustSense Autothrottle with LifeGuard protection on the new-generation King Air 260 and 360," Hedrick concluded. "They are currently the only factory-new turboprop airplanes in the world with VMCa mitigation. That says a lot about their commitment to safety." T&T

Dale Smith *has been a commercial, private and business aviation marketing and media communications specialist for nearly 40 years. He is an award-wining aviation journalist and aviation artist. Dale has been a licensed pilot since 1974 and has flown more than 40 different types of aircraft. Contact Dale at* **dalesmith206@comcast.net.**

by **Kevin R. Dingman**

Litanies

The story of a go-around at DCA

Litany: noun, *plural* litanies. A prolonged account: a list, catalog, enumeration.

It's ten-past midnight at the end of a 14-hour day. You're flying an ILS; the weather is 300/1. Winds at 3,000 feet on final show a 40-knot tailwind. It's reported at the surface as a direct cross at 20 knots. The runway is wet, but braking action is good. Runway length required for your jet tonight is 4,750 feet; runway length available, if on glide slope, is 5,862.

On five-mile final, the approach is not working. You're too fast. The spacing on the plane in front of you is insufficient, you're not fully configured, you dropped your pen, and a shoe came untied. You're dreading the go-around because the missed follows a critical ground path. You feel the hairs standing up. If you are a musician, this is an unrehearsed time signature and key change at Carnegie Hall. If a CFO, Mr. Potter just stole the Building & Loan's bank deposit. What now? You go around.

Announce the go-around to your partner, press the TOGA (takeoff/go-around) button. Verify the motors spool up to the correct power setting. Follow the flight director. Flaps to approach. Positive rate, gear up. Set missed approach altitude. Verify roll mode, LNAV or HDG. Set speed, VNAV or LVL CHG in the FMS. Call tower. Tell them you're goin' around. Answer their question about why.

Switch to departure control. Answer their question about what you want to do next. For now, you tell them vectors for another approach. The flight attendant chime is going off or your pax are calling you; they need to talk. Could be something bad and not simply them wanting to know what happened.

As PIC, you must prioritize the multiple sources of change and possibly critical, incoming information. Retract the flaps. Get stabilized on the obstacle avoidance procedure, missed approach, special use airspace avoidance track, or the heading and altitude assigned by departure control. Make sure their instructions don't send you into the rocks. Level off at the missed approach altitude. Run the after-takeoff checklist. If not already done, engage the autopilot or give the airplane to the FO. Check your fuel and decide: try again or divert. Tell the FO your thoughts, get his/her input and then tell ATC your decision. Call the FA's. Tell them what happened and your decision. Make a PA to the folks and explain why we didn't land. Reassure them that all is well as you tell them your decision. Execute your decision, and if it's to divert to an alternate, send a message to the company; tell them your decision. Be grateful this was not a single-engine missed approach. Take another breath. Bow to the applauding Carnegie Hall audience, snatch your deposit back from Potter.

Good work, you just did a missed approach/go-around. Maybe it was the first one this year, maybe the first one in this airplane, maybe the first real one ever. You're on your way around the radar pattern or to the alternate. Look around. You will have missed something not directly addressed by a checklist: landing lights, deice equipment, spilled your coffee, something. Fix it. Look at your fuel again. Re-calculate for the radar pattern or the trip to the alternate. It's been busy so far, but if your fuel-math is wrong and one or two motors cough because of it, that will be what busy really feels like.

But your math was good. Take breath number two, ask your partner how your hair looks. The go-around procedure for your jet most likely has similarities to the one above.

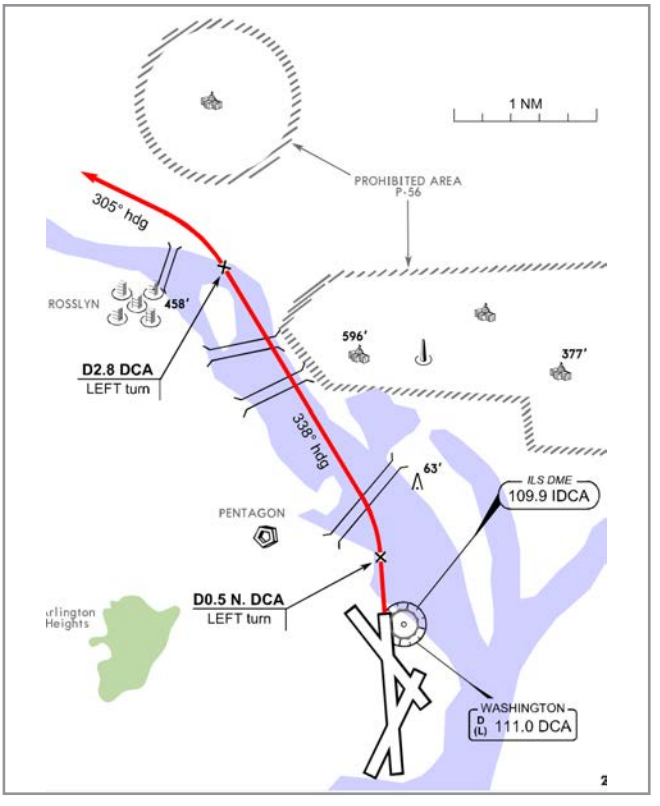
In the Guppy, you'd better add a step to trim nose-down somewhere very early in the procedure after you TOGA. Unlike the Duke, F-16 or the MD-80, the 737's wing-mounted engines will pitch the nose to the moon as they spool up. As that happens, the airspeed will drop like a Cessna 150 in a 30-degree climb. One night at Washington Reagan, that was an issue I encountered and it almost precipitated another. But let's not get ahead of ourselves.

Like a Nightmare

The go-around litany sounds straightforward. It's not rocket science or brain surgery, but holy cow. Can you say "busy?" And how often do we get that busy, that quickly, at the end of a flight, probably in the weather, perhaps at the end of a long day, and perhaps late at night.

And how often do we perform the maneuver? After 23,000 hours, other than in the sim and for practice, I've flown a go-around in the military, GA and Part 121 combined, maybe a dozen times. And I've learned that it's this infrequency that generates the stories we read about when a go-around doesn't "go around" very well. A windshield full of bad can be in your face if you allow yourself to be caught by surprise.

Memorizing a missed approach/go-around litany and thinking about it along with the published missed approach procedure once configured and stable on final, will make the ordeal dreamy instead of nightmarish. And it will help to limit the number of things you must "fix" after you are finished with it. An excellent technique is to tell yourself on every approach (IMC and VMC) at about 5 miles: we are going around, get ready. Whisper the litany to yourself, and then be ready. I also like to add: we have enough gas to do this twice more before we divert. If you get to land instead, well, you've done that a million times. Piece of cake. But remember, you can still go around even after initial touchdown. Maybe because of a runway incursion, for example. The final red line for a go-around decision in most jets is once you deploy the reversers. After you pull that trigger, you are normally committed to the surface.



Washington Reagan (DCA) special use avoidance airspace.

SAMs and The Big Kahuna

> Washington is a city of Southern efficiency and Northern charm.
>
> – John F. Kennedy

In past articles, we've discussed routing options for takeoff, including those for an engine failure on takeoff (SIDs, ODP's and EOSIDs). Some airports also have a special use airspace avoidance procedure for departures and go-arounds. Ronald Reagan (DCA) has a particularly significant routing. There is a ground track for north takeoffs and go-arounds to avoid national landmarks and our leaders working in and around prohibited area P-56. And they're serious about it, including rumors of SAMs (surface-to-air missiles), small-arms fire and all flavors of pilot certificate nastiness. Maybe an engine coughing during the missed isn't the most intense of possible outcomes after all.

And therein lies the difficulty with my go-around at DCA. Our story's opening scenario is what I had, except for the dropped pen and untied shoes. And there was indeed a 40-knot tailwind from about 15-mile final to the marker. I didn't get the jet slowed down in time to be configured by our stable approach decision point, and spacing with the aircraft in front of us was also getting tight. When I initiated the go-around, the nose pitched up. While trimming nose-down, distance was passing by on the avoidance procedure. Fortunately, the go-around was initiated four or five miles out on final, so all was good by the time we reached the first turn of the avoidance ground track. No SAMS fired or noise complaint from The Big Kahuna. It was embarrassing, though – especially since we heard about the tailwind from other airplanes. I guess I hadn't pre-whispered the litany thoroughly enough.

Familiarity Breeds, Well, Familiarity

In most jets, in addition to the operating manual, there are operator or training department-developed litanies for both common and uncommon events. In order of likelihood, typical litanies are for normal takeoff, two engine go-around, engine failure on takeoff and single-engine go-around. They're not created as a replacement for operating manual procedures, system malfunctions or abnormal procedures. Although due to infrequency, a missed approach or go-around could easily be classified as such. Similar to a memory mnemonic like GUMP, these litanies serve as a supplemental memory jogger and are, by design, succinct yet complete. Consisting of just enough of the essentials to avoid a Carnegie Hall, lost bank deposit brain freeze. For example, the litany in the Guppy for the two-engine go-around above is boiled down to seven steps: TOGA, Flaps 15, positive rate, gear up. Set missed approach altitude,

select/verify roll mode, set speed, VNAV or LVL CHG. Clean up on schedule. Distractions from radio calls and cabin crew or passenger issues should not be ignored but prioritized and feathered into your litany, as well as your fuel calculations and what to do next.

Flight planning and reviewing upcoming events during the flight are ways to minimize errors, increase safety, and to save brain cells for more, possibly critical, decisions later. We've always called it staying ahead of the airplane. In flight, a big surprise can turn out poorly, and there's no need to make it difficult on ourselves by trying a seat-of-the-pants maneuver or trying to come up with a litany at the last second. Ask around, find some of the litanies for your jet and if you like them, give them a try. They should help you avoid Mr. Potter, SAMs and tweets from The Big Kahuna. T&T

Note: Originally published June 2017.

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Mustang to Mustang

by **Bryan Currier, Owner-Pilot**

In 2001, I had a first officer offer letter in hand and engaged to the most beautiful girl in the world. We were set to get married in September, and I'd start my new job as an F.O. in November.

Of course, on September 11, the whole world changed – especially aviation. I found myself four days away from being married, with no clue what the aviation career track would be for me. I decided to abandon a professional flying career and focus on building my computer consulting company and integrating aviation into my business. The company grew, my travel requirements grew, and general aviation met the need wonderfully.

Our first "company plane" was a Grumman AA1 Yankee. I flew to appointments all over Michigan. Then we started to add people and clients in Chicago, Wisconsin and Indianapolis, so we upgraded to a Rockwell Commander 112. Over the next 15 years, we moved to a Rockwell 114, a Mooney 231, Cirrus SR20, Cirrus SR22, Saratoga, Bonanza, Malibu Mirage, and the Meridian. Each one was special, and each purchase was exciting. The first time I started the PT6 on that Meridian, I was in heaven. But with four growing kids and an ever-growing mission profile, we had reached the limits of the Meridian within 18 months.

Cost of Ownership

My first thought when it came time for another upgrade – TBM 850. It fit every profile with room to spare. Additional option – older King Air. A second engine may be nice, and you can fill them full of bricks and they fly (although I would really miss the G1000). Too poor for a Pilatus, I started losing sleep looking at "Controller" and pouring over a spreadsheet comparing aircraft.

A wise friend then told me, "For the money you're spending on a TBM or a King Air, you can fly a light jet." I seriously laughed at him. "Dude, did you miss the part about being too poor for the Pilatus? Now you're talking about a jet? Get real." He gently encouraged me to add two columns to my spreadsheet – one for a Citation Mustang and another for the Phenom 100.

I spent the next few weeks entering data from my logbook, recreating flights in ForeFlight and modeling them for each aircraft. He was right. The total cost of ownership on the four were very close. I took the family to look at a TBM and then a Mustang. The difference in cabin comfort is huge. Replaced headset jacks with cupholders? Yup, a green light from wifey. No need to look at the turboprops any further. If the jet will do the mission, nothing else will do.

A three-month process working with Mark Rogers and his team at Lone Mountain Aircraft led me to an off-market Mustang, 510-0328. And on November 11, 2017, I stood outside Cessna headquarters in Wichita and took delivery of N328CL. There are a few days in life you'll always remember: getting married, the birth of kids, first house. This day is up there on the list.

Mission Profiles

From Nashville, my typical mission profile is 500 to 1,000 nm. Ninety percent of the time, it is just me, or me and one to two passengers. A special

Sixteen days after the tornado hit, they were finally able to remove the wreckage from the hangar.

mission consideration is flying our family (two adults, four kids, dog and bags) to Florida or Michigan. An example of one of my most restrictive missions – three people from Nashville to Marine City, Michigan (3,100-foot strip), no fuel, turn around and come back. This is no small ask for a jet.

By the Numbers

- **Service Ceiling –** FL 410, and you'll go there easily on a standard day.
- **Range –** at FL 410, the advertised 1,150 NBAA IFR profile with 100 nm alternate is doable (although I tell people it's a 1,000 nm airplane IFR with STARs). The airplane is miserly with fuel at 410. If you're doing less than 900 nm, you're going to be in the upper 30s and zipping along at max cruise speed. Trade off a bit of fuel for payload and fill the seats.
- **Useful Load –** 3,380 lbs. The 2,580-pound fuel tanks provide a full fuel payload of 800 lbs. My whole family with bags and the dog weighs 1,100 lbs. We can fill the seats, bring whatever we want and go pretty much anywhere we regularly go (Florida, Michigan) with no issues.
- **Speed –** Cessna advertised a cruise speed of 340 kts, and it usually beats that a bit.
- **Landing Distance –** 2,390 at gross weight. You'll land in half that if you're light. It's amazing. The short-field performance is remarkable.
- **Baggage –** Forward baggage is 20 cubic feet with a 320 pound-capacity, and the tail cone is 37 cubic feet with 300 pounds. Inside, the cabin has storage of 6 cubic feet and 98 pounds. I run out of room in the SUV before I run out of room in the airplane.

Modern Simplicity

One of the things that I love about the Mustang is the simplicity and reliability of the modern design. The Garmin G1000 (now with NXi) makes the avionics transition a breeze. The rows of warning lights are replaced by a digital readout on the MFD. Digital checklist, XM weather, onboard radar, TCAS and TIS. Almost everything is electric, served by two independent generators that automatically load shed in the event of a failure. FADEC engines. Single hydraulic system. The fuel system is simple and requires no interaction. LED lights and HID landing lights. Simple and effective anti-icing systems – turn it on, and that's it. The wheel comes out from the panel, so you do not have to straddle a column going into the floor like most jets.

Cessna was very intentional about making this an owner-flown friendly jet, and they nailed it. By keeping things simple, they also made it very reliable. In three years of ownership, I've never canceled a mission because of a maintenance issue.

March 3, 2020

Last March, I woke up around 6 a.m. to multiple missed calls, texts and e-mails. "Are you OK?" "Are you home?" "Is the family OK?" As I was about to try and figure out what all of this was about, my phone rang – my FBO manager.

"Bryan, are you on a trip?"

"Um, no. What's up?"

"Is the plane here?"

"Um, yes, shouldn't you know that?"

"I'm sorry, man. It's gone."

"What do you mean gone?"

The tornado that hit Nashville the night before was little more than a thunderstorm at our home. We slept through it. John C. Tune Airport (KJWN), however, was decimated. It was several days before I could even go to the airport. And it was 12 days before they found the wreckage of my plane (the last to be found) in the corner of one of the destroyed hangars. Sixteen days after the tornado hit, they were finally able to remove the wreckage from the hangar. Both wings were snapped, the tail was dangling, both wings were leaking fuel, the windshield was shattered, and the fuselage was so mangled that I couldn't open the door.

It was a painful and emotional day.

So, Now What?

Early March 2020 was turbulent. The United States was heading into lockdown due to COVID-19, the stock market crashed, rates were cut, stimulus was discussed, the VIX spiked, and business froze. My clients (primarily small medical and dental practices) were all ordered closed. A stay at home lockdown? Will my business survive this? Will my clients stick with us? Can we continue to pay our staff? Oh, and what to do about the airplane.

My business (spread across eight states) depends on having access to

> "You know you've made the right aircraft choice when you do it all over again."

an airplane, and the depreciation recapture tax implications were very real. The question wasn't if, but which one? Once again, I looked through my logbook, looked at my missions, looked at the finances, and spent stupid amounts of time on "Controller." Of course, we couldn't leave the house, so that wasn't so terrible.

Validation

After doing all of the research, and in a buyer's market (remember, the world was burning), I found the perfect next airplane – another Mustang. It checked all the boxes.

A guy who owned a Citation XLS had purchased it as his second jet when he wanted to fly single pilot. He gave it to Cessna in 2019 and ordered avionics updates, all maintenance, new paint, and new interior – essentially made it a brand-new airplane. When the pandemic hit, he felt it best to stick with one jet and decided to sell the refurbished one without ever flying it. We came to an agreed price, a quick pre-buy, and my perfect upgrade was on its way home to Tennessee. A few weeks later, with some paint additions and a tail number change, my 2007 Citation Mustang became N915CF. You know you've made the right aircraft choice when you do it all over again. Now eight months in of flying the new Mustang, and it still amazes me.

And Finally

Whatever your plane, we should all recognize how blessed we are to have aviation as part of our lives. This year, I'm more aware than ever, more grateful than ever, and more determined than ever to advocate for and protect our freedom to fly. T&T

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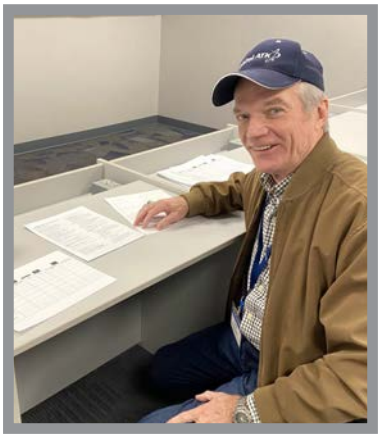
What Good Looks Like: Part II

Last month, we met Neil Singer, part of our CJP safety team. This month, we'll have a chance to pick the brain of astronaut Charlie Precourt, chairman of the CJP Safety Committee.

Charlie is a four-time space shuttle guy, commanding two missions. Currently flying a CJ1+, he is a board member of EAA and NBAA and in his spare time runs a company that builds rockets for the stuff you see blasting into space on a regular basis.



Needless to say, Charlie is a "pilot's pilot." On his first flight in a Citation Mustang, he made the landing from the right seat and literally touched down without any sensation whatsoever. The kind of landing I make about every 10 years. Unfortunately, I was in the left seat…and so pissed off. I put my hand on his shoulder as we taxied off the runway and said, "Don't worry, Charlie, it will get a little better each time you try."

I thought you might like to hear from someone who has pretty much done it all.

What military aircraft have you flown?

In order of highest hours to least: T-38 Talon, A/T-37 Dragonfly, F-15 Eagle, F-4 Phantom, L-39 Albatross, A-7 Corsair, Shorts Tucano, Mig-21 Fishbed, L-29 Delfin, KC-135 Tanker, C-550 Radar testbed, T-33 T-Bird (Shooting Star), Mirage III, C-130 Hercules, H-58 Helo, C-141 Starlifter, Lockheed U-2 Dragonlady, F-111 Aardvark, Mirage 2000, T-43 (Boeing 737), AV-8A/B Harrier, H-1 Huey, H-206B Helo, Lockheed S-3A Viking, F-104 Starfighter, F-1 Mirage, MB-339, OV-1 Mohawk, F-16 Falcon, F-18 Hornet, French Jaguar, T-28 Trojan…and an additional 30 or so GA aircraft.

You were involved with the Columbia space shuttle. Can you talk about how that accident changed you?

The biggest impact was losing close friends. It is sobering to see those close to you lost in an activity you love. As NASA's chief astronaut at the time, I had personally selected and certified them for that flight. What we learned in the aftermath was had we acted earlier on information in front of us, we may have had a chance to prevent this. The real underlying cause was what we have come to call "normalization of deviance" – accepting problems as OK when we shouldn't have. In the loss of Columbia, it was pieces of foam coming off the external tank, which had happened without consequence on every flight – until the one time it had a big consequence. What the experience made me realize is accidents are preventable if we have the right mindset about risks and take measures to mitigate risks. Things like lots of training, ensuring proper maintenance and joining a type club for mutual support and learning.

Compare flying a military fighter jet to a Citation.

One word: maneuverability. Fighter jets are extremely aerobatic and extremely powerful. Initial climb rates in excess of 20,000 feet per minute are not unheard of. High G turns up to 9 G are also common. On the other hand, the Citation challenges you in different ways – precision instrument flying, smooth maneuvering, handling complex air traffic and weather situations, and managing passengers and crew. Although the two are very different from a handling and maneuvering standpoint, they are equally challenging to the pilot's mental capacity!

You are spearheading CJP's FOQA effort. Can you talk about what that is and why we need it?

FOQA stands for Flight Operations Quality Assurance, which describes a data-driven technique for catching safety trends before accidents happen. The airlines have had huge success with it and have seen accident rates drop to amazingly low levels. Performance data is collected from the aircraft each flight and allows flight crews to spot areas in need of improvement, and to share lessons learned with everyone in their FOQA group. An example would be catching a tendency of pilots to arrive high at the threshold and land beyond the desired touchdown point. Seeing this happen among a number of pilots in the group could lead to changes in SOPs, or it might lead to changes with air traffic control in the event they contributed to the trend with their own handling procedures.

Charlie practices what he preaches. During a recent Citation Mustang recurrent at FlightSafety Textron Aviation Training in Wichita, I saw him spread out three system diagrams and a memory items checklist on the classroom table. All of them personally designed by him. He made a 100 on the class test…I didn't.

Fly safe. T&T

David Miller *has owned and flown a variety of aircraft from light twins to midsize jets for more than 50 years. With 6,000 plus hours in his logbook, David is the Director of Programs and Safety Education for the Citation Jet Pilot's Safety Foundation. You can contact David at* **davidmiller1@sbcglobal.net**.

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