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Thriving Market And Innovation Drive Business Aviation

Strength in the market for aircraft change pressure from supply chain, workforce shortages and environmental groups.

By Bill Casey

From corporate clients globally seeking the new Dassault Global Quest, to single flight operators flying 20 airlines in 2023, the industry is thriving. Here's how to stay on top of the latest news, trends and opportunities.

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AVIATION WEEK
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LEE ANN SHAY
Editor-in-Chief

Breathing Room

What comes next after a grand pause.

A GRAND PAUSE IN MUSIC—when the orchestra suddenly stops playing to punctuate a moment—provides dramatic effect. Grand pauses are brief, but they also allow musicians to catch their breath.

The business aviation industry could be in such a pause. Why?

Some of business aviation's key performance indicators are down, but this isn't necessarily a bad thing.

For instance, the number of used business jets on the market increased 26% year-over-year in April, with jets less than seven years old up 27% for the period, according to Jefferies estimates. The firm tags 1,161 business jets for sale, or 4.8% of the active fleet.

Prices are down 2% year-over-year.

U.S. business jet departures are down 5% year-over-year, but they remain higher than in 2019. Jefferies points out that European business jet departures have been a bit more volatile, but traffic remains up 3.9% year-over-year.

Business jet and turboprop manufacturers delivered 178 aircraft during the first three months of 2024, which is down from 193 a year ago, according to preliminary data from Aviation Week Intelligence Network Fleet Discovery. However, deliveries during the quarter were the second-highest over the last five years—and OEM backlogs remain strong.

Aviation Week Network Fleet Discovery data shows the in-service business jet and turboprop fleet continues to steadily increase. In March, the fleet included 3% more in-service aircraft than it did the same month last year.

Supply chain pains linger, but they're largely improving.

Putting all this together means the business aviation industry remains very strong, but there's a bit of breathing room compared to the frenzy post-pandemic.

But what's on the other side of the grand pause?

Fractional and charter operations experienced higher utilization in 2023 compared to 2019 and leaders in these markets are bullish for the year. But there is an asterisk at the end. As Mark Briffa, Air Partner CEO and Wheels Up EVP charter, says in Jeremy Kariuki's charter feature on pg. 10, "The world today is in quite an unstable place. There's lots of potential conflicts and conflicts going on, which have an impact on the consumer confidence in how it wants to spend its money and how it wants to travel."



TETMC/GETTY IMAGES

While market uncertainties exist, the second half of the year won't switch to a minor key, but the melody might be a bit slower.

This could provide time to check out the following:

First up: On pg. 6, read Kent Jackson's Point of Law column on the Internal Revenue Services' new audits of corporate jet usage. If you are based in the U.S., this is not something to ignore. Prepare.

Second, consider bolstering your education. NBAA is accepting registrations for its Six Months CAM Program through June 24. The program includes study guides and groups to prepare for the Certified Aviation Manager exam.

Third: Consider giving back. This issue features two examples of how the private aviation industry does this. The Fast 5 on pg. 4 spotlights the Corporate Angel Network's new CEO Robert Stangarone, who talks about the need for more aircraft seats for cancer patients and how to volunteer, among other things.

Bill Garvey's column on pg. 8 focuses on how volunteer pilots play a crucial role in humanitarian flights. The Air Care Alliance has about 60 volunteer pilot organizations and helps pair interested pilots with upcoming missions that span medical care, animal rescue, conservation support, education and emergency response.

Enjoy this issue!

Best wishes,
Lee Ann

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5 QUESTIONS FOR CAN's CEO

FOUNDED IN 1981, the Corporate Angel Network (CAN) has pursued its mission to provide cancer patients with transportation to treatment centers onboard corporate aircraft. To date, the nonprofit organization has conducted more than 68,000 flights with help from donations from businesses, organizations and individuals.

CAN is led by its newly appointed CEO Robert Stangarone, whose career in aviation spans leadership positions with Embraer, Cessna Aircraft, now Textron Aviation, and United Technologies.



Corporate Angel Network CEO Robert Stangarone

1 What inspired you to join Corporate Angel Network?

I have known the people at Corporate Angel Network for a number of years and have always admired the mission. And so, when I was approached about the job, I really jumped out, and I thought it was a fantastic way to cap a career. I'm really grateful and honored that they want me ... I always believed in giving back. I've been involved in Able Flight, The Red Cross, the [New England] Air Museum, some STEM programs, the Special Olympics Airlift—and those are such fantastic, heartwarming experiences. It just fills a part of your life that you can't get from anywhere else, and to have it coupled with aviation is like the cherry on the cake.

2 What is your vision for the future of CAN?

It's very focused. It's all about saving lives and reducing cancer patients' physical, emotional and financial stress as they go through treatment. And there are two components to achieving that. We need to increase awareness of our services in the patient community so they know they can come to us if they have the need to travel to their treatment centers. The other component is to have the seats available on corporate aircraft to fill those missions ... Both of those objectives require extensive outreach and relationship building in lots of different ways, and that's where I'll be spending much of my time. We also need to reach out to the business aviation community to maximize the number of seats available on corporate aircraft. This is a huge challenge—because of the shortfall in lift capability, we just can't fill all the patient requests we get.

3 What are some of the biggest challenges you expect to face with CAN?

I think, certainly, one challenge is financial. It's making sure that we have the revenue stream to support the mission and grow the mission. I think that's the fundamental urgency. I think we want to take this to the next level. I believe this can go exponential in the years ahead, because it's such an untapped area, and I think we have the human resources to do it. I have so many relationships in place with every sector of aviation, because of the number of companies I've been with and the length of my service in this industry. So, I think I could bring all that to the table and bring it to the next level.

4 How does CAN raise funds for its operations?

Our biggest revenue source is from our annual event, which we call Fund An Angel, which generates several hundred thousand dollars' worth of revenue through ticket sales and auctions, donations, sponsorships and that sort of thing. We also receive corporate and individual contributions and grants from foundations, but overall, it's an ongoing effort to continue to raise funds and to keep our capabilities growing, so we can serve more patients in the years ahead.

5 If someone would like to get involved with CAN, what should they do?

We're always looking for volunteers. A lot of the volunteers we have schedule the flights with the patients; it's a very rewarding part of the operation. You interface with patients, with medical centers, with the corporate leads and you put them together to fulfill the missions. Donations are always welcome, and if anyone wants to learn more, I would welcome them to call me directly or call our office and we would be happy to see how we can work together. I'm sure there's something for everybody. **BCA**

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KENT S. JACKSON
Contributing Editor

IRS Starts Jet Usage Audits

The IRS is not here to help you.

FOR YEARS, FAA inspectors have liked to jokingly say, “I am with the FAA, and I am here to help you.” The Internal Revenue Service (IRS), however, does not say “I am here to help you”—and they do not joke.

In February, the IRS issued a press release titled “IRS begins audits of corporate jet usage; part of the larger effort to ensure high-income groups don’t fly under the radar on tax responsibilities.” The IRS went on to say that it plans to begin dozens of audits on business aircraft involving personal use. The audits will be focused on aircraft usage by large corporations, large partnerships and high-income taxpayers. It also will focus on whether for tax purposes the use of jets is being properly allocated between business and personal reasons.

Preparation is the key to surviving a tax audit and receiving a “no change” letter acknowledging that your tax returns were proper. Aircraft operators know the FAA does not believe that an inspection occurred unless the paperwork proves it. The IRS will not believe that you use your aircraft for business unless the paperwork proves it. Do you have documents that show the business purpose of every person in every seat on every leg of every trip? That is what the IRS expects. And the IRS expects the records to be contemporaneous, not pulled together a year or more later by the harried flight department after the CFO informs them that an audit is underway.

The flight department can provide a great deal of help to the CFO in maintaining up-to-date records to prove the business purpose of every person in every seat on every leg of every trip, because the flight department knows the who, when and where of each flight. But the flight department’s knowledge of who flew does not always mean they know the business purpose of why they flew. The company executives must either give the flight department adequate guidance on the business purpose of each person on each trip, or someone in the C-suite must complete that information in the flight records separately as the flights occur.

And of course, there will always be some non-business flights. If someone is not on business, do your records distinguish between an employee entertainment trip (a Colorado ski trip, for example) and a personal trip (like a Mayo Clinic appointment)? The employee will need to have fringe benefit income added to his or her W-2 for either trip, but the company will only lose deductions for the entertainment trip.

The IRS statement makes it clear that this audit campaign will be focused on personal use. But the big win for the IRS is not just to impute some additional income to executives—it is

to attack corporate aircraft deductions that should have been reduced based on entertainment use of the aircraft.

The IRS says: “For someone such as an executive using the company jet for personal travel, the amount of personal usage impacts eligibility for certain business deductions. Use of the company jet for personal travel typically results in income inclusion by the individual using the jet for personal travel and could also impact the business’s eligibility to deduct costs related to the personal travel.”

When the IRS hints at “the business’s eligibility to deduct costs,” it is talking about the IRC § 274 entertainment deduction disallowance rules. These rules are complicated, and in fact, if the executives want to know what the effect of a

particular entertainment trip in June will be, you cannot give them an answer until the end of the year, because you have to know how the year’s usage played out.

Although the calculations are complex, the lesson is simple: butts in seats.

When the IRS set out to attack entertainment use of corporate aircraft 20 years ago, it made a simple observation. Too many flight departments restrict the roster of employees who can use the aircraft for business, and yet they do not limit the number of guests of executives on entertainment flights. The result is too many entertainment butts and not enough business butts.

The IRS approach to looking at seat use rather than merely comparing flight hours is deadly to companies that never let anyone but the CEO and guests on the aircraft. What companies need to realize is that the IRS seat approach is virtually harmless to companies that use aircraft to shuttle any and all employees. This is because the number of business butts in seats dominates the calculation, leaving the IRS little room to disallow deductions for entertainment use of the aircraft by the owners, officers and directors.

The best way to prepare for these IRS audits is to make sure that your flight department is tracking all the necessary flight details in real time—and to watch the trends and report them to management. In other words, if you see entertainment use rising, give management an opportunity to schedule more business flights with more business people in the seats.

No audit is fun, but if your company is ready, the auditor will leave and look for a less-prepared victim. **BCA**



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Kent Jackson is founder and managing partner of Jetlaw. He has contributed this legal column to BCA since 1998 and is also a type-rated airline transport pilot, flight instructor and repairman.

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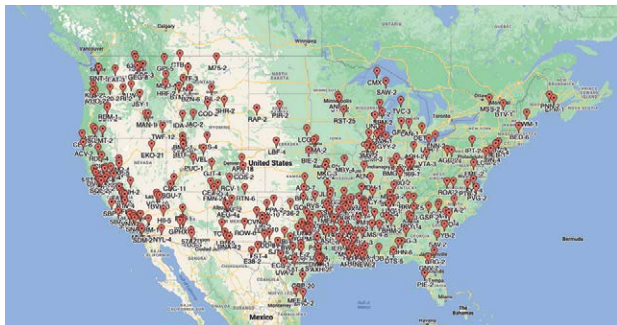
WILLIAM GARVEY
Contributing Editor

Pilots With Heart

Wings to help, give hope and protect those in need.

WHAT DO A CHILD with cancer and yearning for a puppy, a remote clinic in urgent need of O- blood and a pair of right whales migrating across busy shipping lanes have in common? Volunteer pilots committed to serving and protecting them and putting things right.

While most flight hours logged by the general and business aviation fleet involve commerce, training, public service or recreation, the segment has always supported a vital humanitarian element for reasons that are both practical and noble.



Air Care Alliance's Common Flight Board is a web tool that features a national map illustrating all upcoming missions to help connect pilots with volunteer opportunities.

Regarding the former, numbers, geography and flexibility matter. Of the 300,000+ general aviation aircraft extant globally, the FAA counts two-thirds as registered in the U.S. Put simply, they're everywhere, within reach of nearly every U.S. resident and able to launch for wherever on short notice.

As to the latter, general aviation's pilots and owners comprise a population of do-ers who respect and support one another and are willing to challenge the status quo. So, when there is trouble—be the cause tempest, disease, mishap or something else—if wings can help, they respond again and again.

Often that response is coordinated through a volunteer pilot organization (VPO). While several such groups are well known—the Corporate Angel Network, Veterans Airlift Command, Civil Air Patrol and the Coast Guard Auxiliary's AuxAir, among others—there are scores more, often regional in service area, with some focused on a specific purpose. Examples of these include Louisiana-based Pilots for Patients, which transports ambulatory patients to area medical centers; Pilots N Paws, which takes furry and occasionally feathered or flipped animals in need to welcoming homes and shelters; and the Emergency Volunteer Air Corps (EVAC), which goes wherever disaster strikes to assist victims.

Most VPOs have a core of volunteer members, but the groups always welcome more. It is not unusual for pilots to be members of several VPOs and log multiple humanitarian flights annually.

Typically, a VPO will alert its pilot members to upcoming missions via its website or by reaching out directly by phone or email. Accordingly, multi-VPO pilots might have to investigate several sites to match a mission with their personal availability and aircraft capability. However, that hurdle is about to be lowered—and potentially eliminated altogether.

Some 60 VPOs are members of the Air Care Alliance (ACA), a national organization founded in 1990 to facilitate members sharing best practices; identify common regulatory, legal or procedural challenges; provide information to interested pilots and potential users; and to celebrate achievements in furthering humanitarian aviation. Although ACA is not involved with group operations, a new service may help make those ops more efficient and effective.

A highlight of ACA's annual convention, held April 19-20 in Ft. Lauderdale, Florida, was the unveiling of the Common Flight Board (CFB), a new web service designed by Stephan Fopeano, a software developer and Angel Flight West's long-time webmaster.

Fed information by its respective VPOs, the CFB features a national map illustrating all upcoming missions. Pilots can narrow the map's scope, center on a particular airport or set a mission-mile limit. Meanwhile, supporting text pages provide details on each mission, including departure date, time and destination, passenger numbers and estimated weights. Once a pilot accepts a mission, the listing VPO provides the volunteer with further details. Initially, the CFB will display only medical patient missions, but it is expected to eventually display other mission types, as well.

Kristinia Luke, ACA's executive director, says the goal of the CFB is to smooth the currently "clunky" process for pilots assessing flights across VPOs. Its goal is to help aviators find and sign up for missions that might otherwise go unfulfilled, as well as help attract newcomers to the current roster of some 13,000 volunteer pilots who selflessly apply their skills and aircraft to help those in need.

Other matters on the agenda at the convention included the FAA's disallowance of reimbursement for humanitarian flight fuel expense, which can be considerable. Turtles Fly Too founder Leslie Weinstein estimates pilots collectively fork over \$500,000 to \$1 million annually flying cold-stunned sea turtles to recovery centers. **BCA**



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Surviving The Burst

The air charter industry after the post-COVID surge.

FOUR YEARS AGO, THE ONSET OF the COVID-19 pandemic changed the shape of social lives, work experiences and the economy on a global scale. For the private air charter market, a surge in post-pandemic “revenge travel” drove demand for private aviation to unexpected heights.

In 2023, charter companies began realizing the short-term reality of pandemic-related demands. Now, the charter industry is experiencing levels comparable to its last “normal” year, 2019.

“Everyone started to travel after COVID. So, then you got to 2022 levels of charter, where levels of private jet travel were really high, you know, exponential growth,” said Mark Briffa, Air Partner CEO and Wheels Up EVP charter. “Everybody felt that that wasn’t sustainable. But what you did find is people had to staff up, either for staff or fleet, to get more airplanes in. Demand was really hot for airplanes, [but] difficult to get supply.”

The stagnation in supply has since been reflected in 2023 and early first-quarter 2024 results. Business aircraft deliveries among Bombardier, Textron Aviation and Gulfstream Aerospace have not kept up with initial goals—driven in small part by the delayed FAA certification of Gulfstream’s G700 ultra-long-range jet and more broadly by supply chain challenges that mitigated manufacturers’ ability to boost production. The G700 aircraft was certified in late March. J.P. Morgan predicts strong order activity in 2024, driven by fleet operators.

Operators are closely watching other mitigating factors, however.

“Let’s be really clear: We get a prediction of growth, but then you have to understand—what are the economies going

to do?” Briffa said. “Because the world today is in quite an unstable place. There’s lots of potential conflicts and conflicts going on, which have an impact on the consumer confidence in how it wants to spend its money and how it wants to travel.”

Charter operators experienced a 26% increase in flight utilization in 2023 when compared to 2019, although hours were down 5% when compared to 2022, according to the Aviation Week Network Fleet Discovery database. Fractional ownership providers, meanwhile, experienced a 43% increase in utilization in 2023 compared to 2019 and a 4% increase in 2023 when compared to 2022.

Air charter providers experienced a slight increase of aircraft in service from 7,018 in 2022 to 7,158 in 2023. Fractional ownership providers experienced an increase of 110 aircraft in service in 2023, according to Aviation Week data.

As it stands, 2024 will be an eventful year in many aspects. The ongoing Russia-Ukraine war, the Israel-Gaza war and a historic political rematch for the presidency in the U.S. are just a few among many factors affecting consumer confidence in air travel, domestically and internationally.

Andy Christie, group private jet director for Air Charter Service (ACS), believes private jet travel levels will remain ahead of those seen in 2019.

“There are so many economic and political factors that are likely to affect 2024, that it is very difficult to make firm predictions,” Christie said. “Overall, we think that flight levels will remain relatively flat, year-on-year, potentially with a slight increase in the first half of the year, but this is likely to be offset by a decline in the second half [with] the uncertainty of elections potentially putting the decisions on long-term projects on hold.”

Confidence on behalf of some charter companies seems to remain high. Volato co-founder and CEO Matt Liotta described 2023 as a successful year, following the company growing its fleet of HondaJets.



WHEELS UP



Air Partner CEO and Wheels Up EVP Charter Mark Briffa

JEREMY KARIUKI/AVIATIONWEEK NETWORK



**Wheels Up's Member
Operations Center in Atlanta.**

"We expanded the size of our floating fleet to 24 HondaJets in 2023, increasing aircraft usage revenue by 162% year-over-year, and providing us with greater flexibility to meet growing customer demand," Liotta said.

In Volato's 2023 full-year results, Liotta cited "industry factors beyond our control—specifically aircraft delivery delays," as negative factors affecting the company's topline revenue.

"We are in close contact with our suppliers and partners and understand that production and supply chain issues are easing, providing us with good visibility into our 2024 and 2025 delivery pipeline," Liotta said. "We expect continued fleet expansion will propel revenue and margin in several ways, including increased fractional sales and operating revenue, and more efficient aircraft utilization. We remain focused on growth and our path to profitability."

According to ACS Chairman Christopher Leach, the company's private jets division experienced a 34% increase in revenue year-over-year, "driven by growth in new clients, longer flights on larger aircraft, price inflation and continued demand from existing clients in this sector as customers use private jets to navigate the travel and logistical issues which remain post-pandemic."

"You have some suppliers going out of business," said Briffa, with Wheels Up. "You're not seeing consolidation, which I thought you might see more of."

Briffa believes market performance will be somewhat varied between global regions—developments in the U.S. chiefly among them.

"You look at the U.S. You've got a strong economy, but you've got higher interest rates starting to come off a little bit," he said. "You've got an election going on this year, so you've got to get the confidence back in that—who's going to get into power, where America has positioned itself in the world and in how it actually breeds that confidence into the consumer."

In addition to the inherent uncertainty of an election year, the current administration recently increased legislative pressure on the business aviation industry. In February, the Internal Revenue Service announced a plan to audit corporate jet usage by "large corporations, large partnerships and high-income taxpayers."

"That's why [President Joe Biden] would eliminate a tax break that gives preferential treatment to corporate jets, compared to commercial aircraft," the White House said in a statement. "He would also increase the fuel tax on corporate and private jet travel, so that corporate executives and other wealthy Americans pay their fair share for the use of airspace and other public services related to air travel."

Since Biden's State of the Union address, the National Business Aviation Association (NBAA) has voiced industry opposition.

"The Biden administration's sweeping plan would hurt business aviation and the jobs and communities that depend on it and make it harder for U.S. companies to compete in a global economy," NBAA President Ed Bolen said in a statement. "Among the proposals that single out business aviation for onerous treatment is a five-fold fuel tax increase, even though current fuel taxes already cover the incremental cost imposed on the aviation system. We urge Congress to tell the president that his gambit won't fly with the citizens, companies and communities that rely on business aviation."

Despite the pressure, Briffa believes existing consumers will continue to choose business aviation over other methods of air travel.

"In the UK, we put in air passenger duty. It had very little impact," Briffa said. "And we put in a green tax—very little impact, because those that use private aviation will always use private aviation. They're quite large users and they enjoy the service, and it's very difficult to go back once you've experienced it."

As the aviation industry pushes toward net-zero carbon emissions by 2050, options for carbon offsetting and sustainable aviation fuel (SAF) remain limited and costly, Briffa said. Legislation such as Europe's airport restrictions for business jets further add to the complexities of sustainable air travel.

"That's been around for quite some time now. There's a lot of interest in SAF, and it's becoming more prominent," he said. "As it's growing on the environmental awareness, you're getting more people moving away from planting trees and carbon offsetting and going now more toward SAF. The refining of SAF is very expensive and it's very difficult to get a hold on as well ... I define it as the fashion. It is the thing to be in with at the moment to justify why you're ... using private jet travel. Not a bad thing—it's a really good thing."

According to Briffa, Wheels Up is looking into modernizing its fleet over the next few years. The company also wants to retain charter options available to customers who may not be confident enough to invest in a membership program. Briffa gave a piece of advice for charter companies wanting to succeed throughout the rest of 2024.

"You've got to adjust your business models. Be really quick and frequent to be flexible to give your customer options," he said. "And I think that trend is going to continue on—all the while, the customer has choices, whether they use a digital channel or an analog channel, or whether they use a small jet or large jet. I think you've got to be very flexible in your model in what you offer." **BCA**

**CLAY LACY**

KOXC Ops

Clay Lacy plans to soon open a new facility in Connecticut.

CLAY LACY AVIATION WILL HAVE a larger presence in the U.S. northeast region this summer—literally. The Los Angeles-based private aviation services company plans to open a new, 120,000-ft.² corporate hangar facility with an additional fixed-base operator (FBO) terminal at Waterbury-Oxford Airport (KOXC) in southwestern Connecticut, just a 20-min. to 30-min. flight to New York metropolitan area airports.

Clay Lacy Aviation already provides aircraft management, charter and MRO services at KOXC, where it put down roots in 2015 with the acquisition of the former Key Air. The massive new hangar, office and FBO building raises its profile considerably.

“The East Coast has a huge deficit for hangar space,” says David “Buddy” Blackburn, Clay Lacy Aviation senior vice president, KOXC FBO. “There’s not a lot of airports you can build on. We had the ability to build here. The demand was strong—it still is.”

Blackburn, who is overseeing the development, construction and operation of the new facility, was working from a construction trailer at the foot of the building when BCA visited in late March. This is not his first rodeo: Blackburn

has overseen the addition of 295,000 ft.² of hangar and office space at KOXC since arriving there in 1990, originally with Keystone Aviation Services, then Atlantic Aviation and, since 2021, Clay Lacy Aviation. Nevertheless, this is his largest, career-crowning project.

Clay Lacy Aviation broke ground on what was described as one of the largest private investments in Connecticut’s general aviation airport system in August 2022. The plan was to open the facility in phases, starting with a \$20 million outlay for the passenger terminal, offices and 40,000 ft.² of hangar space. Since breaking ground, the company has decided to build out the entire facility, a \$42 million investment.

The first third of new hangar space was sold out by August 2023, Clay Lacy Aviation says. As of March this year, about 65%-70% of the entire facility was spoken for, according to Blackburn. “Originally it was going to be phased, but the demand is such that we kept going,” he says. “We are going to build it all.”

In addition to its proximity to New York City, KOXC has a higher availability of hangar space—nowadays a precious commodity—compared to metro airports, at 30% lower rental rates, Clay Lacy Aviation says. The airport has an instrument landing system, an FAA contract tower and a 5,801-ft.-long runway capable of handling the latest large-cabin business jets. The surrounding area is less congested than the metropolis to the south and affordable for corporate pilots seeking a place to live.



The new Clay Lacy Aviation hangar facility overlooks Runway 18/36 at Waterbury-Oxford Airport in Connecticut.

Atlantic Aviation, the resident FBO, and the Connecticut Airport Authority funded the establishment of a U.S. Customs and Border Protection facility at KOXC that opened in 2022. Atlantic Aviation also leases office and hangar space to Clay Lacy Aviation for its MRO business at the airport.

DESIGNED FOR THE LATEST BIZJETS

The new hangar building “was conceived, designed and built with today’s largest and most modern business jets in mind,” Clay Lacy Aviation says, naming the Bombardier Global 7500, the Dassault Falcon 10X and the Gulfstream G700.

Located at the northwest corner of the airport, the building fronts on a taxilane that leads to Runway 18/36. The facility consists of three 40,000-ft.² hangars, each with two aircraft bays, or six bays total. Hangar doors are 29 ft. high—one foot more than typical—which provides better clearance for larger jets during snow or inclement weather, Blackburn explains. Clay Lacy Aviation was granted a variance to install a wet sprinkler system for fire suppression, preventing the possibility of damage to aircraft from deluge foam systems.

A ground-level entryway with nearby covered parking leads to the three-level FBO terminal and office facility, a “building within a building” situated between two of the hangars that includes pilot and conference rooms. In addition to hangar space, operators can rent from 500 ft.² to 2,000 ft.² of customizable office space.

Clay Lacy Aviation says all facilities are being built in accordance with its sustainability strategy. All lighting is the more efficient LED variety, and the hangar facility has double the fiberglass insulation by code, Blackburn says. Among other features, the roof of the structure is being provisioned for solar panels.

The site is also provisioned to support future electric vertical-takeoff-and-landing (eVTOL) aircraft. In January, Clay Lacy Aviation announced partnerships with eVTOL air taxi developers Overair and Joby Aviation to install electric chargers at its southern California airport locations. KOXC also figures in its advanced air mobility strategy.

“We have the infrastructure,” says Blackburn, who describes the electrical system layout. “I have conduit coming from a telephone poll underground to a pad that has the transformer for our building now, and there is a separate empty pad for another transformer in case we need more power for eVTOLs. And I have conduit that goes from that pad into our building, which goes through into a chase, that goes up into a hangar. We’re going to run the line inside the hangar out to the [taxilane] and have eVTOL plug-ins right there.”

An early adopter of sustainable aviation fuel (SAF), Clay Lacy Aviation announced a partnership with World Fuel Services to offer SAF at its Van Nuys Airport and John Wayne Orange County Airport FBOs in California in early 2021. The



Clay Lacy Aviation leases office and hangar space at KOXC for its MRO support of managed aircraft.

provision of sustainably sourced Jet-A, as well as a future unleaded avgas for piston-engine airplanes, is planned for KOXC, as well, Blackburn affirms. The company’s new facility will have 40,000 gal. of storage capacity and two 5,000-gal. Jet-A refuelers to service aircraft. **BCA**

Avgas Clash

Potential pitfalls seen in the fuel supply chain.

THE NATIONAL AIR TRANSPORTATION Association (NATA) says the first FAA-approved 100-octane unleaded aviation gasoline is unavailable at the pump because its proprietary formulation is not based on an industry consensus specification, but the first shipment from a 1-million-gal. supply refined by Vitol Corp. was expected from Baton Rouge, Louisiana, late in April after it passed laboratory testing.

G100UL, one of three high-octane unleaded avgas candidates being advanced to replace 100 Low Lead (100LL), has FAA supplemental type certification (STC) approval for use in all piston-engine fixed-wing aircraft, but lacks a product specification from ASTM International—something industry has historically relied on when introducing new fuels, NATA says in a whitepaper paper, “Factors Affecting the Commercial Sale of Emerging Unleaded Aviation Fuels,” that it released in early April.

NATA, which represents the interests of aviation businesses including fixed-base operators (FBO) and their partner fuel distributors, released the paper days before G100UL developer George Braly told *BCA* at the Sun ‘n Fun Aerospace Expo in April that about 1-million-gal. of the new unleaded fuel was stored in Baton Rouge, Louisiana, awaiting final laboratory testing. Once found to conform with his company’s STC, the fuel can be shipped to any FBO or airport that wants to sell it, Braly said.

STANDARDS

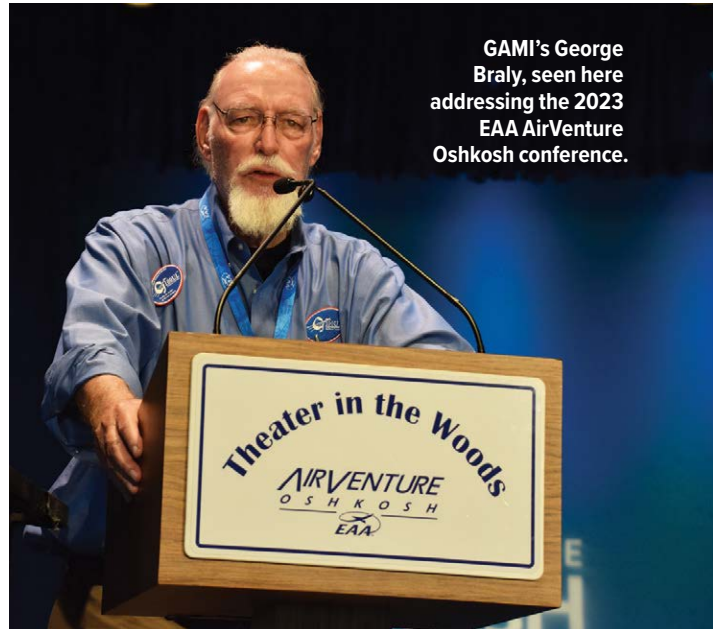
General Aviation Modifications Inc. (GAMI), Braly’s company, first started work on the 100-octane unleaded avgas in 2009 but has not sought an ASTM product specification. Vitol Aviation, a Swiss-based multinational energy company, refined the first batch, confirmed Robert Emmett, Vitol’s project coordinator and head of compliance.



BILL CAREY/AVIATION WEEK NETWORK PHOTOS

Formerly known as the American Society for Testing and Materials, ASTM is a standards organization that develops product specifications through a consensus process involving industry technical experts.

Whereas STC approval by the FAA certifies that a fuel complies with the agency’s airworthiness requirements for safe operation in an aircraft, ASTM evaluates a fuel for its



GAMI’s George Braly, seen here addressing the 2023 EAA AirVenture Oshkosh conference.

compatibility with materials throughout the supply chain upstream of the aircraft, “including those used in hoses, filters, gaskets and other wetted components among railcars, transport trucks, fuel farms, mobile refuelers, and other dispensing equipment,” NATA says.



A 100 Low Lead refueler is parked with other refueling trucks in this Atlantic Aviation FBO fleet.

The FAA granted approved model list STCs allowing the use of G100UL in all spark-ignition piston engines and airframes in September 2022.

Since 2015, Swift Fuels of West Lafayette, Indiana, has produced UL94, a 94+ MON (motor octane number) unleaded avgas for lower-compression, lower-octane-demanding engines. UL94 was vetted through the ASTM process and meets the ASTM D7547 specification. Swift is also seeking FAA STC approval of 100R, a 100-octane unleaded avgas, as well as an ASTM fuel specification.

A third high-octane unleaded fuel—UL100E, developed by LyondellBasell and VP Racing—is undergoing testing through the FAA-led Piston Engine Aviation Fuels Initiative (PAFI). The companies have said they are also applying for an ASTM specification.

When asked if he would consider licensing GAMI's patents and other intellectual property for G100UL, Braly said at Sun 'n Fun that he would consider it. "For a whole lot less than they're spending on PAFI, the government of the U.S. could negotiate an agreement," he said. "Let's make a deal."

COMPATIBILITY FOR MIXING

The NATA whitepaper advises that in addition to materials compatibility with the fueling infrastructure, FAA approval does not address the fungibility or compatibility of mixing different unleaded fuels in aircraft, airport storage tanks or refueling trucks, exposing aviation businesses it represents, including FBOs and fuel distributors, to potential liability. The association recommends against offering an unleaded avgas unless it has an ASTM or other industry-consensus specification, confirmation of its materials compatibility with the fueling infrastructure and FAA verification of its compatibility with other FAA-approved unleaded avgas formulations.

"G100UL has an FAA STC approval based on a proprietary fuel specification known only to the FAA and GAMI; however, no industry consensus standard or ASTM International product specification has been set for G100UL at this time," the NATA paper states.

"Because the FAA does not indemnify any entity in the supply chain for damages caused by fuel-related issues, fuel distributors and FBOs will similarly lack assurances that the unleaded fuel they are selling will not expose them to liability. At present, G100UL is not commercially available for distribution and sale in the U.S. largely due to the fact it does not have an ASTM International product specification."

At GAMI's Sun 'n Fun press conference, Braly also said the G100UL stored in Baton Rouge is about the amount of fuel that piston-engine aircraft in California burn in a month. Sale of 100LL is prohibited at some airports in California, so there is a pressing need there for a 100-octane unleaded avgas, he said.

When Vitol can offer G100UL for sale, the fuel will be considered commercially available, he advised. That is an important distinction because a 2014 consent decree reached between parties in the California Superior Court in Alameda County requires FBOs in the state to sell high-octane unleaded fuel when it becomes "commercially available."

FBOs that continue to sell 100LL once G100UL is available could be held in contempt of court and face fines, Braly said.

The NATA whitepaper also references the consent judgment in California. It reports that the plaintiff in that legal action—the Oakland-based Center for Environmental Health (CEH)—recently demanded that fuel distributors offer G100UL for sale by March 1. The CEH did not respond to a BCA inquiry seeking more information.

"NATA's understanding is that most distributors and FBOs do not believe that G100UL is 'commercially available' as defined in the settlement and have provided a detailed response to CEH explaining their reasoning," the paper states.

"NATA shares the position of these distributors and FBOs. The FAA's approval of G100UL for use in a broad portion of fixed-wing (but not yet rotor-wing) aircraft engines and types is a positive step, but by itself should not be interpreted to force distributors and FBOs to offer G100UL as a sole replacement for 100LL at present."

"All of the engines used in both normal category and transport category rotorcraft are already covered in the Engine [approved model list] STC," Braly said in an email. "The 'rotorcraft airframes' are not yet covered. However, that process is very far along and that approval is anticipated fairly soon.

"Robinson Helicopter did independent flight testing and wrote a report finding G100UL Avgas to be transparent to the use of 100LL in the Robinson helicopters. That report has been provided to the FAA as part of the GAMI / G100UL data package in support of the rotorcraft airframes being added to the G100UL AML listings for aircraft." **BCA**

Decked Out

What's driving cockpit upgrades.

AS BUSINESS AIRCRAFT CHANGE HANDS, or owners opt for keeping their aircraft in service longer, the odds are pretty good that an order will be placed for a new avionics package.

The business jet cockpit avionics upgrade market is being driven by a combination of factors. One is the constant evolution of technology. “More systems not only enhance the overall performance of the aircraft, but they also reduce the workload for pilots, particularly during critical phases of flight,” says Dan Lyon, Textron Aviation’s vice president for aftermarket sales.

Lyon adds that advancements in airspace regulations and requirements are also pushing owners to update their avionics systems to ensure compliance and maximize safety.

Universal Avionics CEO Dror Yahav reports that the long-term value of many used aircraft has led to an active avionics upgrade market. Many popular business jets were manufactured decades ago, and while they are still reliable, they are at risk of aircraft-on-the-ground status due to obsolescence, frequent failures and a lack of parts availability for avionics equipment.

“These airplanes are also missing advanced navigation and communication functionality, which limits operations and gives them low priority from air traffic controllers,” he says. “Avionics upgrades are solving those obsolescence and support problems while simultaneously bringing them up to speed with the operational efficiency of a new aircraft.”

In fact, Eddy Diaz, avionics manager at Clay Lacy Aviation in Van Nuys, California, reports that the MRO gets requests from jet owners as their obsolete avionics systems break, as well as from sellers of used aircraft who want to make the aircraft more marketable by upgrading outdated or obsolete systems. Among the equipment being replaced are legacy Garmin G1000 displays, GWX-68 weather radar, Honeywell 1310-1 cockpit displays, the Honeywell flight management system (FMS) and multi-control display units one and two, Diaz notes.

Along this line, Eric Smith, MRO technical sales manager



Garmin recently announced an avionics makeover for the Citation CJ2, now available through its dealer network—and a similar upgrade for the CJ1 is on its way, too.

at Banyan Air Service in Fort Lauderdale, Florida, says that obsolescence is among the chief drivers for avionics retrofits. “Traditionally, business jets built 10 or more years ago” are candidates for new flight decks, he says. “This has been particularly noticeable right now with the larger jets—the Globals, Challengers, Gulfstreams and Falcons—specifically those with avionics that were factory-installed. As an example, we are seeing Collins Pro Line Fusion replacements of the Pro Line 4 and Pro Line 21.” Smith cites the Challenger 604 as an aircraft trending toward Pro Line Fusion retrofits.

The Fusion flight deck—the newest member in Collins’ series of Pro Line advanced avionics systems, which is an evolution from the prior Pro Line 4 and Pro Line 21 series—integrates the FMS directly into touchscreen displays, allowing ease of use when it comes to tasks such as flight planning, routing and overall performance calculations. “The FMS also integrates with air traffic control systems, streamlining communications with the ground during the most critical stages of flight,” says Marc Ayala, Collins Aerospace senior sales director for business and regional avionics.

Ayala says Fusion also integrates directly with synthetic and enhanced vision systems, providing visual clarity for all weather conditions, terrain changes and lighting scenarios. “The newest [version] of Pro Line Fusion features Combined Vision, which overlays synthetic and sensed images to



GARMIN INTERNATIONAL

ensure a forward view is always visible regardless of weather conditions,” he notes. “It is available across a multitude of platforms, and its modular architecture allows for simplified integration of future technologies as they become available. We also continue to offer modernization packages for Pro Line 21 aircraft, which include the Hawker 800/900, Premier 1A, Falcon 2000 and the King Air family.”

OBSOLESCENCE COST

Bill Forbes, vice president of avionics programs at Elliott Aviation in Moline, Illinois, explains that a combination of used aircraft sales, parts scarcity and obsolescence, as well as demand by owners who want to upgrade their aircraft are all driving avionics retrofits.

“Our market is King Air and medium-sized jets. We are primarily doing Garmin G1000 retrofits on the King Airs and G5000 retrofits on the Citation Excel and XLS,” says Forbes. “The cost to maintain the legacy systems is a big driver in our G5000 program. Parts obsolescence is playing a role in the older King Air models—the King Air 200s and C90s—specifically those manufactured before Pro Line 2 was available.”

Forbes points out that legacy autopilots are also hard to support, as are the older horizontal situation indicators and attitude direction indicators. “This is particularly true for the

King Air 200s below manufacturer’s serial number BB-1100, and LJ-1063 for the C90s, which have antiquated avionics that are getting harder to get parts for,” he says.

As examples, Forbes cites the Garmin G1000 as a replacement for the Pro Line 2 in the King Airs and the G5000 for the Honeywell Primus system in the Citation XL and XLS, as well as the Beechjet’s Pro Line 4. The Pro Line Fusion, he adds, is a replacement for the Pro Line 4 in the Challenger 604, and the Pro Line 2 and Pro Line 21 in the King Air series.

Going forward, Forbes sees the Citation market presenting even more opportunities. “That is my best guess,” he says. “They have older avionics that don’t fully utilize the capabilities of the airframes.”

Forbes adds that since mid-year 2023, demand for avionics upgrades has reached 10% or better over pre-pandemic levels. “The demand has contributed to a pricing surge—but [demand] is not the main reason,” he stresses. “Most avionics manufacturers typically have a price increase every year and in the last couple years, with supply chain issues and materials cost, it was at a greater level than before. Although supply chain issues have largely subsided from what they were over the past couple of years, labor costs have gone up significantly since 2019. Those two factors, more than demand, have been responsible for pricing increases.”

NEW AND LIKE-NEW

Garmin International offers two popular retrofit integrated flight deck solutions for the business aviation market, as Kyle Ludwick, the OEM’s senior aviation marketing manager, reports. They include the G1000 NXi, which features Garmin Autoland and Autothrottle, for the King Air 200. (The suite will soon be available for the King Air 350.) Also from Garmin is the G5000 cockpit for the Citation Excel and XLS, and the Beechjet 400.

In March, Garmin also announced a total avionics modernization program for the Citation CJ2. The retrofit, described as a “complete upgrade of the light jet’s original flight deck,” will be available under a supplemental type certificate, according to a company press release. The all-Garmin retrofit will include TXi flight displays, GTN Xi navigators, GFC 600 digital autopilot and several more optional upgrades. The full CJ2 cockpit retrofit is slated for sale through Garmin’s dealer network, starting in the second quarter of this year. Garmin also plans to certify a similar flight deck upgrade for the Citation CJ1—although no date has yet been announced.

Universal Avionics’ major cockpit retrofit is its InSight flight display system. As Universal Avionics’ CEO Yahav explains, the glass cockpit upgrade removes as much as 300 lb. of old avionics and wiring weight while adding intuitive touch controls and advanced features to simplify pilot workload.

“It builds on the success of our synthetic vision system, with interactive airport maps/charts, and sharper graphics for terrain, weather and traffic,” he explains. “InSight also integrates with the satellite-based augmentation system-capable Universal FMS to enable precision-based navigation approaches and data communications.”

COLLINS AEROSPACE



Collins Aerospace offers its Pro Line Fusion flight deck for various business jets, including the Gulfstream 280, shown here.

InSight flight deck upgrades are certified for multiple business jets including the Falcon 2000, Falcon 900B, Falcon 50, Falcon 20, Citation VII and Hawker 800 models. The installation, Yahav says, offers maximum flexibility and is compatible with legacy avionics configurations. Modifications may include three or four displays, depending on cockpit space, with an optional fifth display for engine indication available for certain aircraft.

“The door is open to certify InSight as a retrofit modification for many other business jets,” Yahav says. “We are expanding InSight integration options with additional cost-effective IRS/AHRS [inertial reference system/attitude heading reference system], new weather radars, radio management, as well as engine instrument display to address more aircraft platforms.”

The current market for avionics upgrades is driven by both existing owners and new customers who want a cockpit with the safety features and functionality approaching that of new aircraft, says Aaron Kreissler, Bombardier’s regional vice president for service sales in the Americas.

In that regard, Kreissler notes that last year, Bombardier introduced its new Advanced Avionics Upgrade (AAU) for the

Bombardier Global Vision flight deck (GVFD), “which aims to elevate the safety features of the avionics systems and enhance passenger comfort.” He reports that the avionics software and hardware enhancement, which is powered by Collins Aerospace, incorporates the latest technology and is the first major update to the GVFD avionics package since it debuted.

“The new AAU is meant to enhance situational awareness and offers advanced visualization features for in-service Bombardier Global 5000, Global 6000, Global 5500 and Global 6500 aircraft equipped with the GVFD,” Kreissler says. “The new software allows for the

installation of Bombardier’s combined vision system, which integrates the best features of the synthetic vision system and the enhanced vision system in a single view to reduce crew workload and achieve maximum situational awareness through the toughest weather.” Installation of the AAU, he reports, is available across Bombardier’s service center network.



UNIVERSAL AVIONICS

Universal Avionics’ InSight cockpit upgrade is shown undergoing flight testing.

Bombardier has mitigated supply chain and lead time issues by significantly expanding its service center network and adding close to 1 million ft.² of new service infrastructure to its worldwide footprint over the last two years, Kreissler says. The OEM also hired supply chain experts and embedded them with its suppliers at their facilities to provide support on a variety of issues, from planning and sourcing to quality management. **BCA**

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Joby VS. Archer

Vertical integration strategy a key split.

Joby has developed most of the key components for its S4 air taxi in-house.

JOBY AVIATION

IN MANY WAYS, ARCHER AVIATION AND JOBY AVIATION are highly similar startups. The two front-runners in the nascent U.S. air taxi market are both developing piloted, four-passenger electric vertical-takeoff-and-landing vehicles with the goal of launching commercial service next year.

Both companies plan to start by offering airport shuttles in partnership with major airlines, and both are manufacturing their aircraft in partnership with global automotive companies.

But when it comes to their specific manufacturing strategies, the two companies have staked out sharply different paths: Joby is vertically integrated and largely develops its components and systems in-house, while Archer is pursuing a more traditional model by relying on a roster of Tier 1 legacy aerospace suppliers.

Both strategies come with trade-offs. Developing components in-house allows Joby to optimize for its specific aircraft and improve visibility into the integration process, giving it a higher-performing vehicle at market entry. Archer's strategy of relying on legacy aerospace suppliers creates a leaner business model with lower capital investment costs—and, all else being equal, a lower certification risk that it says can translate to a faster path to market.

That difference in strategy is evident in many layers of the two companies' aircraft. While Archer is using more commonly produced cylindrical battery cells, Joby is relying on pouch cells that are more novel and likely harder to certify. Similarly, while Joby is using additive manufacturing and composites to build its vehicle, Archer is sticking to traditional aerospace materials that it expects regulators will greenlight more quickly.

This divergence in supply chain strategy could prove to be the decisive difference between these two neck-and-neck startups.

Archer has developed its own battery packs and motors while sourcing most other key parts from traditional aerospace suppliers.



ARCHER AVIATION

Archer founder and CEO Adam Goldstein tells Aviation Week that the company's supply chain strategy was conceived with the goal of getting to market as quickly as possible with minimal capital investment and certification risk—although not necessarily the best-performing first-generation aircraft.

“Our strategy is to create the most streamlined path to market, starting with sourcing 80% of our vehicle's major components and subsystems through suppliers with a proven track record of FAA certification,” Goldstein says. “This isn't a flashy approach; it's efficient and pragmatic so that our commercialization timeline can rapidly advance with less risk.”

Mark Moore, the Uber Elevate co-founder who pioneered distributed electric propulsion technology at NASA and more recently founded quiet electric propulsion startup Whisper Aero, generally agrees with Goldstein's assessment of the challenges of vertical integration.

“From my interactions with the specific FAA officials, there is a prior relationship of trust that exists with companies that have a proven track record as aerospace suppliers

of FAA-approved parts,” Moore says. “It takes time for a new supplier to have this kind of relationship with the FAA, which makes sense to me because that's true for how I work with our suppliers as well. It is certainly more challenging for Joby to be vertically integrated and provide most of their components, from a certification perspective.”

Joby, however, insists that its vertically integrated model gives it a greater ability to optimize each component specifically for its electric vertical-takeoff-and-landing (eVTOL) aircraft, which will have superior range and speed compared with Archer's Midnight air taxi.

JoeBen Bevirt, Joby founder and CEO, points to technology companies such as Tesla and SpaceX as examples of the benefits of vertical integration, which he says allows them to manufacture high-performing, state-of-the-art systems while avoiding some of the headaches associated with relying on a web of suppliers.

“When you're building hardware, there is no substitute to being vertically integrated with the rate of progress that

you're able to deliver and the quality of the products that you're able to create," Bevirt tells Aviation Week. Being vertically integrated has "enabled us to build a dramatically better-performing aircraft that is quieter, faster and, most importantly, safer. When your engineers are steeped in the design, manufacturing and testing of the components, you get better, safer and more reliable designs."

Joby also says its model will make it easier to integrate the various aircraft systems, avoiding the need for late-stage redesigns that can arise during the integration process.

"When you look at a traditional fly-by-wire aircraft that is made with pieces that are cobbled together from different suppliers, the software stacks are different, the hardware stacks are different, and you're not going to deliver the performance and the integration that we've been able to achieve," Bevirt says. "We all see the inverse of that in a bunch of different aviation companies today that used to be vertically integrated, and they let pieces of the supply chain go. Now that's causing them significant heartache."

While most industry-watchers agree that Archer's strategy offers a lower-risk path to type certification, many also see merits in Joby's approach, especially given its impressive achievements building and flight-testing full-scale prototypes.

"Joby does have the advantage of having more optimal components that are uniquely designed for the exact application, with tight design coupling to all the internal lessons learned across development," Moore says. "Like everything in aerospace, it's a trade-off—and Joby decided to take the more difficult and expensive path that gives them the most control but potentially also more profits."

Sergio Cecutta, partner and president at SMG Consulting, says Joby's strategy might have "gone a bit too far" in terms of vertical integration. But given the company's testing and certification progress, he doubts its vertically integrated model will meaningfully change its time to market.

"I think they have already prepared and put all the items into place to make sure the added effort of vertical integration doesn't impact their schedule," Cecutta says.

Which strategy will prove the most efficient and profitable path to type certification and commercialization remains to be seen. But given the high-stakes trade-offs involved, it may be reasonable to expect that the two sharply different approaches to supply chain and production could translate into vastly different commercial prospects for Joby and Archer in the years to come. **BCA**

Advanced Air Mobility

REPORT



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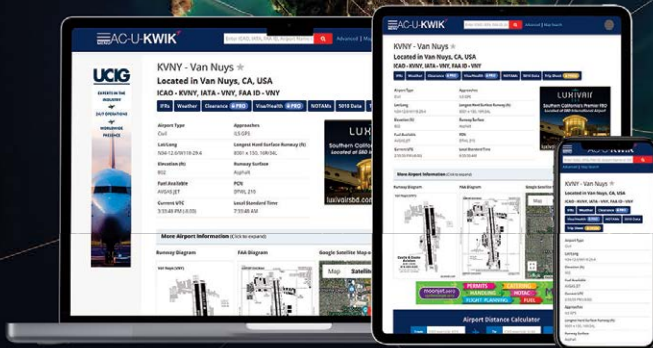
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The Beechjet 400A, A Constant Performer

The light twinjet remains popular through corporate change



BILL CAREY
Contributing Editor



Beech announced production of the Beechjet 400 in 1986 after acquiring the manufacturing rights from Mitsubishi.

NIGEL PREVETTI/AVIATION WEEK

OVER NEARLY FOUR DECADES and a rotating cast of corporate owners, the Beechjet 400A has remained a constant in the pre-owned market for light business jets.

The original Beechjet 400 twinjet was derived from the MU-300 Diamond, an aircraft that Japan's Mitsubishi designed in the 1970s before selling the manufacturing rights to Beech Aircraft in 1985.

Wichita-based Beech, a Raytheon subsidiary after 1980, announced in 1986 production of the Beechjet 400, powered by 2,900-lb.-thrust Pratt & Whitney Canada JT15D-5 engines. The factory-new list, average-equipped price of the 400 model that year was \$3.475 million, according to the Aircraft Bluebook. Its current average retail sales value is \$750,000.

Beech launched the Beechjet 400A in 1989 with JT15D-5 engines, Collins Pro Line 4 avionics, higher gross weight, improved performance and a larger cabin. Accommodating up to 11 passengers but typically seating seven, it flew to a maximum range of 1,885 nm (2,170 mi.) with maximum cruise speed of 465 kt. (535 mph).

The FAA certified the A-model in June 1990, and deliveries followed later that year. Its factory-new, average-equipped price in 1990 was \$4.58 million.

Raytheon acquired the Hawker business jet line from British Aerospace in 1993 and merged it with Beech in 1994 to form Raytheon Aircraft Co. Renamed the Beechjet 400A/Hawker 400XP, the twinjet listed for \$6.65 million equipped in 2003, the last year it was produced. The current average retail sales value of the 400A is \$1.5 million, the Bluebook says.

More corporate takeovers followed. In March 2007, Raytheon sold its Raytheon Aircraft Co. subsidiary to Hawker Beechcraft Inc., a new company formed by Goldman Sachs and Onex Partners, for \$3.3 billion.

Hawker Beechcraft entered Chapter 11 bankruptcy in May 2012 and emerged in February 2013 as Beechcraft Corp. Textron acquired Beechcraft Corp. in March 2014 to form Textron Aviation, bringing together its iconic Cessna business with the similarly renowned Beechcraft and Hawker lines.

Adding to the mix, Cleveland-based Nextant Aerospace introduced the Nextant 400XT, a remanufactured Beechjet 400A with Williams FJ44-3AP engines and Collins Pro Line 21 avionics, in 2011.

Textron Aviation in 2017 delivered its first Hawker 400XPR—a baseline Beechjet 400A/Hawker 400XP with Williams FJ44-4A-32 turbofans, new winglets and refurbished interior. Customers had the option of upgrading from Collins Pro Line 4 avionics to Pro Line 21 or a new Garmin G5000 integrated flight deck.

FLIGHT DECK MODERNIZATION

The FAA awarded Garmin a supplemental type certificate in 2016 for its G5000 flight deck modernization of the Beechjet 400A/Hawker 400XP series. The upgrade features three high-resolution 12-in. flight displays forward with dual touchscreen display controllers on the pedestal that serve as the primary crew interface with the system.

Garmin announced in 2022 that it had made enhancements to the G5000 flight deck program for the twinjet, to incorporate FAA Data Comm messaging capability with air traffic control, ADS-B in traffic and weather information, TCAS II Change 7-compliant traffic alerting system, a digital radar altimeter and new cockpit connectivity options.

Aviation Week's Fleet Discovery Database counted 18 Beechjet 400s and 443 Beechjet 400A/Hawker 400XP/XPRs in March, plus 10 jets stored, parked or in the possession of a third party. There were 62 Beechjet 400XT/XTis.

There were 20 prior-owned Beechjet 400As, or 8% of the 400A fleet, for sale in March, with an absorption rate—the speed at which an aircraft is sold—of about 10 months, says

Kevin O'Leary, president and CEO of Jet Advisors, based at Hanscom Field in Bedford, Massachusetts.

The asking price for earlier Beechjet 400As is about \$1.35 million, and those with the Garmin flight deck upgrade command \$1.55 million, O'Leary says. Competing aircraft include the Cessna Citation Ultra and Learjet 31A.

"The Beechjet 400A continues to be a popular light jet because of its cabin and reliability," O'Leary says. "The JT15D-5 engine shop visits are predictable and therefore make the Beechjet a value-priced option in the marketplace. The airframe is built strong, making upgrades like the avionics a reasonable option to extend the life of the aircraft."

The jet's cabin measures 4.8 ft. high, 4.9 ft. wide and 15.6 ft. in length, with a flat floor, an enclosed rear lavatory and a refreshment cabinet.

"The Beechjet 400A has an excellent combination of cabin and speed," O'Leary observes. "The flat floor allows for passengers to swivel their seats to avoid other passengers' legs without needing to straddle a dropped aisle."

Beechjet 400A inspections are required at 200 hr., 400 hr., 1,200 hr. and 5,000 hr. Operators should expect direct operating costs of roughly \$2,950 per hour, including \$1,140



GARMIN

The FAA awarded Garmin a supplemental type certificate for its G5000 flight deck modernization of the Beechjet 400A/Hawker 400XP series in 2016.

for fuel (190 gal. at \$6/gal.), \$1,000-\$2,000 for parts, labor and reserve, and \$600 for crew and supplies, O'Leary says. **BCA**

BCA welcomes comment and insight from aircraft dealers and brokers for its monthly 20/Twenty pre-owned aircraft market feature. The focus aircraft for May is the Pilatus PC-24, and for June, the Learjet 60. To participate, contact bill.carey@aviationweek.com.

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Growth Plans



How European FBOs balance investment decisions.

WITH THE AFTEREFFECTS OF THE COVID-19 pandemic and its travel restrictions now well in the rearview mirror, Europe's business aviation sector is getting a clearer idea of what its new operational normality looks like. While there are granular differences on certain routes and individual cities, in broad terms, utilization of private aircraft has settled at a level higher than in 2019, albeit not as high as at certain points in the post-COVID rebound.

Even as clarity emerges over demand signals, though, there are other factors that affect bizav's ability to plan for the medium and longer terms. For reasons that are widely known, if not necessarily accepted, the sector has found itself being singled out for attention by both environmental activists and governments as pressure builds across society to cut greenhouse gas emissions.

As well as protests at airports, trade shows and industry conferences, bizav is coming under pressure from national and local governments. Amsterdam's Schiphol Airport announced restrictions on business aviation among a raft of proposals to limit flights more generally, only to rescind those plans following pushback from the Dutch government. Spain has joined France in banning domestic flights between cities with high-speed rail links. In the London region, the continent's busiest bizav market, Farnborough Airport is facing unprecedented levels of opposition to its plans to raise its movement cap, while Stansted and Luton airports will be largely closed to out-of-hours business aviation traffic again this summer.

All of this represents a challenging enough planning environment for aircraft owners and operators, but for fixed-base operators (FBO) the complexities are even more pronounced. Capacity and seamless throughput of passengers and cargo can only be guaranteed by investing in expensive and long-term infrastructure, but if the certainty over the ability to operate is affected by political responses to shifting social

Harrods opened their second FBO at London Stansted Airport in October 2023. The Brompton complements the adjacent facility, now known as the Knightsbridge.



HARRODS

perception, how can FBO owners make sensible and cost-effective plans?

“We look at the geopolitical environment in every country that we look to operate in as a natural part of our business planning,” says John-Angus Smith, managing director for Europe, Middle East and Asia with Signature Aviation, which operates a network of FBOs at 200 locations in 27 countries. “I get questioned all the time by our global management about the environment over here [in Europe], and how we’re planning our business in relation to those risks.”

“It’s not just about what we do as a company, it’s also about what we should do as an industry,” Smith continues. “The industry adds significant value at country level—at any level. What we’ve got to do as a business is defend our reputation.”

Smith stresses the role that trade associations, such as the European Business Aviation Association (EBAA) and the British Business and General Aviation Association (BBGA), have to play in advocating for sector companies at a government level. But ultimately, companies like Signature Aviation can only exercise a direct influence over aspects of the business aviation ecosystem that they control. For this reason, in part, he believes that the company’s work to decarbonize its own operations is critical.

“It’s important for our brand, and the progressive perception of our brand, that we are a leader in minimizing our carbon footprint,” he says. “We’re doing that through proactively addressing the three areas of emissions. In terms of Scope 1, we are moving our GSE [ground support equipment] fleet progressively to electrically driven vehicles. We’re putting our first electric fuel bowser [at Nice Cote d’Azur Airport] as part of a commitment we made to the airport when we renewed our license there. On the Scope 2 side, we’ve moved all of our lighting to LED, so we are minimizing our power use. And we’re a major supplier of sustainable aviation fuel.”

Sustainable aviation fuel (SAF) is as critical to FBOs meeting their own emissions-reduction targets as it is for aircraft manufacturers and operators. Demand is still limited by the price differential with standard fossil fuel, but supply is currently the bigger problem for Signature.

“We want as much SAF as we can get,” Smith says. “We sold over a million gallons at Luton last year. As a global organization, we sell over 8% of the world’s SAF. We want it everywhere around the network, and this is an area where governments could really help us, by mandating the airports to make SAF available. But the challenge on our side is really encouraging the suppliers to make SAF available to us. They’ll have a tendency to prioritize [airlines], which is clearly more commercially beneficial to them.”

This multi-stranded approach is mirrored by other FBO operators. Harrods Aviation expanded its footprint at Stansted Airport in 2023 after acquiring the private facility owned by the late owner of the Harrods brand, Mohammed Al Fayed. The firm’s commercial director during that expansion, Will Holroyd, left the company in February 2024, but during an interview conducted before his departure explained that the decision to acquire its third FBO and its second at Stansted was motivated by the increasing demand the company had seen at the hub airport.

“They’re both unique, and they both offer something very different,” Holroyd says of the two Stansted FBOs, which the company calls the Knightsbridge and the Brompton. The former has larger lounges as well as separate areas for smaller groups, so lends itself to large-aircraft charter and head-of-state or VVIP flights. The new Brompton location can comfortably handle groups of up to 30 people, but also enables passengers to be driven direct to the aircraft. And with the significant increase in hangar space acquired with the addition of the Brompton, Harrods Aviation is better able to accommodate customers who wish to park aircraft at Stansted for extended periods.

Holroyd acknowledges that wider public perception and regulatory questions are not ones he and his company are



Jet Aviation supplied sustainable aviation fuel at Zurich Airport during the World Economic Forum in January.

able to control, so instead he is concentrating on the parts of the sustainability challenge that Harrods Aviation has the power to directly affect.

"I've got to look at my business," he says. "We don't operate any aircraft, but we do operate three very large facilities. What can we do in those facilities to make a difference? We're looking at simple things: LED lights, for example, and how we heat the hangar. When we replace a vehicle, we're replacing a fossil-burning vehicle with an electric vehicle. We'd looked at carbon offsets, but we've been educated that perhaps that isn't [the right thing to prioritize]. You should be looking at what changes you can make to actually make yourself more efficient."

SAF is not yet available to Harrods' Stansted locations, but the company has been able to implement a book-and-claim system, through a fuel-supplier intermediary, which sees SAF uploaded to aircraft "five miles from where it's actually made," in California, Holroyd says.

While book-and-claim is working at Signature Aviation's U.S. locations, the company has not yet found a workable solution for Europe. There are differences across different nations as to how carbon credits from paying for the fuel can be claimed by the purchasing entity—which, at present, are preventing the company from being able to offer this as an option to its customers in Europe, Smith says. He highlights this as an area in which government intervention, and lobbying by the associations, could make a big difference.

Jet Aviation, which operates several FBOs across Europe, including at Amsterdam Schiphol, says it, too, supplies SAF at its locations "where it is available in close proximity." This includes Amsterdam. The company also supplies SAF during

certain events, such as the World Economic Forum and at EBACE in Geneva.

Joao Martins, Jet Aviation's vice president for regional FBO operations in Europe and general manager of its Zurich facility, also tells *BCA* via email that the company has "offered book-and-claim worldwide since 2021," without describing how this has been achieved.

Like Harrods and Signature, Jet Aviation is investing in solar power and electric ground vehicles at multiple locations worldwide. Martins also highlights the use, at the company's Basel, Switzerland, completions center, of a 25% plant-

based resin in production of composite parts for aircraft interiors. This reduces "the overall environmental impact when compared to traditional epoxy resin," he says. The company is also "offering customers more sustainable solutions during their journey," he adds, such as locally sourced catering or a reduced use of plastics.

Even when added together, these measures are unlikely to win over the increasingly well-organized protest lobby. Smith notes that Signature Aviation has increased the physical security of the perimeter of its Le Bourget FBO near Paris



Signature has invested in improving its existing facilities at several airports during the post-COVID period, including at Birmingham, England.

following an incident in 2023, and says the company invests in intelligence-gathering and regularly tests its business continuity plans to ensure it can cope with disruptions.

Nevertheless, with Harrods more than doubling its footprint at London Stansted and Signature acquiring TAG's Swiss FBOs and opening improved facilities at Birmingham and Edinburgh in the UK, it is clear that geopolitical uncertainties are not deterring FBO companies from making long-term investments.

Martins says that Jet Aviation "continually review[s] our

John-Angus Smith (right), with Birmingham FBO manager Emma Woodcraft and then-mayor of Solihull, Ken Meeson, cut the ribbon to open Signature's Birmingham FBO in 2022.

global footprint to ensure we can offer relevant services in key locations where our customers travel and where we believe there is reasonable growth potential."

The length of lease available at an airport is a far bigger determining factor than concerns around potential flight caps or climate-related operational restrictions, Smith says. Any potential new site, or significant investment into an existing one, would need to provide a good fit with the company's existing network, and funding for the project would only be signed off once a solid business case had been established.

"We've got a very, very good understanding of how our customers move around our network and where the value-add opportunities are," he says. "We are careful. But the



SIGNATURE AVIATION

whole focus of the business is on ensuring consistent frictionless travel. Wherever our customers want to be, we want to be, but it has to be on terms that work for us, from an investment perspective." **BCA**

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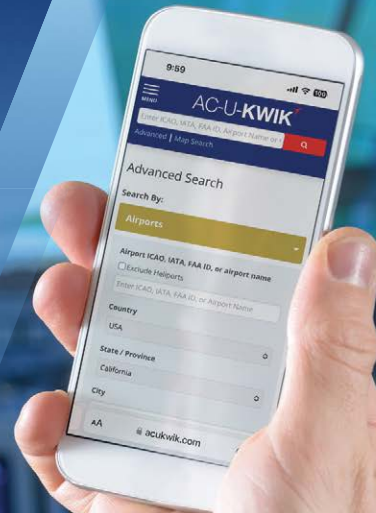
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AVIATION WEEK
NETWORK



Path To The NTSB

The long and winding journey to safety board appointments.

IT WAS AN OTHERWISE MUNDANE Tuesday morning in June 2006. I was at the airport office of our business aviation flight department when I got the call. When the White House calls, only the 202 area code pops up—not the full set of digits. I knew who it was and immediately grabbed it. On the other end of the line was Janae, an employee in the Office of Presidential Personnel (PPO).

“Hi Robert, how are you?” she asked. “I don’t know, Janae. You tell me how I’m doing,” I replied. There was a serious lump in my throat. I had been waiting for this call for weeks and did not know if she was calling with good news or bad. I had been sweating bullets that it would not be good.

“I’ve got good news,” came her reply. “This afternoon the president will make an announcement that he’s nominating you to be a member of the National Transportation Safety Board, and upon confirmation, designate you as vice chairman.” In total disbelief, I literally had to ask her to repeat what she said just to make sure I properly understood it.

Nine months earlier, my good friend Bill Weeks and I were at a reception and dinner in Washington. That is when he broached the idea that I needed to pursue my dream of being appointed to the NTSB. Bill and I go way back, starting in 1983 when we were part of the small team that introduced the Fokker F-28 into Piedmont Airlines’ fleet. We spent six weeks in Holland as sim partners, and then worked together to write the manuals, procedures and training program. We later did a good bit of safety work together for the airline. At the reception, Bill wrote on the back of a cocktail napkin a list of people we needed to talk to. A few days later, I called then-NTSB board member Debbie Hersman, who later became chairman, and asked her advice. She said I was a long shot and wished me good luck.

Long shot or not, one by one, I started getting support from people on Capitol Hill. I met with the transportation secretary and the deputy secretary. I met with the chairman of the Senate Commerce Committee, which has jurisdiction over nomi-



nees for transportation-related positions. There were trips to Washington and there were phone calls and letters. I had a meeting with the director of the PPO. Throughout all of this, PPO is vetting other candidates, too. This became embarrassingly apparent when I was sitting in the waiting area outside a key senator’s office when one of the other potential nominees walked out.

By statute, NTSB has five board members, each of whom are presidential appointees with senate confirmation (PAS). The road to nomination and confirmation is an extremely arduous and painstaking process. I successfully navigated it on four occasions.

After all these meetings, phone calls and letters, in March 2006, I received a call from the director of PPO. “I’ve just left the Oval Office, and the president [George W. Bush] wants to move forward with your nomination to NTSB.” He mentioned something about a background investigation and then warned: “The quickest way to not get this job is for us to read somewhere that you think you have it.”

The fun now begins.

BACKGROUND CHECKS

There are scores of forms and documents that need to be completed and signed. There is the SF-86, which is the application for a security clearance. A set of White House ques-



In July 2019, President Trump renominated Robert Sumwalt for another term as NTSB chairman. A few days after the hearing, the Senate Commerce Committee voted to send the nomination to the floor for a vote by the full Senate.

NTSB. How exactly does someone get appointed as a member of the NTSB? The answer lies in Article II of the Constitution, which states that the president “shall nominate, and by and with the Advice and Consent of the Senate, shall appoint Ambassadors, other public Ministers and Consuls, Judges of the Supreme Court, and all other Officers of the United States.”

In other words, the president nominates his or her choices for these high-level positions. The Senate then has the responsibility to conduct its own vetting and decide whether to confirm the nominee. Just like the televised testimony for Supreme Court nominees, NTSB nominees must undergo a Senate confirmation hearing, too. I have personally known four people who were nominated for the NTSB but did not get confirmed. You cannot take anything for granted.

One of the new board members was nominated back in 2022, but just recently confirmed. When he and the other nominee came for a Senate vote in December, one senator blocked both nominations—not because of their credentials, but simply because he had a vendetta against the Senate majority leader. After all, these are political appointees, and the process to get there is political in nature.

Two new members recently joined the board. This brings the board back to its full complement of five members for the first time in nearly five years. Furthermore, it has been down to just three members since I departed in mid-2021. The day after these new members were sworn in, the White House announced the president’s intent to renominate the current chair for another five-year term, including an additional three years as chair.

HOW TO GET NOMINATED

How do you get the attention of the president to nominate you to one of these highly coveted positions? Good question. Basically, there are two types of people who are appointed—those with excellent transportation credentials, and those who have excellent political connections.

Whenever someone tells me they want to be an NTSB board member, the first question I ask is, “Are you a Republican or a Democrat?” While safety is nonpartisan, the statute states that no more than three of the members may be from the same political party. The party with the greatest number of seats is typically the same as the president’s party. For

tions supplement that form, and then there is the extremely detailed and cumbersome financial disclosure form, the OGE-278. The questions on these forms are quite pointed and direct. Falsification can lead to fines and imprisonment. Fingerprints are taken.

And then—despite the warnings you have received to keep quiet—your neighbors and friends start getting calls and visits from a little organization called the Federal Bureau of Investigation (FBI). Two of my neighbors freaked out when an FBI special agent showed up at their houses and started asking questions about me. They each then called me to make sure I was not about to go to jail.

The background investigation lasts around three months—possibly more. The NTSB’s ethics officer, meanwhile, must heavily scrutinize your financial disclosure form and other aspects of life to make sure there are no ethical conflicts. The director of the Office of Government Ethics must clear you before anything moves. You must sign an ethics agreement to attest that you will divest of any conflicting financial interests and organizations.

Despite all this angst, through all of this, I had finally received the call from Janae. I was about to be nominated. Now, I had to worry about the Senate.

By way of background, there are around 1,200 PAS positions in the U.S. government. These include cabinet officials, federal judges, heads of agencies such as FAA, NASA and

NTSB



One of NTSB board members' many tasks is to conduct briefings after accidents. On a cold January day in 2013, Robert Sumwalt briefed media in New York City after Seastreak Wallstreet, a commuter ferry boat, plowed into the dock and injured several passengers.

example, when we have a Democrat president, if you are a Republican and there are already two Republicans on the board, forget it for another four years.

The statute also requires that “at least three members shall be appointed on the basis of technical qualification, professional standing and demonstrated knowledge in accident reconstruction, safety engineering, human factors, transportation safety or transportation regulation.” When Jim Hall was nominated in 1993, the Washington Post commented on his heavy political background and coziness with influential politicians and quipped that Hall’s “only transportation experience apparently is a driver’s license.” Hall later rose to

be NTSB chairman and proved to be a quick learner and an outstanding leader.

In the early 1990s I had the opportunity interview NTSB member John Lauber for a magazine. Dr. Lauber had very strong technical credentials, having done early research at NASA on crew interactions. He and his team came up with the notion of crew resource management. He was type-rated in a Boeing 727. Despite his strong technical qualifications, he made an excellent point: “I think it is important to have a board with people of diverse backgrounds because everybody brings a different point of view. Accidents are not just technical issues. They involve issues of state and government oversight, organizational practices, public policy, economic issues and legal issues. I think collectively we come up with much better decisions than if we were all aviation psychologists or all lawyers. I think the net result is one that has positive benefits for the traveling public.”

I first joined the board in 2006. During a swearing-in ceremony, I read a statement I had run across during the long and winding journey to being appointed to the NTSB. “Public service is one of the highest callings in the land. You have the opportunity to make a positive impact on families, communities, states and sometimes the world.”

I truly believe this statement applies so well to the work of the NTSB—and I was so honored to serve for 15 years. **BCA**

Robert L. Sumwalt is executive director for the Boeing Center for Aviation and Aerospace Safety at Embry-Riddle Aeronautical University. He was a member of the NTSB from 2006-21, where he served as chairman from 2017-21. Before that, he managed a corporate flight department for a Fortune 500 company, and previously was an airline pilot for 24 years. He recently co-authored the third edition of Safety Management Systems in Aviation, with Alan Stolzer and John Goglia.

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AVIATION WEEK NETWORK



ROGER COX
Contributing Editor

Runway Incursions

The problem with estimating the risk of runway incursions is they are so unpredictable.



The morning after the JAL A350 collided with the Japan Coast Guard Dash 8-300.

RICHARD A. BROOKS/AFP VIA GETTY IMAGES

RUNWAY INCURSIONS MAKE THE NEWS when there is a spectacular collision, as happened recently at Tokyo Haneda Airport. On Jan. 2, a Japan Airlines Airbus A350 collided with a Japan Coast Guard Dash 8-300 turboprop. All 379 occupants of the A350 evacuated safely after the airliner came to rest, but five of the six people on the Coast Guard aircraft were killed.

The severity of the crash makes runway incursions seem like a major threat to air safety. But the likelihood of an incursion is also important in judging risk, and that is hard to estimate.

To help understand the likelihood, or probability, of a catastrophic incursion accident, the FAA now tracks all incursions at U.S. airports, whether they involve giant aircraft maneuvering in close proximity to one another or just aircraft rolling a few feet past a hold-short line.

Air traffic control staff at the incident airport are required to make Mandatory Occurrence Reports and categorize the event according to its apparent hazard. The A and B categories are incidents they judge to be the most serious. When aircraft narrowly avoid a collision, it is an A. When there is significant potential for a collision and/or evasive action, it is a B.

MOST INCURSIONS ARE BENIGN

What the FAA data shows is that most incursions are benign. The 2020 iteration of the “FAA Administrator’s Handbook,”

for example, showed there were 1,644 runway incursions in 2017, but only five that were categorized as A or B. The more recent “Air Traffic by the Numbers 2023” addressed only major “Core 30” airports, but the pattern was the same. In fiscal 2022, Core 30 airports reported 299 incursions; one was categorized as A, and one as B.

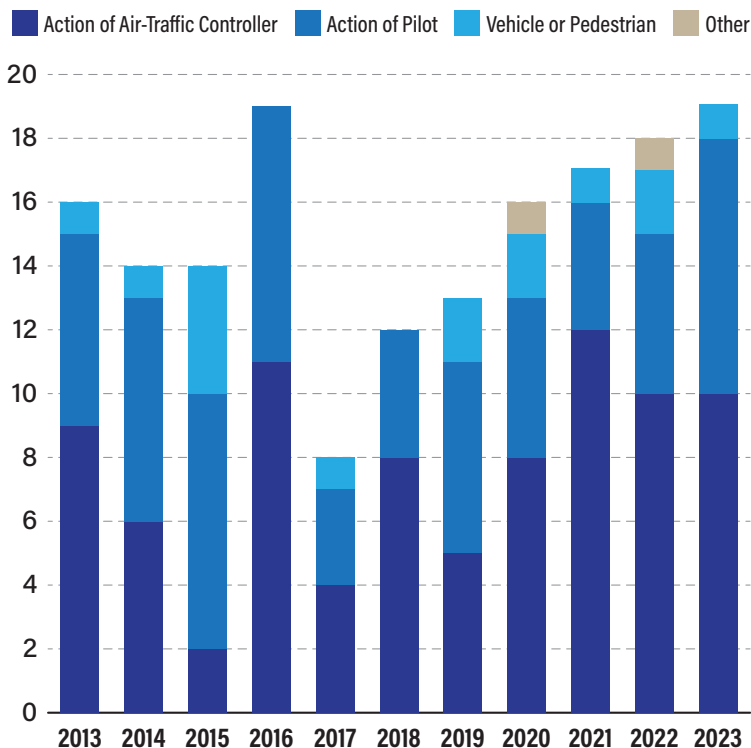
An FAA graphic of A and B incursions from 2013-23 shows a saw-tooth pattern, with eight incidents the low and 19 the high number. There is no discernible pattern or trend. The average incidents over the 11 years is 15.1, so the high of 19 is not statistically very significant. Unless there is an underlying factor driving more incursions, the number will revert to the mean.

The problem with estimating the risk of runway incursions is they are so unpredictable. They are unlike runway excursions, where you can pretty well guess that on a short, slippery runway in windy conditions a runway excursion could happen. You can create mitigations for excursions.

Runway incursions happen at large airports and small, in good weather and bad—with airliners and small airplanes as well as with experienced pilots and novices. They happen when the flow of traffic seems normal and when it is busy. Sometimes pilots miss a clearance, and sometimes controllers create a conflict or fail to see one developing. Airport vehicles rollout on runways and cross them when they are occupied.

The people involved in runway incursions must always be surprised. Imagine the reaction of the pilots of a NetJets

SERIOUS RUNWAY INCURSIONS, BY CAUSE



Note: For category A and B incidents, 2023 data is through October.

SOURCE: FAA

Bombardier Challenger 350 suddenly facing an oncoming Cessna 150 trying to land on their takeoff runway. When cleared for takeoff from DeKalb-Peachtree Airport Runway 21L, they were told the Cessna 150 would be departing 21R. What they could not have known was that the Cessna pilot would have a rough-running engine and was going to turn back and fly right at them. The Challenger crew pitched the jet up aggressively and managed to overfly the Cessna by 200 ft.-300 ft.

Then there was the crew of a Hawker 800 twinjet that overflew an airport fire truck just as they were lifting off from Runway 14 at Treasure Coast International Airport in Fort Pierce, Florida. The crew cleared the truck, which was not cleared to be driving across the departure end of the runway, by 50 ft.-100 ft. The pilots likely had some moments of shock, followed by great relief.

A Gulfstream GV crew had to abort its takeoff from Van Nuys Airport Runway 16R after a Beechcraft Bonanza flew over and landed in front of the Gulfstream. Picture the consternation of the Gulfstream pilot as he saw the light airplane cut him off after he had begun his takeoff roll.

After these incidents, two business jets finally came too close and collided. On Oct. 24, 2023, a departing Raytheon

Hawker 850XP struck the empennage of a landing Cessna Citation Mustang at William P. Hobby Airport in Houston. The Hawker’s left wingtip and the Mustang’s tail were damaged, but both aircraft landed safely.

Given the unpredictable nature of this type of event, what precautions can we take to prevent damage and injuries? One answer was contained in the testimony of FAA Administrator Michael Whitaker to Congress on Feb. 6. The FAA, he said, will provide more controller training and supervision and deploy tower simulator training systems in 95 facilities by December 2025. There will be runway incursion warning systems and vehicle automatic dependent surveillance-broadcast emitters to cut down on vehicle/pedestrian deviations. The agency is focused on airports that have a history of runway incursions and locations that have incidents of wildlife affecting airport operations.

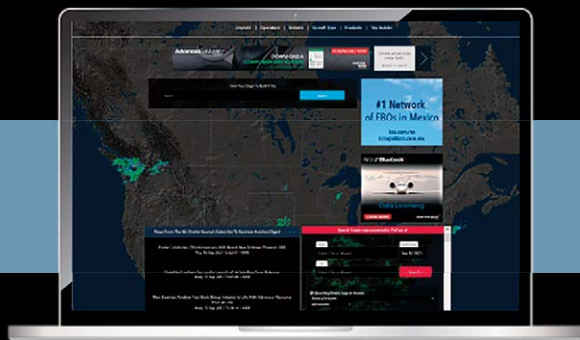
One initiative that I like but was not mentioned by Whitaker is the agency’s “From the Flight Deck” videos and handbooks. The FAA began producing videos about individual airports roughly two years ago, and the number of installations has increased steadily.

The videos remind me of the Jeppesen 10-7 pages we had at airlines to provide pilots with important operational details about the airports we flew into. Most of the videos concern mid-size airports that host both light airplane and business jet traffic. They provide pilots with excellent airport familiarization.

In FAA announcements and press releases, there are a certain amount of vague promises—but also a glimpse into more substantive actions. Never underestimate the agency’s ability to manipulate statistics in the most favorable way. But runway incursions could be reduced by a concentrated effort on all our parts. **BCA**

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Plummeting Hawker

Does the crash of a Hawker 900XP reveal deeper underlying issues for the industry?



The wreckage of the Hawker 900XP, which crashed in Utah near the Colorado border. The author's hope is that important lessons from the tragedy can be used to make positive changes.

THE PHOTOS OF THE IMPACT SITE are grim. The preliminary information from the NTSB reveals that the final minute of the pilots' lives was spent in an uncontrolled plummet toward the ground.

Sadly, this is not the first time a Hawker jet has experienced a violent loss of control while performing a post-maintenance flight test after maintenance on the TKS ice-protection panels. When viewed in combination with similar accidents, this leads to questions of unresolved weaknesses in our safety system, not just for post-maintenance flight tests in general,

but also for the training to fly swept-wing aircraft.

The NTSB's preliminary report, which contains the caveat that the information is subject to change, revealed that the Hawker Beechcraft 900XP twinjet operated by Vici Aviation and managed by Clay Lacy Aviation arrived at West Star Aviation's facility at Grand Junction Regional Airport (GJT) in Colorado on Dec. 20, 2023. Information from the maintenance facility indicates the wing leading edges and TKS panels were removed to inspect for cracks and signs of corrosion. The aircraft was returned to service on Feb. 6, 2024.

The flight crew planned to fly the jet from GJT to Gig Harbor, Washington, on Feb. 7, 2024. While en route, the

pilots would perform a stall warning check. The pilot operating manual requires a minimum altitude of 10,000 ft. AGL, 10,000 ft. above clouds and below 18,000 ft. MSL. The test also requires day VMC with a good visual horizon, the autopilot disengaged, an operative stall identification system, external surfaces free of ice, an empty ventral tank and the weather radar on standby.

The flight crew asked for an altitude block from FL180 to FL200. Initial analysis of ADS-B data reveals the aircraft leveled off near the top of its requested altitude block, then began a rapid descent in a circular pattern that resembled the shape of a corkscrew. At one point, the rate of descent was in excess of 10,000 fpm. The jet made multiple rotations before impacting flat terrain in Utah near the Colorado border, approximately 25 mi. northwest of GJT. Both pilots were killed.

Unfortunately, the violent impact with the terrain likely destroyed important perishable evidence. This would include whether the leading edges were clean or exhibited signs of ice that might have accumulated when the aircraft may have flown through the clouds that existed at the time of the accident. Piecing together and analyzing all the tiny bits of evidence will be a time-consuming process.

While the industry waits for the final official report on the Feb. 7, 2024, accident, there are many other closely related accident reports and engineering studies that bring into question the adequacy of current training and procedures in swept-wing jets that are worth examining.

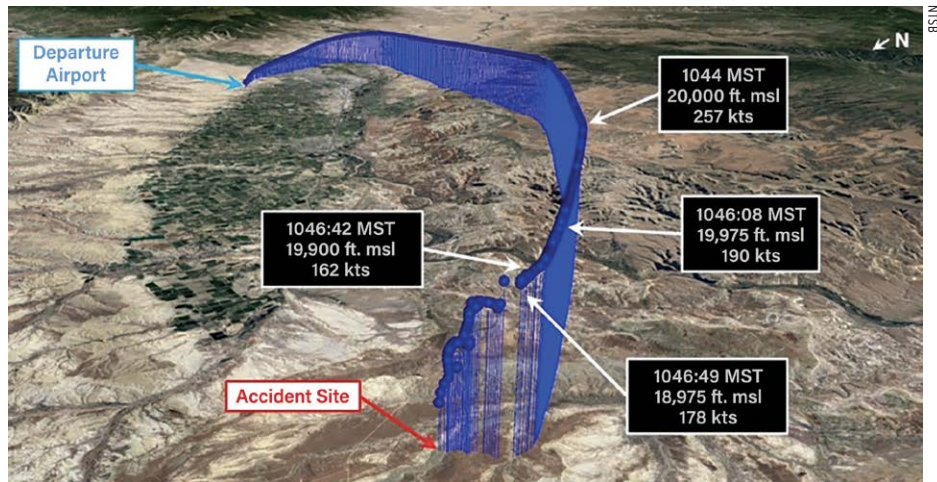
DEPARTURE FROM FLIGHT ENVELOPE

A temporary loss of control occurred on May 4, 2006, to a Hawker 800A during a maintenance test flight northwest of Lincoln, Nebraska. The aircraft had just come out of extensive maintenance. Onboard were two Raytheon test pilots and four passengers that Raytheon considered crucial for the test flight.

The first maneuver to be performed was a clean stall. The crew calculated the stick shaker activation speed to be 115 kt. and the stick pusher speed at 107.5 kt. The aircraft was level at 17,000 ft. MSL with the autopilot engaged in altitude hold and heading hold modes.

As the aircraft slowed to approximately 126 kt., the right wing suddenly stalled, the nose dropped through the horizon and the aircraft continued to roll to the right in a near-vertical descent. The jet entered a cloud layer below and due to its attitude, the gyros tumbled. The crew was unable to determine the attitude of the aircraft until they exited the cloud layer.

The jet continued to roll to the right about three turns total when it experienced a rapid roll reversal to the left, rolling



Initial analysis of ADS-B data reveals the Hawker twinjet leveled off near the top of its requested altitude block, then began a rapid descent in a circular pattern that resembled the shape of a corkscrew.

about two-to-three turns in that direction. When the crew exited below the base of the cloud layer, the captain saw only ground through the windshield and immediately pulled back on the yoke and regained control at approximately 7,000 ft. MSL. The crew returned to the Lincoln airport, declared an emergency and made a no-flap landing on Runway 36.

Subsequent investigation discovered that the crew had difficulty in locating an area that was VMC to perform stall tests. Two passenger statements mentioned that they saw ice on the leading edge of the wings. During the interview, pilots stated they never activated the TKS system.

The aircraft flight manual specifically noted that all external airframe surfaces must be free of ice when performing intentional stalls. A possible explanation for the sudden drop-off of a wing at a speed far above the calculated stick-shaker speed would be ice contamination. The manual states that clouds should be at least 10,000 ft. below the aircraft prior to stalls and the autopilot disengaged. They should not be initiated in icing conditions.

In the aftermath of this incident in Nebraska, Raytheon issued a stall training syllabus that outlined operational considerations for stall testing and clarified approved recovery procedures. In addition, the company discontinued the practice of approaching intentional stalls with the autopilot connected for in-service aircraft until the stall characteristics of the aircraft have been ascertained.

NO NATURAL STALL WARNING

The Hawker 900XP Pilot Operation Manual clearly states, "There is no natural stall warning or aerodynamic buffet prior to the stall." This is a common trait of swept-wing aircraft.

Unfortunately, the important point is poorly communicated in aviation training materials and by online commentators.

The span-wise component of the airflow over a swept wing

experiences more skin-friction drag, which in turn slows down its velocity and increases the development of an adverse pressure gradient closer to the wingtips. If you watch the videos of older wind tunnel tests performed by NASA, notice how the trait of the span-wise flow increases as the overall angle of attack is increased. On those older swept-wing designs, the worsening adverse pressure gradient creates a separated boundary layer (i.e. a “stalled” region of the airflow) beginning at the wingtips.

This behavior was noted when a team of engineers equipped an early-series Learjet with yarn tuft indicators to visually illustrate the behavior of the boundary layer on an unmodified wing. As the angle of attack was increased, the region of separated flow would grow from the wingtips inward.

The separated boundary layer from the wingtips does not flow over the empennage, and thus there is no buffeting of the tail surfaces to provide a tactile indication of the stall condition. This is completely different from the stall characteristics of rectangular planform wings in which the wing root section begins to stall first, resulting in the separated boundary layer flowing over the empennage and providing the classic tactile indications that are quite normal in light general aviation aircraft.

The tendency for the stall to begin at the wingtips on unmodified swept-wing planforms creates additional problems for aircraft handling. Swept-wing aircraft that use ailerons will experience lessened roll control. Additionally, the loss of lift from the outboard sections will move the wing’s center of lift forward, thus creating an adverse nose-up pitching moment.

Modern transport wings are often built with a deliberate change in the airfoil sections along the span to improve a wing’s lift-drag ratio during cruise flight as well as its behavior during transonic flight. This sophisticated method is called “aerodynamic twist.” Additionally, the leading edges tend to be thinner out toward the wingtips, which increases the tendency toward a leading-edge stall behavior.

The teams of engineers working to certify the Gulfstream IV design learned from the flight envelope expansion tests that the unmodified wing demonstrated a leading-edge stall beginning at the mid-span when the aircraft’s angle of attack was increased. Eventually the engineers resolved this undesirable aerodynamic behavior by mounting a series of vortilons in a carefully tested location along the leading edge.

Each aircraft has its own unique aerodynamics, handling characteristics, flight-control effectiveness and limitations that can vary considerably depending on the phase of flight; response dynamics related to the aircraft’s weight distribution; and engine location. It is important for pilots to be prop-



KIMBERLY HENNEMAN

The author inspects the wing of a Hawker 800XP after the TKS panels had been removed and reinstalled. One important item to check is the sealant between the TKS panels and the wing.

erly trained in the specific reactions to prevent and react properly to an unwanted motion.

The examples cited in this article also demonstrate that the simplified drawings in outdated pilot training materials and explanations by online personalities are unlikely to accurately represent the design and flight characteristics of supercritical airfoils and modern transports. The aerodynamics of modern wings are much more complicated, and thus their behavior is far different from the simplified discussions contained in the majority of pilot training materials.

STICK SHAKER IS AN ARTIFICIAL WARNING

The previously mentioned characteristics make it necessary for swept-wing aircraft to be equipped with a stick shaker to provide an artificial stall warning. The sticker shaker provides the first tactile warning on the Hawker and many other swept-wing jets of a high angle of attack.

The design of artificial stall warning systems is a subspecialty that requires in-depth aeronautical engineering knowledge, training and a great deal of experience. The consideration of where to place an angle of attack vane on an aircraft is a complex process, and there is not an ideal location that is free from the equivalent of position error. The effects of takeoff rotation and adverse crosswinds are just a few of the complexities that specialists in this field of engineering must analyze for each aircraft design.

There are a number of conditions in Hawker manuals that require a post-maintenance stall test flown by a pilot familiar with the stall identification system and the stall characteristics. These include removal of the leading edge assembly as a whole for any reason; two or more TKS wing distribution panels installed or removed on one side; either of the one-piece leading edge sections removed or installed; and either of the stall triggers adjusted, replaced or removed/installed.

MANUAL REQUIRES TRAINED PILOTS

The stick shaker is set to operate at an indicated airspeed of 7% to 9% above the stalling speed in the Hawker 900XP series. Unacceptable stall characteristics include the tendency to roll at the stall. The Raytheon manual allows the stick pusher to coincide with the natural stall, provided that any rolling motion can be constrained to within 20 deg. of bank with “normal” use of the ailerons.

One of the unusual reactions during stall testing cited in the Hawker manual can be the sudden un-commanded movement of the ailerons contrary to pilot control input. The movement of the yoke can be so sudden and strong that the yoke is wrenched out of the pilot's hands.

Long ago, this undesirable movement was termed "aileron snatch." The vast majority of pilots should never encounter this phenomenon on a modern jet that is properly maintained and kept within the aircraft's maneuvering margins. Thus, it is entirely likely that nearly all the current population of pilots have never been trained for this, and frankly it would be hard to justify training in this abnormality for line pilots.

On the other hand, given the possibility that this can occur during a post-maintenance test flight, a strong argument can be made that the flight crew needs proper training in the

recognition and recovery from this abnormality. This brings into question the fidelity of a flight simulator's programming.

This was an important point brought to the industry's attention by an in-depth NTSB investigation into the loss of a Douglas DC-8 during a post-maintenance test flight, killing all six people on board. On Dec. 22, 1996, an Airborne Express flight crew was performing a post-maintenance test flight after major maintenance on the narrowbody airliner. Subsequent analysis of the flight data recorder found that the pilot flying continued to hold aft control column inputs as the aircraft began to pitch down and roll during a deliberate clean stall maneuver.

Unfortunately, an inoperative stall warning system failed to reinforce to the pilots indications that the aircraft was in a full stall during the recovery attempt. The NTSB determined

Other Bizjets Exhibit Stall Behavior

Many business jets exhibit no natural stall warning or aerodynamic buffet prior to the stall. The following is an excerpt from the NTSB's Office of Research and Engineering report into the investigation involving a Bombardier Challenger 600 at Truckee, California. It is important to note that this important document was prepared by credentialed engineering experts.

Several key statements are italicized for emphasis.

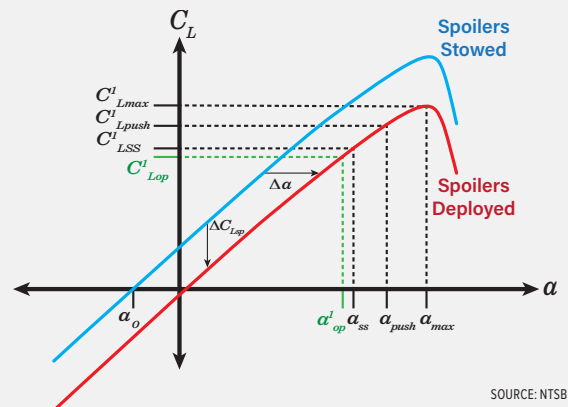
"The Challenger 600-series wing design is characterized by a 'leading edge' stall; as the angle of attack (AoA) increases toward the stall, a separation bubble begins to form near the leading edge on the upper surface; at first, this is a localized phenomenon and is not evident in the aircraft-level characteristics. Specifically, no pre-stall buffet occurs. *If the AoA is further increased, the bubble grows and then suddenly, without any precursor indications, 'bursts,' the upper surface airflow separates almost entirely aft of the burst bubble.* This occurs at a critical spanwise location at close to mid-span, but this 'bursting' disrupts the flow both inboard and outboard of that location, which is already approaching local flow separation conditions anyway, and thus the stall spreads rapidly—almost instantaneously—both inboard and outboard of the initiating location, not reaching fully inboard, but close to fully outboard.

The NTSB's Aircraft Performance Study of the Challenger 600 accident at Truckee, California, revealed that a wing's maximum lift is substantially reduced by the deployment of spoilers.

"As this is a 'sudden' behavior, in most practical circumstances *the stall occurs and fully develops on one wing before the other wing has even begun to separate.* The sudden loss of lift on one wing therefore not only causes a sudden drop in overall lift and thus load factor but also causes an abrupt rolling moment, and the resulting rapid rate of roll induces an increase in AoA on the already stalled wing, driving that wing into a more stalled condition, while simultaneously reducing the apparent AoA on the opposite wing, tending to prevent a stall developing on the 'unstalled' wing. Thus, the rolling moment is if anything reinforced. The Challenger 600 series has relatively small

aileron for roll control, and with one wing almost fully stalled outboard, the effectiveness of that wing's aileron is negligible. *It is thus impossible to arrest the rolling motion until the AoA is reduced and the stalling condition removed.*

SPOILER DEPLOYMENT AND STALL MARGIN



"The natural stall characteristics of the Challenger 600 series (and thus the Challenger 605 specifically as well) are thus a stall with no pre-stall warning, an abrupt load factor reduction at the instant of stall, and *an uncontrolled and uncontrollable rolling motion.*"

There are many important points to take from this analysis. The Challenger 600 is yet another modern business jet that exhibits leading edge stall behavior. The lack of aerodynamic warning and the abrupt roll are flight characteristics that a pilot should understand about the aircraft. Are pilots of high-performance business jets adequately trained in the aerodynamics and handling qualities specific to their aircraft? Perhaps not.

Let us consider this analysis in regard to upset prevention and recovery. Notice that any other recovery action to the rapid rolling motion other than reducing the angle of attack is ineffective for this aircraft. **BCA**

that a contributing cause of the Airborne Express accident was the DC-8 flight training simulator's inadequate fidelity in reproducing the airplane's stall characteristics.

One of the important points illustrated by the DC-8 accident is that before simply requiring extra simulator training for post-maintenance flight crews, it is essential to ensure the aerodynamic models in the simulator are accurate within the boundaries of the desired flight tests.

Raytheon's manual contains a special warning about aileron snatch. "Aileron snatch may occur at or prior to stall and is not acceptable," the company says. "The aileron snatch may be strong enough to affect recovery using aileron input, in which case the elevator control must be moved forward to decrease the angle of attack and allow the return of normal aileron control. In such an event, the pilot must be prepared to recover from an unusual attitude."

The Raytheon manual stipulates that "pilots conducting stall checks should have prior experience in performing stalls in the Hawker and must be prepared for unacceptable stall behavior at any point leading up to and throughout the maneuver."

This leads to the bigger question pertinent for the training and qualification of pilots who conduct post-maintenance test flights. What extra training in aerodynamics is necessary?

Dynamics, examined the effectiveness of previous upset recovery training. It is important to note that this was a panel of impartial subject-matter experts conducting an experiment that conformed to the highest scientific standards of subject selection, experimental design and statistical analysis.

According to the NASA study authors: "The standard 'textbook' recovery techniques were ineffective because of underlying changes in normal control response that initiated the upset and also complicated the recovery attempts. Most pilots had difficulty transitioning to an alternative control technique when confronted with ineffective response from the normal controls or recovery procedures."

SPECIAL PRECAUTIONS FOR TKS PANELS

There are important lessons for pilots who fly aircraft equipped with TKS ice-protection systems. Be aware that removal of the TKS panels for maintenance requires extreme care during reinstallation to make certain that the panels are aligned with laser-like precision on the proper location along the leading edge of the wing.

Good friends who were Non-Routine Flight Operations captains in TKS-equipped aircraft cite incidents in which the

aircraft rolled to beyond 90 deg. of bank during post-maintenance test flights due to very slight misalignments of TKS panels after removal and reinstallation.

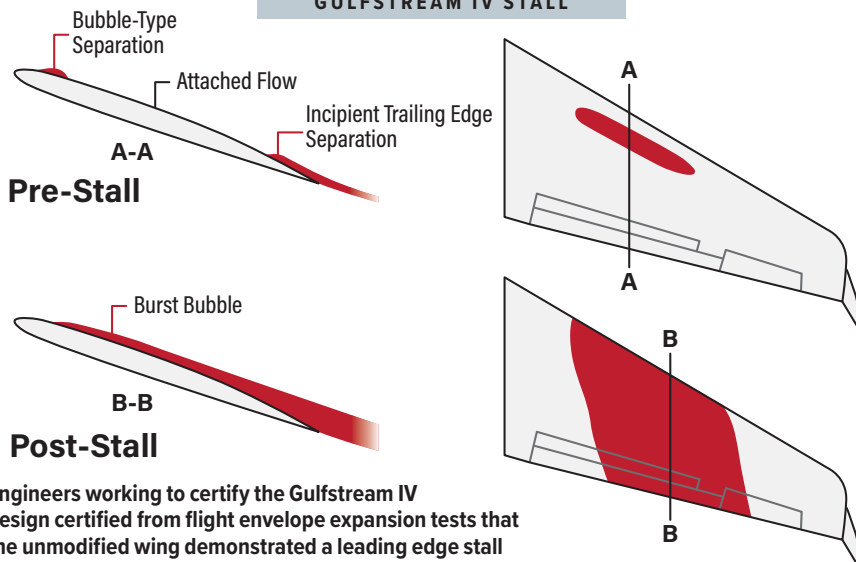
Secondly, the adhesive used to reseat the TKS panel to the wing should not protrude above the metal edges. That seemingly miniscule protrusion of adhesive can negatively affect the wing's critical angle of attack.

It is recommended that TKS panels be frequently operated even in the summer to keep the plastic supply tubes from cracking due to dryness, as well as preventing the micro-pores from clogging. Astute colleagues who have paid close attention to the preflight of Hawker 800XP jets during aircraft acceptance checks have noted that TKS panels did not exude a proper distribution of TKS fluid during preflight checks. This would create a condition in which part of the wing would not be de-iced or anti-iced in-flight when the TKS system was applied, leading to a dangerous wing condition of an ice mass building up on a portion of the wing.

BIG PICTURE QUESTIONS

There are flight instructors and examiners who require stalls during in-aircraft training and checking in swept-wing aircraft, and these are ending badly. An example comes from

GULFSTREAM IV STALL



Engineers working to certify the Gulfstream IV design certified from flight envelope expansion tests that the unmodified wing demonstrated a leading edge stall beginning at the mid-span when the aircraft's angle of attack was increased for approach and landing.

What training in the specific behavior of the aircraft should be required, and can a simulator accurately replicate the beginning of the deterioration in the maneuvering margins?

The NTSB's investigation of an accident involving a Eurocopter AS350 B2 helicopter at Mosby, Missouri, on Aug. 26, 2011, brings into question whether it is possible to instill the correct "primal response" in a pilot when their background comes from aircraft with significantly different handling characteristics.

An extensive NASA study led by Valerie Gawron, a fellow at the Flight and Aerospace Research division of General

SOURCE: PETE REYNOLDS/AIAA

flight training in a Hawker 700 in preparation for a Part 135 checkride on Sep. 20, 2003, near Beaumont, Texas.

The instructor pilot asked the first pilot to perform a stall in the approach configuration. The first pilot is overheard on the cockpit voice recorder asking the instructor if he has done stalls in the aircraft. The instructor replied, "It's been a while." The first pilot then remarked: "This is the first time I've probably done stalls in a jet. Nah, I take that back. I've done them in a Lear." The instructor then said he had stalled the Lockheed JetStar on a Part 135 ride.

Minutes later, the aircraft impacted the ground violently, killing all three pilots.

Failure by both pilots to respond correctly to the stall warning system in a Bombardier Challenger 600 at Truckee, California, on July 26, 2021, resulted in a left-wing stall and impact with terrain. Contributing to the accident was the first officer's improper deployment of the flight spoilers, which decreased the airplane's stall margin.

Faulty aerodynamic concepts taught by pilots in the Advanced Maneuvers Program at American Airlines were contributing factors to the structural failure caused by excessive rudder movements of American Flight 587 shortly after takeoff from New York John F. Kennedy International Airport. The NTSB review of other carrier's upset recovery

programs indicated that the shortcomings were not unique to American and that inconsistencies existed at other carriers, as well.

These represent just a sample of accidents involving swept-wing jets that exceeded their maneuvering envelopes—and may be the proverbial tip of the iceberg. Underneath the surface are an unknown number of incidents that are not widely disseminated due to a lack of adequate analysis of flight data or companies' being protective of their flight data monitoring.

The safety implications and consequences of providing misleading information or applying poor instructional technique are significant, especially when nearing an aircraft's maneuvering margins. An essential component in the effective delivery of ground and flight training in swept-wing aircraft is a properly trained and qualified training cadre who possess sound academic and operational knowledge.

Let us not forget that a flight crew paid dearly in the accident on Feb. 7, 2024, as well as in other accidents related to this topic. None of us want the worst minutes of our lives judged in that way. Their loss deserves the respect to analyze systemic failures within our aviation training and safety—and get those fixed. Otherwise, we are condemned to repeating the same mistakes from the past. That is not an acceptable answer. **BCA**

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In January 2024, Gestair revealed the selection of TrustFlight's Centrik software for real-time operational fleet management. Gestair's fleet of 35 aircraft will operate under Centrik's holistic management system, which incorporates operators, MROs, regulators and airports. The system also reinforces Gestair's Electronic Flight Bag system, according to Rafael Melero, Gestair Aviation's managing director. marketplace.aviationweek.com/company/gestair

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Among those partnerships, NetJets signed an agreement with Textron Aviation for an option to buy up to 1,500 Cessna Citation aircraft, including the Citation Ascend, Citation Latitude and Citation Latitude business jets over the next 15 years. Deliveries are expected to begin in 2025. marketplace.aviationweek.com/company/executive-jet-management-europe



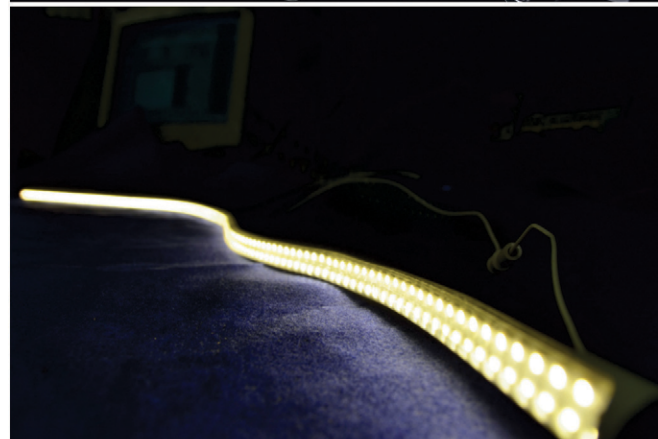
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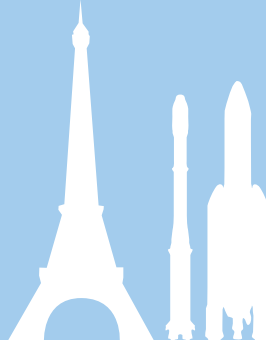


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Aircraft owners can take multiple steps to avoid tracking.

NOT ONLY DO TAYLOR SWIFT and Elon Musk have private drivers, they have private pilots, too. And entrepreneurial fans and stalkers have figured out how to track them, leading to increasing security concerns and Swift selling her jet.

Given the growing interest and potential threats that come with extensive flight data tracking, executives, high-profile individuals and their teams need to understand the continued security risks and be equipped to counter them.

NAVIGATING TRACKING APPLICATIONS

Aircraft data has long been public record, and consumers tracking flights is nothing new, but advancements in technology and increasing interest in the lives of celebrities and high-net-worth individuals make it a hot-button topic.

Jet tracking accounts use various technologies including automatic dependent surveillance-broadcast (ADS-B) data, GPS and satellite tracking to collect and publish information related to an aircraft's activity. These applications broadcast pertinent details about the aircraft, including the make, model, registration number and ownership.

ADS-B, which is mandated by the U.S. FAA, provides air traffic controllers with an aircraft's precise position. It helps to prevent midair collisions and allows people on the ground to know where the jet is at all times.

Tracking applications could also integrate data from radar systems, flight planning sources and public websites or aviation enthusiast forums. By understanding how the tracking apps work, the data they collect and the potential threats they present, aircraft owners and operators can better assess their privacy needs and implement the appropriate countermeasures to alleviate these risks.

ADS-B was not intended for stalking, harassing or gawking at celebrities' whereabouts, yet there are always bad actors who exploit such data, even though it puts people's safety at risk. Because the data is unencrypted and publicly available, anyone can pick it up and do whatever they want with the information.

Ergo, the FAA launched a service known as the Privacy ICAO Aircraft Address (PIA) program for private jet owners to apply for an anonymous identification code. Despite the good intentions, it is a laborious process, and the codes are locked in for 60 days. The FAA also offers a free service called Limiting Aircraft Data Displayed (LADD), which allows aircraft owners to redact their tail numbers from public tracking.

While open-source flight tracking applications serve as a useful visibility tool, they also pose significant security risks that can lead to dangerous scenarios if sufficient risk management strategies are not implemented.

The real-time tracking can result in targeted attacks on the

aircraft or individual, ranging from terrorism to in-person confrontations, theft, stalking and kidnapping. In less dangerous situations, it can lead to reputational damage.

Corporate espionage, a less discussed threat, could happen if competitors are able to monitor travel patterns of high-profile executives and gain insights into corporate activities and strategies. On the digital front, private jet tracking apps collect and store vast amounts of sensitive flight data, making them a rich target for cybercriminals seeking to exploit vulnerabilities in the system.

FLYING UNDER THE RADAR

Although the FAA continues to find new provisions to end the doxxing of private jet owners, trackers and hackers will continue to find new ways as technology advances.

For maximum protection, aircraft owners should participate in both LADD and PIA—however, they are not foolproof. It is key to travel alternating routes when possible so bad actors do not learn patterns and anticipate threats based on the travel itinerary. Analyze potential threats along flight paths or specific segments, including the best diversionary options in emergency situations.

Stand up active monitoring for immediate notifications of moderate or high-risk mentions of tail numbers and the individual's travel plans that could escalate to threats. Conduct periodic reporting on the volume and sentiment of tail number mentions. Hold regular training sessions for security personnel on privacy protocols, procedures and responsibilities. Use a data removal service to clear the aircraft from certain tracking websites.

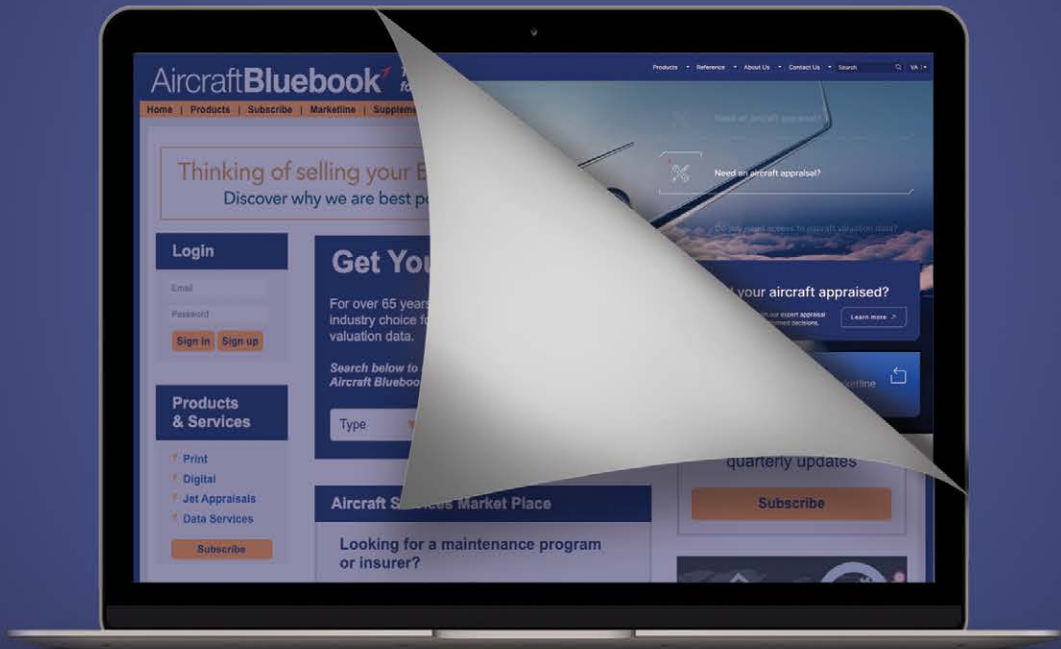
Jet tracking can bring unwanted media attention, as it has also become a climate accountability tool, and individuals or organizations may receive backlash for their carbon footprint. To avoid the media hot seat and reduce negative exposure, investigate options and tactics to measure, reduce and offset carbon emissions from private jet usage.

Constant collaboration and information sharing among security and intelligence professionals is critical to mitigating risks during travel. By implementing a multi-pronged approach that combines technical protocols, operational procedures, regulatory framework, continual vigilance and ongoing education, owners and operators can protect their privacy and reduce the threats posed by tracking applications.

As tracking tools innovate, so must security teams to ensure people's safety. **BCA**

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