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Q1 2023

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Business & Commercial Aviation

Practical SMS

Preventing Fuel Mishaps
Avoiding Vortex Ring State

AVIATION WEEK NETWORK

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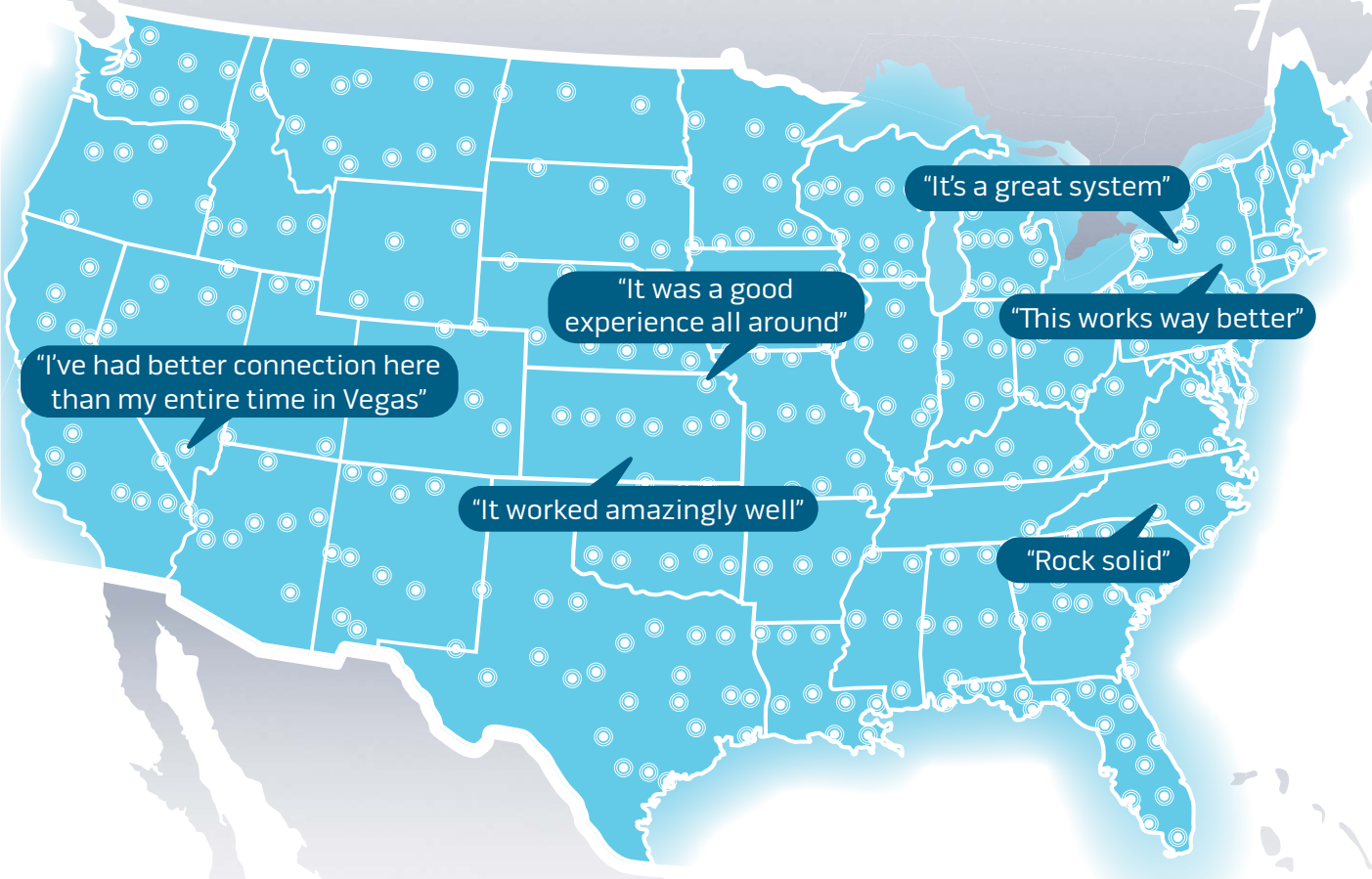

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Editor-in-Chief **Lee Ann Shay** – leeann.shay@aviationweek.com

Contributing Editors **Molly McMillin** – molly.mcmillin@aviationweek.com
Bill Carey – bill.carey@aviationweek.com
Matthew Orloff – matthew.orloff@aviationweek.com

Director, Editorial and Online Production **Michael O. Lavitt** – mlavitt@aviationweek.com

Art Direction **Lisa Caputo** – lcaputo@aviationweek.com

Art Department **Thomas De Pierro, Rosa Pineda, Colin Throm**

Associate Producer **Theresa Petruso**

Editorial Offices 2121 K Street, NW, Suite 210, Washington, D.C. 20037 +1 (202-517-1100)

Publisher **Elizabeth Zlitni** – elizabeth.zlitni@aviationweek.com

Senior Vice President, Data, Intelligence & Media Business Aviation Intelligence **Anne McMahon** anne.mcmahon@aviationweek.com Phone: +1 (646) 291-6353

Senior Fleet Analyst for Business Aviation **Nigel Prevett** – nigel.prevett@aviationweek.com

Head of Valuations, Chief Appraiser **Chris Reynolds** – chris.reynolds@informa.com

Senior Audience Development Manager **Tyler Motsinger** – tyler.motsinger@aviationweek.com

Subscriber Services bca@aviationweek.com Phone: +1 (913) 850-6929

Reprints **Wrights Media** informa@wrightsmedia.com Phone: +1 (877) 652 5295

Executive Vice President, Informa Markets **Gregory Hamilton**

ADVERTISING SALES

Publisher **Elizabeth Zlitni** – elizabeth.zlitni@informa.com

NORTH AMERICA ADVERTISING SALES **Rob Howlett** – rob.howlett@aviationweek.com

Pacific Region **Miguel Ornelas** – miguel.ornelas@aviationweek.com

Midwest Region **Jodi Espinoza** – jespinoza@aviationweek.com

Eastern Region **Eddie Lohmann** – eddie.lohmann@aviationweek.com

Southeast Region **Beth Eddy** – betheddy@aviationexhibits.com

Canada **David Seaberg** – david@seabergmedia.com

Strategic Accounts **Tom Davis** – tom.davis@aviationweek.com

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Sara Hellon – sara.hellon@aviationweek.com
Michele Markarian – michele.markarian@aviationweek.com
Jennifer Shafer-Doyle – jennifer.shafer@aviationweek.com

WORLDWIDE ADVERTISING SALES **Andrea Rossi Prudente** – andrea.rossiprudente@aviationweek.co.uk
Robert Springthorpe – robert.springthorpe@aviationweek.co.uk

By Informa Markets

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AVIATION WEEK NETWORK
By Informa Markets

Lee Ann Shay
Editor-in-Chief

CHECKLIST: Considerations for 2023

Lots to consider for the next year.

Let this issue of *BCA* serve as a checklist for the new year. You will find predictions and wisdom from 17 people in the "Business Aviation Predictions" article on pg. 14. Do you agree with their opinions of what the biggest challenges will be?

In the Fast 5 on pg. 4, VistaJet U.S. President Leoni Qi says she convened a group in January to examine ways to overcome disruptions such as fuel rationing at certain airports. "For example, if we know Cabo San Lucas and Turks and Caicos are going to have fuel issues, do we include a fuel stop as part of the flight path. Normally we would want to fly someone directly from Cabo to San Francisco, for instance, but we need to look back at the percentage of flights that were impacted and schedule accordingly," she said. To ensure the best possible on-time performance, what measures is your flight department or charter operation examining?

ADOBE STOCK/9DREAMSTUDIO

Kent Jackson's Point of Law column on pg. 6 looks at ESG considerations, including sustainable fuel and book-and-claim programs. Private aviation is a target for people who want to paint it as an excess: ESG efforts can be one point in a broader fact sheet about the utility of private aircraft—as well as simply good business and stewardship.

Rene Banglesdorf's Viewpoint on pg. 52 provides tips for recruiting and retaining maintenance technicians. As you think about your workforce, it could prompt some new ideas to foster your workforce.

Our cover story on Safety Management Systems (SMS) is very timely. In the U.S., the FAA issued a notice of proposed rulemaking on Jan. 11 to extend SMS requirements to Part 91, Part 135 and some Part 21 design manufacturing companies. The comment period ends on March 13. https://www.federalregister.gov/documents/2023/01/11/2022-28583/safety-management-systems Before submitting your feedback, read James Albright's article on pg. 18 to see why he switched to fully embracing SMS. Have you had similar experiences to his? If so, would you let me know about them?

Speaking of involvement and making a difference, I'd like to flag two other timely things in this issue. Have you flown into Aspen/Pitkin County Airport (KASE)? If so, see Rob Mark's article on pg. 30 about a task force that is looking into how to make flying into and out of that airport safer. If you have suggestions for the group, contact Barry Vaughan at bcvaughan@gmail.com.

For those who fly helicopters, Patrick Veillette is very enthusiastic about new training that could help operators avoid Vortex Ring State. He really thinks the approach could be life changing (see pg. 26). Being aware of it could change how you approach parts of your training this year.

And lastly, I'd be remiss if I didn't point out the checklist on appraisals. Whether you are an aircraft buyer or seller, the list on pg. 36 should be helpful.

I'd love to hear your feedback on any of these topics or ideas for what you'd like to see in the next issue. I can be reached at *leeann.shay@aviationweek.com*.

PS: BCA Podcast: *Don't miss our biweekly podcast! https://aviationweek.com/business-aviation/podcast Matthew Orloff talks with Verijet CEO Richard Kane in the Jan. 23 episode.*

INTERVIEW BY **LEE ANN SHAY**

Five Questions for **Leona Qi**

She is president of **VistaJet U.S.**, a role that she has held since September 2018. She previously was president of VistaJet Asia-Pacific.

VISTAJET

1 VistaJet had a very strong 2022. What is your focus and outlook for 2023?

Last year was a tremendous business year and a busy one for everyone in private aviation because of the surging demands. A big focus for us in 2022 was to grow the customer base. The Vista group also acquired and invested in several companies, including Jet Edge in the United States. We were very busy in the second half of the year and we had great results in Q3, with three times the customer base growth, which was largely attributed to the influx of fleet and availability. We sell a subscription-based program with a closed fleet, so we are busy integrating the (Jet Edge) fleet and making sure it's united—from the exterior paint to the flight attendance training. We don't have our full-year results yet, but I can tell you anecdotally in Q4 we had the most flights ever for the holiday season.

The weather and supply chain disruptions caused big problems for the airlines—and fuel supply. We flew to airports during the holidays where you had to wait three hours for fuel and they were rationing it. As an operator, we needed to make sure our clients got home and everyone was safe. For large operators like us, we have more than 360 aircraft around the globe, we do use commercial airlines to fly our crew, and that factors into how crew duty is calculated. We are recruiting pilots but with the pilot shortage and airline flight delays and cancellations, we have to minimize that impact for our business.

In January, our biggest task is to regroup and make sure we overcome that hurdle. For 2023, we're going to figure that out, continue to unite our fleet, continue to train our staff and expand our recruiting efforts to make sure that we can continue to give customers the best service.

2 Have you encountered fuel rationing much?

It doesn't occur often. Last year it happened at Turks and Caicos. This past holiday season there was fuel rationing at Cabo San Lucas, where you had to wait three to four hours to get fuel. So, we refuel at other airports to avoid that. This was an industry-wide problem—the supply chain is not fully restored and it was a more pronounced problem during the holi days.

3 Going back to recruiting, is VistaJet primarily focused on pilot or broader staffing, too?

It's across the board because it takes a lot for one flight to take off because of our premium service. Each flight includes VVIP catering. We just enhanced our partnership with Nobu, for example. In addition to the private dining team, we need finance people for billing. We are also hiring crew and our own maintenance staff because we are insourcing some work. It comes down to how we as an operator and service provider can make sure that service is minimally disrupted.

4 What work still needs to be completed in 2023 to harmonize the fleet, following the acquisition of Jet Edge in 2022?

We started painting the acquired aircraft in silver and red and modifying the interiors with our iconic carpet in August 2022. To minimize aircraft downtime, we try to schedule this work to coincide with scheduled maintenance. Our traditional fleet was all Bombardier—from the Challenger to the 7500. Because of the investment, we added Gulfstream G450s. The windows are different, but customers will have the same look across the fleet.

In addition, flight attendants coming in complete a six-week course at the British Butler Institute. Each month we have flight attendants graduating from the program. For interior amenities, we use Egyptian cotton and Christofle china. We ordered all that last year but we're still waiting for some of it to be delivered. We hope to finish bringing the entire fleet to the VistaJet standard in the next six to nine months.

5 Do you think inflationary pressures will curtail business aviation market growth in 2023?

I think it will still be a seller's aircraft market in 2023. We could replace aircraft ownership or supplement aircraft ownership. I also think this year will be another good year for the Vista group, including XO, to grow membership on both sides. **BCA**

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Kent S. Jackson
Contributing Editor

ESG Considerations

How SAF and book-and-claim fit in.

AVIATION PIONEERS OVERCAME GRAVITY AND DRAG. NOW AVIATION is engineering for sustainability. The industry and the FAA have been trying to fast-track sustainable aviation fuel (SAF), but it is not available for everyone yet. Despite the high cost and low quantity issues that affect SAF use, the financial sector is increasingly looking at SAF use as part of evaluating a company's "ESG."

What is ESG?

Environmental—pollution, raw material use, energy efficiency and recycling practices. Carbon emissions are quickly becoming a concern for investors who would like to take part in exciting new aviation ventures but are afraid of falling victim to "flight shaming."

Social—employee diversity, employee engagement and turnover, health and safety, satisfaction (both employee and customer), equality, transparency, supply chain and procurement. Aviation has been working on diversity, but there is a lengthy period between recruiting a diverse workforce and seeing that workforce progress from learning, to advancing within the ranks, to leading.

Book-and-claim systems standards ensure SAF credits are double credited.

JIM PARKIN/ALAMY STOCK PHOTO

Governance—management compensation, bribery, corruption, whistle blowing schemes and whistle blower protection, lobbying and political influence. Investors are often mystified at the interrelationships between the FAA and industry, particularly in aircraft certification.

The FAA and the aviation industry have been working on the environmental piece of ESG and the FAA's Continuous Lower Energy, Emissions and Noise (CLEEN) program is poised to accelerate even faster with new funding. CLEEN is the FAA's principal environmental effort to accelerate the development of new aircraft and engine technologies that will reduce noise, emissions and fuel burn. Through this program, the FAA partners with the aviation industry via a cost-sharing approach to enable the industry to expedite integration of these environmentally beneficial technologies into current and future aircraft. Technologies developed by it should result in a fleet of aircraft that produce less noise, fewer emissions and use less fuel. These technologies support the overall environmental performance goals of the FAA's Next Generation Air Transportation System (NextGen) to achieve environmental protection that allows sustained aviation growth.

The FAA just received millions in additional funding for CLEEN, but many companies need to show sustainability accountability today. How do companies that cannot yet buy SAF at the pump satisfy investor and public concerns about corporate commitment to sustainability?

An answer is book-and-claim programs. In a typical book program, customers purchase SAF (the claim) no matter where they're located and pay the premium cost for SAF over traditional Jet A. In return, they receive the credit for its use and apply it to their ESG scores. This SAF is taken off the book at an airport where the fuel is stored and sold to customers who are simply paying for jet fuel and do not get to claim credit toward using SAF in their ESG scores.

How do investors and others who are watching ESG scores and sustainability commitment know whether the book and claim system is accurate? In other words, if a company pays for SAF and obtains the claim, how do we know that the company that received and used the SAF in their aircraft will not also claim credit for using SAF? This question focuses on the "book" in book and claim.

There are many examples of book-and-claim accounting in the regulatory context, including the treatment of renewable natural gas under both EPA's Renewable Fuel Standard and the California Low Carbon Fuel Standard. The concept of book-and-claim did not begin with SAF. Book-and-claim accounting is a common practice where the sustainability attributes of a product or input are separated from the physical flows of a feedstock, energy input or final product. Under book-and-claim, the production and use of sustainability attributes are documented in a robust manner, typically by a third party, to ensure that attributes are not double counted.

Book-and-claim is a very necessary step to get the industry from the present to a future where SAF is available at every airport. The carbon reduction of SAF can be easily negated if it is transported by truck over long distances. Ultimately, SAF production needs to be as widespread as Jet A production is today.

The aviation industry always has been driven by the desire to go higher, farther, faster. Increased fuel efficiency directly translates to all three. And so, aircraft and engine designers sought to increase fuel efficiency long before the environmental impact of fossil fuels became a public concern. But today, consumers can see the emissions associated with their trip when they purchase their ticket. Savvy corporate and charter operations are investing in the future of their own operations and heading off public relations battles, by participating in SAF book-and-claim. **BCA**

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There has been a shift in the power structure on Capitol Hill in Washington, with Republicans taking control of the U.S. House and Democrats retaining a slim majority in the Senate.

FAA Is On The Plate For A New Congress

The current multiyear authorization of the FAA expires in September.

BY **BILL CAREY**

Streamlining FAA certification and approval processes, cultivating a future workforce, meeting environmental challenges and setting the stage for new aircraft entrants are foremost among business aviation legislative priorities for a new U.S. Congress.

Among the pressing issues for lawmakers who convened for the 118th Congress in January is FAA reauthorization. The current legislation to renew the agency's funding and authorities passed in 2018 and expires in September. The bill represents the first major multiyear reauthorization of the FAA since 2012; the prospects of Congress approving a new multiyear bill before it expires were uncertain.

Reauthorization legislation sets an agency's program funding levels over a fixed period; Congress passes appropriations bills each year allowing agencies to spend the money that has been authorized. The FAA was operating under a budget of $18.6 billion for fiscal year 2023—funding that was contained in the $1.7 trillion omnibus appropriations bill the 117th Congress approved and President Joe Biden signed into law on Dec. 29, 2022.

The $1.2 trillion Bipartisan Infrastructure Law that Biden signed in November 2021 will add $5 billion in advanced annual appropriations to the FAA's fiscal 2023 budget, increasing it to $23.6 billion. The law commits $25 billion for

BILL CAREY/AVIATION WEEK

aviation over five years: $15 billion for airport infrastructure projects, $5 billion to replace airport terminals and $5 billion to modernize air traffic facilities.

When Congress does approve new reauthorization or other legislation, trade associations representing the general aviation (GA) industry want to see the FAA's certification and oversight processes shortened and made more efficient. In November 2022, the agency issued a final rule extending the duration of aircraft registration intervals to seven years from three years as of Jan. 23, satisfying an amendment that was introduced in the 2018 bill. But as it emerges from the COVID-19 pandemic, the FAA is managing through an attrition of leadership and experience in its ranks that creates drag on the industry it regulates.

The agency has said that 40% of its certification personnel have less than two years' experience working at the FAA, notes Paul Feldman, General Aviation Manufacturers Association vice president of government affairs. "There is a huge backlog of not just rules but regulatory policy guidance materials, things that our members need to get product to market," says Feldman. "There's been some improvement getting those materials out, but they're still struggling with that."

FAA technology and equipment constraints were revealed in glaring fashion on Jan. 11 when the agency's Notice to Air Missions (NOTAM) system malfunctioned, causing the first nationwide ground stop since the Sept. 11, 2001, terrorist attacks. The FAA said a preliminary analysis had determined that a data file "was damaged by personnel who failed to follow procedures."

The NOTAM system breakdown "highlights a huge vulnerability in our air transportation," said U.S. Rep. Sam Graves (R-Missouri). "This incident also underscores the number of empty desks and vacant offices at the FAA. Centuries of combined experience has gone out the door in the past several years and far too few of these positions have been filled. The FAA does not run on autopilot—it needs skilled, dedicated and permanent leadership in positions across the agency, starting with the administrator's office."

Naming Permanent Leadership

Billy Nolen, formerly head of the FAA's Aviation Safety organization (AVS-1), has led the agency as acting administrator since April 2022, after former Administrator Steve Dickson unexpectedly stepped down halfway through his five-year term. President Joe Bid en nominated Denver International Airport CEO Phil Washington to the post last July.

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Billy Nolen, formerly head of the FAA's Aviation Safety organization, has led the agency as acting administrator since April 2022.

But the appointment of a permanent administrator, which requires Senate confirmation, foundered when Washington's name surfaced in a corruption investigation by the Los Angeles County Sheriff's Department, relating to his tenure as a former CEO of LA Metro. Washington has denied any wrongdoing, and Biden renominated him to serve as FAA administrator on Jan. 3.

In the wake of the NOTAM system outage, Senate Majority Leader Chuck Schumer said Jan. 15 that he would "push to clear the bureaucratic logjam" preventing Washington's confirmation, which he blamed on Republicans.

Sen. Ted Cruz (R-Texas), ranking member of the Senate Subcommittee on Aviation Safety, Operations and Innovation, derided the nomination of Washington during a September 2022 hearing at which he also called out "more than a dozen important roles" at FAA being served by acting officials.

"Even when the administration finally sends us a nominee for FAA administrator, they send someone with almost zero aviation experience—a requisite for the job—and who as recent news has highlighted, has more than a little bit of scandal surrounding him," Cruz charged. "It is more than a little rich watching the transportation secretary beat up on the airlines when he seems to simultaneously ignore the absolute hollowing-out of the FAA and the lack of confirmed, permanent leadership."

Industry representatives believe a permanent administrator reinforces stability and consistency at the agency. "There is a real concern about moving forward and getting a confirmed administrator," Feldman says. "Part of that as well is they took the head of AVS-1 [Nolen] and made him the acting administrator. What that caused within the safety organization is a lot of people who are doing great jobs but are in acting positions right now because it created a ripple effect."

The National Air Transportation Association (NATA), which represents FBOs, Part 135 carriers, fractional ownership companies and other aviation businesses, seeks improvements in the FAA's check pilot functions for charter operators and Part 135 aircraft conformity approvals.

"Our members have experienced very inconsistent timelines and processes at the various [FAA] district offices," says Karen Huggard, NATA vice president of government affairs. "We are hoping that FAA can be mandated or directed to work with industry to review these current processes and come up with recommendations to modernize processes and make sure that the FAA workforce is allocated correctly to avoid bottlenecks."

"There's a huge queue right now in the certification process," Huggard

adds. "We had a member report that it took two years to get a new 135 certificate approved, and this is someone who has been in the industry, has plenty of experience and had [everything] in order to start the process."

Aviation Workforce Grants

GA associations are aligned in advocating for the extension and possible enlargement of the Aviation Workforce Development Grant Program for pilots and maintenance technicians, another legacy of the 2018 legislation.

"We look forward to building on programs from the 2018 FAA bill, including grant programs to support the education of future pilots, the recruitment of much-needed aviation technicians and the introduction of other much-needed professionals into our sector," NBAA President and CEO Ed Bolen stated in testimony to the Senate Subcommittee on Aviation Safety, Operations and Innovation. The recommendations of two groups that Congress ordered formed in the last reauthorization bill—the Youth Access to American Jobs in Aviation Task Force and the Women in Aviation Advisory Board—"will provide excellent starting points along these lines," Bolen said.

COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE REPUBLICANS

U.S. Rep. Garret Graves of Louisiana, who previously served as ranking member of the House Aviation Subcommittee, was expected to become its chairman.

The FAA accepted the final applications from schools and other entities for Aviation Workforce Development Grants last June; the so-called "625" grants have proven "wildly popular," says Huggard. NATA would also like to explore an expansion of pilot visa approvals to recruit pilots from other countries who have trained in the U.S., and extend federal loan eligibility to include flight schools, she adds.

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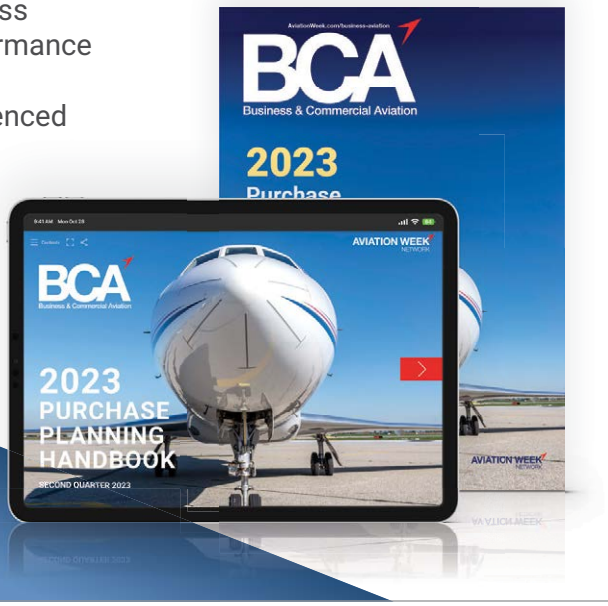

Contact:

Elizabeth Zlitni
Publisher and Sr. Director,
New Business Development
Elizabeth.Zlitni@aviationweek.com

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Firefighting Foams And PFAS

BILL CAREY/AVIATION WEEK

A&P mechanic Crystal Castaneda, a graduate of San Diego Miramar College, worked last year on a Cirrus SR20. Workforce development is a pressing issue for associations representing general aviation.

NATA advocates exempting from potential litigation all federally obligated airports, hangar owners, aviation businesses and airport lease holders that have been required to maintain foam fire-suppression systems containing Per- and Poly-Fluoroalkyl Substances (PFAS). Under federal law, military installations and FAA-regulated airports for decades have been required to use Aqueous Film Forming Foam (AFFF) containing PFAS chemicals to suppress aircraft fuel fires.

PFAS chemicals persist in the environment and can move through soils and contaminate drinking water sources. Studies of laboratory animals given large amounts of PFAS indicate that some chemicals may affect growth and development, according to the U.S. Centers for Disease Control and Prevention (CDC). Human health effects from exposure to low levels of PFAS are uncertain, the CDC says.

Congress directed the FAA in the 2018 reauthorization bill to eliminate the mandate within three years. The FAA and the Defense Department (DoD) are testing PFAS-free firefighting foams, with the Navy expected to release a new specification in January 2023, according to the American Association of Airport Executives. In September 2022, the U.S. Environmental Protection Agency published a notice of proposed rulemaking that would designate two PFAS chemicals as hazardous chemicals "and help to hold polluters accountable for cleaning up their contamination."

"It's dangerous for the environment and it's also dangerous for our businesses because it opens them up to potential litigation," says Huggard. "No. 1, we're looking for FAA and DoD to fast-track a PFAS-free alternative to AFFF. No. 2, we're looking for guidance for not just airports but also for aviation businesses located on airports, on how to remediate systems that have had PFAS chemicals in them."

"There may also need to be some funding for that," Huggard adds. "We have heard, depending on where you are in the country, that it can cost anywhere from $500,000 up to closer to $1 million dollars to remove a foam fire-suppression system that has fluorine foam in it from an aircraft hangar."

Under its $15 billion apportionment for airport infrastructure, the Bipartisan Infrastructure Law commits up to $2.39 billion per year for primary airports and up to $500 million for GA airports, based on the formula for Airport Improvement Program (AIP) grants. Only certain projects are eligible for AIP funding, which goes to airports, not aviation businesses, Huggard points out.

NATA wants to revisit AIP funding mechanisms, including a federal cost-share entitlement for GA airports that has remained stagnant at $150,000 per year, and the treatment of all GA airports as one category under the National Plan of Integrated Airport Systems.

GA associations would like to extend and expand incentives to produce sustainable aviation fuel (SAF) contained in the 2022 Inflation Reduction Act that Congress approved last August, possibly through FAA reauthorization or other legislation. The act provides a blenders tax credit through January 2025 to incentivize SAF production, followed by a Clean Fuel Production Credit that expires in December 2027. Though "thrilled" with the incentive, NATA had asked for a 10-year credit and is seeking guidance from the Internal Revenue Service on how aviation businesses can take advantage of it, Huggard says.

The Inflation Reduction Act also provides $300 million to establish a competitive grant program for projects that demonstrate low-emission aviation technologies or produce, transport and store SAF, with the SAF component receiving more than 70% of funding. "There may be an interest in expanding that program through reauthorization," GAMA's Feldman says. Language enabling the secretary of Transportation to make discretionary grants to airports for infrastructure needed to distribute, blend or store SAF is contained in the 2023 omnibus appropriations bill that Congress approved in December.

The omnibus spending package also boosted funding for the Eliminate Aviation Gasoline Lead Emissions (EAGLE) program, a joint initiative the FAA and industry associations announced in February 2022 to phase out the use of leaded avgas in piston-engine aircraft by 2030. At the time of its unveiling, there was no mention of dedicated funding for EAGLE; the omnibus bill provides $10 million to test unleaded fuels, associations say. The FAA already had budgeted $12 million for fuels testing in general in 2023.

The EAGLE program could be reinforced when the Biden administration submits its next budget request for fed-

U.S. NAVY

Sailors participate in firefighting training in Norfolk, Virginia. The FAA and Defense Department are testing PFAS-free firefighting foams, with the Navy expected to release a new specification.

eral agencies in February. "We'll know [in February] when the administration releases its proposed budget about what additional resources it may ask for," Feldman says. "We're of the mind right now that the EAGLE initiative needs to continue to develop as people are getting together and thinking about what could really make a difference—is there an infrastructure need, is there more testing needed? We'll be in a position to take those [proposals] and talk to [Congress] about that."

Advanced Air Mobility

Associations welcomed passage of the Advanced Air Mobility (AAM) Coordination and Leadership Act that Biden signed into law last October. The act will create a federal interagency working group on AAM led by the Transportation Department. But associations are holding the FAA to account for modifying the certification basis of AAM vehicles, seemingly in midstream of their development.

The agency caught the industry by surprise when it announced the regulatory policy shift in May 2022, soon after Nolen took over as acting administrator. Rather than evaluating new electric vertical takeoff and landing (eVTOL) aircraft under existing Part 23 regulations for airplanes, the FAA informed AAM developers that it will require them to certify their vehicles as powered-lift aircraft under Part 21.17(b) "special The shift requires that the FAA now issue a Special Federal Aviation Regulation (SFAR) to recognize the new class of powered-lift aircraft within its pilot training and operating regulations—something it has committed to doing within two years. Language in the 2023 omnibus appropriations bill reiterated that commitment, requiring the agency to complete the SFAR by Dec. 31, 2024.

"They made some promises that they were going to deliver certain things by the end of 2024," Feldman says. "In [FAA] reauthorization, we would be looking at things that would help facilitate that commitment actually being realized."

Associations applauded inclusion in the 2023 omnibus appropriations bill of the Advanced Aviation Infrastructure Modernization (AAIM) Act, which was introduced in the previous Congress, authorizing the FAA to award $25 million in grants over two years to assist state, local and tribal governments in developing new AAM infrastructure. "The AAIM Act outlines a comprehensive set of considerations for infrastructure planning that will enable communities to maximize the societal benefits that AAM will offer," says Helicopter Association International President James Viola. "States and local governments across the country realize that AAM has the potential to create 300,000 jobs by 2035, and they are eager to make the investments necessary to support new vertical flight technology."

NBAA and members of its AAM Roundtable support an expansion of the Alternative Fuel Vehicle Refueling Property Tax Credit—which allows a 30% tax credit for the cost of electric vehicle charging and hydrogen refueling stations—to cover a charging infrastructure for electric aviation.

"There is an enormous amount of investment being made to try to bring these products to the market," Bolen told senators. "Understanding a clear pathway to a type certificate, production certificate, op specs, and being able to begin the operations—it's very important for us to know what to expect as we prepare."

A Standalone GA Title

The incoming 118th Congress presents the GA industry with a new balance of powers among parties, with Republicans taking control of the House and its committees and Democrats still controlling the Senate.

U.S. Rep. Sam Graves, who had served as the ranking Republican member of the House Transportation & Infrastructure (T&I) Committee, assumed the chairman's gavel previously held by Rep. Peter DeFazio, the long-serving Oregon Democrat who has retired from Congress. Rep. Garret Graves (R-Louisiana), who is not related to Sam Graves, was the presumptive chairman of the Aviation Subcommittee.

U.S. Rep. Rick Larsen (D-Washington) became the ranking Democrat on the T&I Committee, winning out over the more senior Eleanor Holmes Norton, Washington, D.C.'s delegate to Congress, to succeed DeFazio. Larsen previously chaired the Aviation Subcommittee.

Sens. Maria Cantwell (D-Washington) and Roger Wicker (R-Mississippi) carried over to the 118th Congress as chairperson and ranking member, respectively, of the Senate Commerce, Science and Transportation Committee.

Sam Graves, a prominent general aviation pilot and advocate, has spoken of adding a first stand-alone title, or subject heading, for general aviation in the FAA reauthorization bill, raising expectations that GA will have a higher profile relative to other segments of aviation. He has also said he would prioritize the federal permitting process and aviation workforce rules in the new legislation, Roll Call has reported.

"From our parochial interest, we have a vantage point that the top Republican on the T&I Committee is a general aviation pilot," said Jim Coon, Aircraft Owners and Pilots Association (AOPA) senior vice president of government affairs. "He knows what pilots are facing every day and he has indicated that he would like to have a GA title in the FAA reauthorization bill. I don't think it's ever been done before so we're very encouraged by that."

Both Graves's were among 200 House Republicans and six Democrats who voted against the 2021 Bipartisan Infrastructure Law, and Sam Graves has promised to exercise aggressive oversight of its implementation. The two lawmakers were among 200 Republicans and one Democrat who voted "no" on the 2023 omnibus appropriations bill, with another Democrat voting "present."

Notably, Sam Graves and Rep. Scott Franklin (R-Florida), a former U.S. Navy pilot, speaking during a panel discussion at the NBAA-BACE conference in October 2022, were skeptical of the FAA and industry's EAGLE program goal of phasing out leaded avgas by 2030. "I don't want to force it," Graves said of the unleaded fuel initiative. "I worry about the legacy engines that are out there, too."

COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE REPUBLICANS

U.S. Rep. Sam Graves of Missouri now leads the House Transportation and Infrastructure Committee, succeeding the Oregon Democrat Peter DeFazio, who has retired from Congress.

AOPA's Coon was among panelists who spoke during the Air Traffic Control Association (ATCA) Global conference in Washington in November. The annual event, focused on air traffic control policy and technology, provided another occasion for industry experts to call out the need for more stable and predictable, as well as additional, funding for the FAA. Aviation consultant Donna McLean, a former Transportation Department budget official who serves on the FAA Management Advisory Council, said the agency's Facilities & Equipment account of roughly $3 billion has remained static for the past 15 years.

The FAA's fiscal 2023 budget request for F&E includes $536.3 million to improve ATC facilities, of which $481.3 million will be used to chip away at a $5.1 billion backlog in sustainment needs.

"The remaining $55 million, in concert with funding for the replacement of facilities in the Bipartisan Infrastructure Law, will support replacement of aging facilities in poor condition and experiencing operational issues," the FAA says. "Most air traffic control facilities are in poor condition," it reports, with enroute centers ranging in age from 56-62 years and some terminal facilities as old as 79 years.

Paul Rinaldi, past president of the National Air Traffic Controllers Association, delivered a blistering critique of the situation.

"As air traffic controllers walk into this room and see Raytheon's MARS (Multi-platform Application Re-hosting Solution), Harris' equipment and space-based ADS-B, you're scratching your head, knowing you're never going to see that in your career," Rinaldi said. "The system is broken. The way we bring equipment online—it takes too long. When we bring it online, it's already antiquated. [W]e're not able to meet the challenges of the future." **BCA**

Based in Washington, DC, Bill Carey covers avionics, air traffic management and aviation safety for Aviation Week. A former daily newspaper reporter, he has covered the commercial, business and military aviation segments as well as unmanned aircraft systems. Prior to joining Aviation Week in November 2017, he worked for Aviation International News and Avionics and Rotor & Wing magazines.

ADOBE STOCK/TR3GI

Industry experts are bullish on the demand for private and business aviation in 2023.

Business Aviation Predictions For 2023

Business aviation leaders make their predictions for 2023, including the biggest challenges facing the industry.

BY **MOLLY MCMILLIN**

What is the outlook for your part of the business aviation industry or your company for 2023?

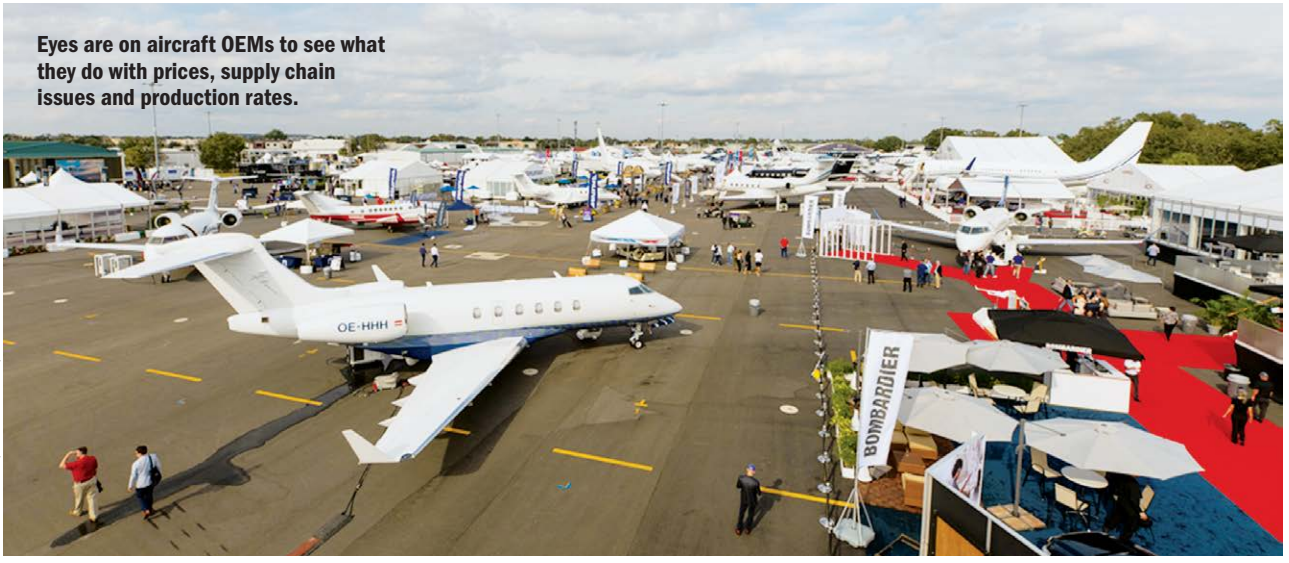
Lynn Fischer, XO chief marketing officer
We saw a major shift in consumer travel preferences throughout the first half of 2022, with more travelers opting to fly XO via our Shared Flight Offerings. In fact, we've had a 93% increase in our Shared Flight offerings compared to the first half of 2021. We expect to see a continued rising interest in Shared Flights, with more people turning to private air travel and looking to buy individual seats at a fraction of the usual private flight cost, all through the convenience and transparency of a mobile app.

Brian Foley, Foley Associates founder
These will perhaps be some of the best times since 2008 for business aircraft OEMs with rising backlogs sold at or near list price.

Patrick Gallagher, NetJets president of sales, marketing and service
We believe that the unprecedented increase in flight demand felt across the industry is tapering off. While that demand is still quite elevated from where we were prior to the pandemic, what we are experiencing now has become much more predictable and manageable. We are proud to say that our nearly 60 years of experience and proven business model helped us to not only weather the storm but thrive. However, many operators who were initially flush with CARES Act money then overexuberant about the prospects of long-term demand growth have heavily leveraged themselves. As interest rates and other costs rise and demand subsides, we expect that there will be continued consolidation as these companies seek strategic alternatives.

Ron Gunnarson, Piper Aircraft vice president of sales, marketing and customer service
The big picture for the business aviation industry as a whole, I think, it that resilience and growth will continue to show, despite ongoing economic and political uncertainties. Our population's "need to travel" appears insatiable.

Janine Iannarelli, Par Avion founder and president
Some expect sales to decline in 2023 because 2022 was the final year for 100% depreciation on aircraft for those who have a qualified business use. But what is not often discussed is the fact that one can still get 80% depreciation in 2023. My take on the market is that the first quarter of the year will be just fine and I am fairly confident that we have a good feel for where pricing will be for most of the bizjet models. Q2 is where it gets a bit gray and foggy.



Eyes are on aircraft OEMs to see what they do with prices, supply chain issues and production rates.

BRETT SCHAUFF /AVIATION WEEK/

Sheila Kayaoglu, Jefferies equity analyst
If demand sustains itself at a steady pace, that that would be the best thing for the industry because everything says it shouldn't—whether it's the Fed raising rates, the stock market volatility or just the fact that money supply is decreasing, and IPO volumes are down significantly. It says 2023 should not be a great year for business jet OEMs. But I think some of those supply chain production delays will help.

Marty Kretchman, Signature senior vice president of operations planning
We're monitoring the impact of macroeconomic factors closely. Industry consensus indicates that the upcoming year could see further stabilization in demand. We saw some of that throughout the industry in the second half of 2022 and broadly expect it to continue into the first half of 2023. Despite being off the peak of the wave created by pent-up demand in late 2021, we're still in a strong position relative to 2019 and prior years. Customers, including new entrants, are continuing to find tremendous value in general aviation as a reliable, safe and efficient form of transportation, and I believe that broader trend is here to stay.

What will be the biggest story of 2023 for the business aviation industry?

Richard Aboulafia, AeroDynamic Advisory managing director
The big story will be how many of the newcomers who've dipped their toes in the private aviation market stick around, as the last of the COVID-related airline service cutbacks disappear and as manager or investor willingness to tolerate higher travel costs diminishes too.

Mark Burns, Gulfstream Aerospace president
Setting the record straight on sustainability and our industry. Business aviation fuels economic growth, job creation and technological advancements, and at Gulfstream, we're doing so with sustainable practices and products.

Eric Martel, Bombardier Aerospace president and CEO
I believe that 2023 will be a story of business aviation manufacturers showcasing the resilience we have built into our respective plans and overall industry. Our industry enjoyed significant boom periods over the last couple of years as more and more people experience and appreciate the advantages of business aviation, particularly in terms of time savings. Now that we have a strong backlog and demand is stabilizing, we remain in a strong position to face uncertainty in varying economic outlooks.

Eric Trappier, Dassault Aviation chairman and CEO
As far as I can tell, in the current situation and into the foreseeable future, supply-chain issues are going to be key.

What will be the most important issue facing the industry in 2023?

Jack Pelton, Experimental Aircraft Association CEO
It would have to be what the new FAA reauthorization bill contains for general aviation. Privatization of ATC has been the hot topic for years in prior reauthorizations. I hope we are done with that. The more important issue will be specifically addressing general aviation as a critical segment by including issues that will provide FAA support for its growth.

Pete Bunce, General Aviation Manufacturers Association (GAMA) president and CEO
In 2023, the congressional work to pass an FAA reauthorization bill will be a significant story closely followed throughout the industry and by policymakers. This bill will set the framework for FAA's operations, policies and priorities over what is likely the next five years.

Ed Bolen, National Business Aviation Association president and CEO
A key thing in 2023 will be FAA reauthorization. It's an opportunity as we move forward to make sure that here in the U.S. specifically, we've got a framework that allows our industry to move forward, which means that we are able to have the FAA funded, staffed, move the processes forward, and make the legislative and regulatory changes necessary to fully function.

What is the biggest challenge for the industry going forward in 2023?

Richard Aboulafia, AeroDynamic Advisory managing director
The big challenge will be keeping the supply/demand balance right. We will

start to see some of the supply chain challenges loosen, right as the market softens. Will OEMs maintain production discipline, or will pricing suffer?

Ed Bolen, National Business Aviation Association president and CEO
It's constantly getting the message out about who we are and the kind of enormous benefits generated by business aviation in the U.S. and around the world, and working with governments, policy makers and opinion leaders to make sure that business aviation is recognized, understood and has an opportunity to provide these societal benefits.

Pete Bunce, General Aviation Manufacturers Association (GAMA) president and CEO
The biggest challenge in 2023 will be addressing and navigating workforce issues within the FAA and industry. The work being done by FAA leadership is immense and commendable but as you branch out within the agency you see significant reductions in average experience level.

Mark Burns, Gulfstream Aerospace president
Gulfstream has made significant investments over the years, resulting in the introduction of five new aircraft since 2014 and the most formidable, highest-technology fleet in the industry. As a result, we're moving at an unprecedented pace, which poses an industry-wide challenge to deliver greater efficiency in our certification environment. The current environment is ripe for innovation, and we are excited to continue to partner with the FAA and the ODA on driving further efficiencies that keep safety paramount and our industry competitive.

Curt Castagna, National Air Transportation Association president and CEO
The escalating cost of doing business is causing companies to reexamine their pricing strategy, determine which products and/or services truly add value, reassign financial and employee resources to areas that will help them grow, and focus on addressing operational inefficiencies.

Lynn Fischer, XO chief marketing officer
Throughout 2022 we have seen that the overall industry is lacking aircraft availability and reliability. At XO, we've anticipated and responded to this industry-wide challenge by looking at demand data and have expanded not only our fleet and network but our shared charter routes, to best service our client's needs at an accessible price point. For example, we've recently announced the expansion of our New York to South Florida route, which is our most requested route for our members. This expansion gives flyers more travel options to South Florida at one-tenth of the cost of a full charter, with access to up to four daily Shared Flights, seven days a week, all bookable through the XO mobile app.

Brian Foley, Foley Associates
Getting into the mindset that recent years were extraordinary and having more modest expectations for 2023. Recognizing what is a more normalized business environment may be difficult for some.

Sheila Kayaoglu, Jefferies equity analyst
When we look at the OEM net price increases on a net basis, they've been low single-digits at best. What pricing does in 2023 I think is going to be a challenge or big watch item.

Eric Martel, Bombardier Aerospace president and CEO
The answer that immediately comes to mind is workforce. This is a widespread challenge affecting many industries, and I think the particular challenge for business aviation is to convince young people to pursue a career in this fascinating industry. We have openings now, for a variety of positions around the world, but we also must prepare to replace a workforce that is facing significant retirements in the next few years.

Jack Pelton, Experimental Aircraft Association CEO
As the integration of manned and unmanned UAS/UAM into the national air space gets closer and closer, it will be critical to get the regulatory policy right. 2023 will be a big year for much of that work to go out of comment.

Jim Segrave, flyExclusive founder and CEO
Private aviation has chronically been undersupplied for customers who do not own their own aircraft, and this is likely to continue into 2023. The recent surge in demand, driven in part by the pandemic and obstacles faced by commercial carriers, has only widened the opportunity to address the issue. The real opportunity is less about supply and demand and more about our expertise and superior track record as an operator with a scaled model that drives profitability. Our vertical integration platform is key for us as we think about current and future challenges within private aviation. It is not an easy thing to do and for the most part our industry is dominated by those that have aggregated demand but have not solved for the rest of the equation. We intend to build the most vertically integrated private jet operation in the world, controlling our cost, execution, growth and profitability.

Our biggest challenges for 2023 are going to be the ramp-up in production of both our Falcon jets and Rafale fighters and the entry into service of the Falcon 6X.

In 2023, do you plan to make any changes to ramp space management?

David Best, Jet Aviation senior vice president regional operations & general manager Americas
We are seeing a large number of customers increasing the size of their aircraft. This requires larger infrastructure and proactive planning for larger wingspans. We are committed to growing our network and facilities to continue to provide a seamless service for our customers as their needs evolve. We recently broke ground on an 18,000-sq.-ft. hangar in Scottsdale, Arizona, and a 40,000-sq.-ft.-hangar in Bozeman, Montana, along with executing other projects within our FBO network.

Marty Kretchman, Signature senior vice president of operations planning
As aircraft become larger and operational volumes grow, we've put increased emphasis on our ability to safely optimize our ramp and hangar spaces, starting with our most physically constrained markets. The ability to efficiently move and store our customers' aircraft is critical to our ability to meet the growing demand in our industry. At Signature, we're working hard to innovate and improve through updated processes, technology and innovative training that's never been deployed in our space. **BCA**

Molly McMillin, a 25-year aviation journalist, is managing editor of business aviation for the Aviation Week Network and editor-in-chief of The Weekly of Business Aviation, an Aviation Week market intelligence report.

The SMS Journey

Why you should embrace Safety Management Systems.

BY **JAMES ALBRIGHT**

When I first heard the term "Safety Management System," or SMS, I thought it was just another fad from management schools and I gave it the same respect that I gave to Total Quality Management (TQM), Management By Objectives (MBO) and other programs designed to make headquarters suites feel like they were making a difference. Yes, I promptly ignored SMS and hoped it would go away. But when the International Civil Aviation Organization (ICAO) adopted it as mandatory in 2006, I realized that even if it proved a waste of time, I would have to, at the very least, go through the SMS motions. And then something unexpected happened. SMS proved not only useful, but it made me a better and safer pilot. SMS has become more than an academic process for my flight department, it has become a philosophy.

An aircraft marshaller stands ready.

CHALEEPHOTO AT SHUTTERSTOCK

A three-person tow team handling a Gulfstream.

JAMES ALBRIGHT/AVIATION WEEK

If you haven't taken the SMS plunge yet, or if you are still just going through the motions, please consider a short story that illustrates how useful working through a problem with SMS can be. And then, consider starting an SMS program of your own or fully embracing the one you already have.

Smarter Together

The first time I saw our mechanics tow the Gulfstream G450 into our narrow hangar, I was alarmed that there were no markings for the center of the hangar floor and by how quickly the entire operation took place. It was as if they were being timed and got bonus points for bravado. I cautioned them that when towing aircraft, the best you can do is a tie: no damage to the aircraft or hangar; there are no prizes for coming in first. They explained the speed was necessary to get over the bump of the hangar door tracks and that they were using a crack in the pavement for alignment. I told them to stop when the main gear was about 5 ft. short of the hangar door tracks and verify the wings would clear before proceeding. We did that and I thought, "job done."

Over the years I noticed that the aircraft's position on the hangar floor varied by 5 ft. or more. With a wingspan of 77 ft. 4 in., we should have had ample space within the hangar door opening of 95 ft. 4 in., ideally 9 ft. on each wing tip. My next solution was to paint a line down the middle of the hangar. Once again, I thought, "job done." While that improved our accuracy, we still seemed to vary about 5 ft. left and right. The nosewheel may have been on my painted centerline, but the main gear were often anything but equidistant from that line. My autocratic rule as their leader wasn't as effective as I had hoped.

A few years later, our company asked me to replace the G450 with a G500, which has a wingspan of 86 ft. 4 in. empty and 87 ft. 1 in. with a full load of fuel. Now we would have only 4 ft. on each wing and our plus or minus 5 ft. tolerance wasn't going to be good enough. Our safety officer thought using the SMS process would give each member of the team a chance to "buy in" to my earlier solutions: slow down, don't proceed unless the nose gear is precisely on centerline. So, expecting only to have my solutions validated by the group, I filed a Hazard Identification and Tracking form, something our safety officer called a "HIT." What happened next surprised me.

The team immediately identified two reasons behind our accuracy problem. First, we were approaching too fast, trying to build momentum over the steep rise of pavement just before the hangar door tracks. Second, even if the nosewheel was on centerline that didn't mean we would have the wings centered if the main gear were not also on centerline. That much, I thought, was obvious. But each member of the team identified a different part of the problem. Then the group found a solution that many of us never considered.

Problem: not all our pilots and ground support personnel understood

correct marshalling signals and the result was pilots trying to align the aircraft as best they could, quite often ending up with the nosewheel on centerline and the main gear several feet left or right. Only our former airline and Air Force pilots had ever been formally trained on how to give and receive marshalling signals. None of our ground crew had ever received correct training.

Solution: a back to basics marshalling course for everyone.

Problem: the tow team believed they could "save" a bad starting position with creative moves before the wings reached the hangar. Quite often they could get the aircraft properly aligned, but more times than not they ended up with "good enough."

Solution: paint additional lines prior to the hangar door, giving maximum tolerances for the main gear. (If the main gear were not within their lines, the tow team wasn't allowed to proceed and had to back the airplane out for another attempt.)

Problem: the rise in the asphalt prior to the hangar door tracks meant a minimum speed was needed to overcome the inertia of the aircraft going "uphill" into the hangar. I thought the problem was the hangar track itself was beyond repair. But that wasn't the problem at all.

Solution: rebuild the asphalt prior to the hangar door tracks to make the slope more gradual.

It took a few days to train everyone in proper marshalling procedures, a few weeks to get the new lines painted, and a few months to get the slope regraded. A year later we took delivery of our newer (and wider) aircraft and getting the aircraft precisely on centerline is a matter of routine now. The SMS process allowed us to come up with innovative solutions and, just as importantly, gave everyone a deeper understanding of the problem and the reasons behind our new procedures. On those few occasions where the aircraft isn't properly aligned, there haven't been any complaints about having to back the aircraft up for a second try. The entire team has joined me in my zeal for precision.

The Hazard Identification and Tracking process also combined with our Flight Operations Quality Assurance (FOQA) system to improve the way we fly. For example, before we adopted an SMS, FOQA identified an occasional unstable approach at Hanscom Field, Bedford, Massachusetts (KBED), our home field. Many locals prefer to fly inside three radio towers that underlie what would be a normal base turn to Runway 29, and we were no exception. When FOQA identified this as a problem, we thought it was a problem with FOQA, not us. This bugged me because it was our lone exception in an otherwise perfect FOQA report each quarter. I called other local operators with FOQA, and it seemed they all accepted the blemish, there was nothing to be done about it.

But one of our pilots saw this as a case for what SMS gurus call the Continuous Improvement Opportunity Program (CIOP). The team realized immediately that the solution was to fly outside the towers, for a final approach that was about 0.5 mile longer than what most consider standard. We worried about what our tower would think about us hogging a little more airspace, but a quick phone call put that to rest. Our SMS program spurred us to stop accepting unstable approaches as beyond our control.

I think every flight operation can benefit from an active SMS program; it will not only make your operation safer, it will also forge your personnel into a team where everyone feels empowered to contribute.

Getting On Board

You might have heard that achieving an industry-compliant SMS program is simply a matter of finding a vendor, writing a check and placing a new binder on your safety officer's desk. You can find someone who will accept your check and produce just such a binder, but that will not, by itself, get you an SMS program that will do you any good. The key idea when adopting an SMS is that it isn't something you add to your library of company policies and procedures—it is something that is integrated into your existing programs and ties everything together. If this makes it seem like adopting an SMS will be a lot of work, that is because it is. While the process should take many years, each step along the way is manageable. The process never really ends, but you will see benefits almost immediately and as your system matures, the benefits will increase.

The first step is to get everyone's "buy in" and that step begins with senior leaders. Why, they might ask, do we need to adopt this when we've gotten along just fine without it? For most of us, the answer will be: it is required. But that isn't universally true.

If you are a U.S. commercial operator, you must have an SMS program. The regulatory requirement is in 14 CFR 5.1(a), which says, "A certificate holder under Part 119 of this chapter authorized to conduct operations in accordance with the requirements of Part 121 of this chapter must have a Safety Management System that meets the requirements of this part and is acceptable to the Administrator by March 9, 2018." Part 119 defines certificate holders as air carriers and commercial operators under 121, 125 and 135.

If you are flying under non-commercial rules, Part 91, and fly internationally, the International Civil Aviation Organization (ICAO) Doc 9859, paragraph 8.4.7 says, "In accordance with Annex 19, the State shall require that service providers and international general aviation operators implement SMS."

In the United States, that leaves a lone exception to the SMS requirement: domestic-only Part 91 operators. If you fall into this category, an SMS program is voluntary but can be economically beneficial. My Part 91 flight department receives a 15% annual discount on our insurance, more than offsetting any costs associated with our SMS program.

Once you have leadership behind you, the next step is to get everyone in the organization on board. It will be helpful to have at least one person trained to speak the SMS language and ready to show the way with your next chance to improve your operation. Most organizations hand this over to their safety officer, but I think it is important to realize that in a robust SMS, everyone is a safety officer. The person with the title helps train others, but in the end, it takes everyone to inculcate a good safety culture.

Key Parts of an SMS

The key to understanding SMS is realizing that it is a decision-making system designed to change the way you operate. It is built around four components: safety policy, safety risk management, safety assurance and safety promotion. You will need the four components to reap all the benefits of a robust SMS program.

A safety policy is where the organization sets its standard operating procedures (SOPs) and management conveys its commitment to the safety program. This is typically done with a flight operations manual or other written document easily accessed by members of the

VITALLI VODOLAZSKYI/SHUTTERSTOCK

An SMS system contains four key parts.

organization. If you don't have such a document, you can start with the SOPs in your aircraft manual and a letter from the company that basically says you will follow those, and the company will employ a policy that encourages all members to report any safety issues. A key component of this letter is the executive's support of a confidential employee reporting system to report all hazards, accidents, incidents and safety issues without fear of reprisal.

A safety risk management program provides a mechanism for people to report potential problems and for the organization to mitigate those problems in a collaborative process. It can be as simple as a blank form or an email to the safety officer, followed by one or more people coming up with a fix.

Safety assurance is a way to monitor and measure how things are going, including those things that have been addressed by the safety risk management program. In short, it answers the question, "did our fixes work?"

Safety promotion lets everyone know that they are a part of the SMS, the organization's safety priority, reporting procedures and how risks are mitigated. It should involve regular training and participation.

You already may have most of the basic components of a functioning SMS in place or you may be starting from square one. Back in 2008, I was convinced we could bring ourselves up to whatever SMS requirements were needed to fly internationally and only pay for our audits to document our SMS status. This method helped us to really understand the nuts and bolts of our SMS, but it was a lot of work and took too much time.

Getting Started

The easiest way to spool up your SMS program is to hire a company specializing in getting you up to speed quickly; just type "SMS for business aviation" in your favorite Internet search engine. These providers will take your existing manuals and procedures, make them SMS compliant and shepherd you through your first audit. Jim Hosey, president of Aviation Consulting/Auditing, offers some insight into the process when going this route. "A smaller flight department will need six months to a year to get started. A larger flight department can spool up in half that time because they have more people to handle the work. In either case, you can be at 100% in two to three years." He recommends membership in the Business Aviation Safety Consortium (BASC), www.aviationconsortium.com, to streamline the process. Membership runs $5,000 annually.

You don't have to use a consultant or vendor to start your SMS program; you can do it on your own. Fortunately, there is a lot of help available today to flatten the SMS learning curve. The National Business Aviation Association (NBAA) holds regular SMS Implementation Workshops, normally scheduled at its annual Business Aviation Convention & Exhibition. See nbaa.org for more information. FlightSafety International and the International Business Aviation Council (IBAC) have co-developed an SMS course designed for flight department managers and those tasked with developing an SMS. See https://www.flightsafety.com/ for details.

I recommend you look at Advisory Circular 120-92B, Safety Management Systems for Aviation Service Providers. While this AC is meant for Part 121 certificate holders, the guidance is helpful for anyone getting started with SMS.

Phased Implementation

When IBAC first introduced the International Standard for Business Aircraft Operations (IS-BAO) in 2002, the acknowledged progression was to move from an entry level called "Stage 1" and eventually to "Stage 3." Some operators thought that Stage 3 meant you were done and that from that point on you could coast. Of course, this isn't true. You don't need to follow the IS-BAO model at all, but you do need to implement your SMS with the idea it is a continuing process. AC 120-92B recommends a phased approach using four levels of implementation.

Level 1 is for planning and organization. This is where you get everyone on board, identify what you already have and what you need. I recommend sending at least your safety officer to training. Hiring a consultant at this point can speed the remaining steps considerably.

Under Level 2, you have in place a basic safety management system and will develop your safety risk management and assurance programs. Members of your organization should be able to identify hazards and unacceptable risks, know how to report these, and participate in teams designed to identify solutions and mitigate the risks.

With Level 3, you will have a fully functional SMS and will be able to further use your safety risk management and assurance programs in a proactive manner.

Level 4 is for continuous improvement. All required SMS processes are in place, and you will continuously monitor your SMS for the life of your organization.

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Recommended SMS Implementation Levels (AC 120-92B).

"Certification"

If you are a U.S. commercial operator, you will need to prove you have a qualified SMS under 14 CFR 5. If you are flying internationally as a U.S. operator under Part 91, you will need to prove you have a qualified SMS under ICAO Doc 9859. The most effective way to prove your system is through an approved SMS auditor. This will provide more than just peace of mind; it should expedite international ramp inspections. If, for example, you are given a Safety Assessment of Foreign Aircraft (SAFA) under the European Union Ramp Inspection Program (EU-RIP), having an SMS certificate from an accredited auditor may satisfy many of the inspector's questions.

With or without that piece of paper saying you have an SMS program, you should realize that SMS is never finished, it is a continuing process. Even after you have your operation in what appears to be "tip top" shape, realize that SMS will be needed to face the challenges sure to come.

SMS in Action

There is no doubt a SMS can improve your organization during the early implementation and development stages, but the benefits may prove even more valuable with the inevitable changes over time. In the many years since we considered our SMS fully implemented, we've used our program to face challenges as they occurred and even to anticipate them before they could become problems. Here are a few examples:

*Our Hazard Identification and Tracking (HIT) program quickly became my favorite part as it slayed one problem after another. Everything from the way we towed our aircraft to the way we entered a VFR traffic pattern was improved. But it really earned its place in our arsenal the day I was called about a passenger slipping on our hangar floor. The center of our hangar floor had an anti-slip coating, but on that day the ramp was covered in snow and the passenger decided to take a shortcut away from the center. The solution was to recoat the entire floor with the abrasive coating. The reason I was impressed was that the hangar manager, who felt somewhat responsible, didn't think twice about filing the HIT report. I can imagine a few years ago the thought would have been to dismiss the incident as "one of those things" and I might not ever have heard about it.

A good SMS program should have an Emergency Response Plan (ERP) that is well thought out and has been practiced regularly. We had such a plan but never practiced it until one of our audits flagged us for this. At our first practice, a line technician said there was no way he was going to remember the right words if he were contacted by the press so his plan would be to do the "Sergeant Shultz" routine, saying "I know nothing." One of our pilots filed a Continuous Improvement Opportunity Program (CIOP), saying we should give everyone a wallet card with the pre-approved statement. Along the way the team also thought it would be good to have key phone numbers on the reverse of the card.

We give everyone in our organization a chance to rate our "Operator Safety-Risk Profile" at least once a year and whenever we have changes in personnel or equipment. The form we use tracks operational things like our local airport's approaches, technical factors such as problems with our aircraft, and human factors like the number of pilots or mechanics. Over the years we only had two instances of identified elevated risk. The first was when one of our pilots was medically grounded just as another quit and the second was when our aircraft's operations were significantly curtailed due to a fleetwide limitation. In both cases we were able to proactively adjust our operations to accommodate the elevated risks.

You are not alone if you recoil from all the alphabet spaghetti. HIT? ERP? CIOP? Those acronyms are purely optional; the important thing is the culture that goes along with them. A good safety culture fosters in everyone the idea they can report any problem without fear of repercussion. They should appreciate that no matter where in the organization they are, they can generate an idea to make things better and know that idea will be treated seriously.

Our SMS has proven itself time and again. It has made us all safety officers and has changed our mission-oriented operational culture into a safety culture.

If you don't have an SMS program, you need one. It will take time, but you will reap benefits with each step. If you already have an SMS but you haven't given it a thought since your last audit, you should evaluate your safety culture with the idea of making it even better. **BCA**

James Albright is a retired U.S. Air Force pilot with time in the T-37B, T-38A, KC-135A, EC-135J (Boeing 707), E-4B (Boeing 747) and C-20A/B/C (Gulfstream III). Since turning civilian, he has flown the CL-604, Gulfstream GIV, GV, G450, and now the GVII-G500. He is the webmaster and principal author at Code7700.com

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How to Avoid a Vortex Ring State

New insights into how to avoid Vortex Ring State in its earliest stages.

BY **PATRICK VEILLETTE**

The trim string hangs straight down during hover and low speed flight due to the rotorwash's prevailing downward motion. This provides vital information to a pilot of the proximity to the VRS envelope.

The behavior of the trim string is directly indicative of the airflow condition over the nose.

PHOTOS: VUICHARD RECOVERY AVIATION SAFETY FOUNDATION

Helicopters are particularly vulnerable to Vortex Ring State (VRS) during low-speed operations out-of-ground-effect. This could include operations such as external load work, power line inspection, rescue hoist operations and mountain approaches. Yet until recently, effective training to show pilots how to avoid VRS has been lacking.

The Vuichard Recovery Aviation Safety Foundation has released a new safety video on "How to avoid a Vortex Ring State in helicopter operations." This is a "must see" educational video for helicopter pilots that reveals new information for avoiding VRS as well as detecting a VRS in its earliest stages. There is a wealth of information in this video that is necessary for pilots, flight instructors, training program designers, human factors specialists and accident investigators to understand.

How good is this video? I watched it five times, vigorously taking notes each time. Throughout this learning process I called friends who have flown helicopters dating back to the Vietnam Era, pondering how this information eluded the industry for 50+ years. Nearly every aspect of this video contains information that has not been disseminated (nor properly explained) in helicopter training materials.

Loft Dynamics (formerly VRM Switzerland) arranged an in-person visit with Capt. Claude Vuichard in Zürich and generously provided usage of the H-125 flight training device. Vuichard demonstrated many of the lesson points while executing landings to sharp pinnacles and hovering in front of the famous North Face of the Eiger. Vuichard's recovery resulted in a rapid recovery from the VRS with a minimal loss of altitude.

Trim String

Arguably the most informative feature of this educational video is the role of the trim string or "woolometer." It is an important early warning sensor to avoid VRS. The behavior of the trim string is directly indicative of the airflow condition over the nose. It hangs straight down during hover and low speed flight due to the rotorwash's prevailing downward motion. As a helicopter begins to pick up speed, the trim string rises. At 10 kts. of headwind, the trim string will deflect stably straight in the low disk loading category. It takes 20 kts. of headwind in a medium disk loading because the induced velocity from the rotor disk is stronger. Once the trim string rises steadily, the helicopter is outside of the VRS envelope.

The video has excellent illustrations of the trim string during normal operations and as a warning device to remain outside of the VRS envelope. Clearly this simple device has been under-appreciated, and yet it reveals accurate information of a helicopter's airflow condition, especially at slow speeds when the pitot tube is inherently unreliable. During an approach it can indicate the influence of a crosswind.

As the helicopter slows perilously close to the edge of the VRS envelope, the trim string transitions from standing straight out to a random set of "nervous twitches." This indication occurs prior to the other classic warning signs from the helicopter. This advanced warning can be invaluable, especially when the helicopter is operating close to the ground.

Several useful aspects of the trim string became apparent during our hands-on experience in Loft Dynamic's H-125 flight training device in Zürich. The trim indicator is ideally situated in a pilot's visual scan during approach and landing. It is located right on the nose and is easily viewed without the need for the pilot to rotate his or her eyes or head to view it. It is also far enough away from the eyes that an aging pilot who is slower at adjusting to far versus near images won't have difficulty keeping the trim indicator in the visual scan.

It was also interesting to observe during our hands-on

session that the VR technology simulated the changes in the trim string's behavior throughout the flight envelope. This was evident while Vuichard demonstrated approaches to pinnacles, hovering in front of cliff faces and encounters with sudden downdrafts. This is a milestone in simulation technology, which enables systematic training to avoid and recover from VRS in different flight phases.

Vuichard strongly recommends that all rotorcraft manufacturers equip their helicopters with trim strings.

Other Warning Signs

Another significant revelation is the sudden low-g flight condition (0.2-0.8 g) at the initial entry into VRS. Under the mildest conditions, a pilot will feel a lightness in the seat. This is likely the downward acceleration that a pilot encounters when practicing VRS recoveries under the carefully controlled conditions during training.

In contrast, the real world often doesn't mimic the carefully controlled conditions of the training environment. An inadvertent entry into VRS often results in an abrupt downward acceleration. I had not been trained in the Vuichard Recovery so I sought out a flight school that said it was qualified to teach this technique. The flight instructor in a Robinson R22 stated, "Let me show you a REAL vortex ring state." Suddenly it felt as if we were in an elevator whose suspension cables had been cut. The abrupt downward acceleration was unlike any sensation I had ever experienced in an aircraft before. None of the ground training devices used for spatial disorientation training such as a Barony Chair simulate this abrupt downward acceleration.

One positive aspect of this horribly botched "training maneuver" was that it helped me realize the significant human factors with VRS. In a terrestrial environment under 1g, the human body is well adapted to maintain the perception of the correct orientation provided by the body's visual, vestibular and proprioceptive systems. Conversely, during flight, the sensory systems are poorly suited to these abnormal accelerations and can easily trick the body's balance and motor mechanisms. This abrupt downward acceleration opens up a Pandora's Box of visual, vestibular and proprioceptive illusions that can hinder a pilot's ability to make a timely recovery.

Other symptoms of a VRS are the lack of response when increasing power by pulling the collective, and the helicopter exhibits random uncontrolled pitch, roll and yaw oscillations. As soon as the helicopter transition from a hover into a descent, the blades will hit the vortices of the preceding blades, which causes vibration that can be felt and heard in the helicopter. The cyclic will shake and has less control authority.

A fully developed VRS is signified by a reduction in the vibration level of the main rotor when the induced flow circulates in a closed circuit and the rotor blades encounter less turbulent air. This will also be accompanied by a low frequency of random buffeting.

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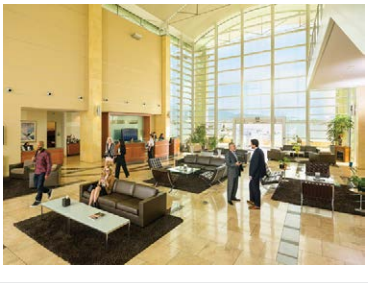

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Descent Rate

The combination of airspeed and descent rates that form the VRS envelope are specific to each helicopter make/model. In general, helicopters with higher disk loading will produce higher induced velocities. Therefore, the envelope of airspeed versus rate of descent (ROD) will generally be larger, and secondly, the descent rate envelope for VRS will begin at a faster rate.

The video compares and contrasts the VRS entry parameters for three categories of disk loading. The R-22, which has a disk load of approximately 4 psf (pounds per square ft.), is in the low disk loading category. The H125, with a disk loading between 4-6 psf, falls within the medium category, and the AW139 fits the high disk load category with 6-10 psf.

For example, at sea level at the maximum takeoff weight, the range of descent rates for entry into the VRS envelope in the R-22 are 500-2,000 fpm. The H125's range is 800-3,000 fpm. The heavily disk loaded AW139's range is 1,200-4,000 fpm.

A vital revelation is the immense descent rate that occurs when a helicopter enters into a full VRS. At sea level and the maximum takeoff weight, an R22's descent rate in a fully enveloped VRS would be 3,600 fpm. This equates with losing six building floors in a second.

By the way, the R22 flight instructor's "recovery" wasn't effective until we were less than 300 ft. above the ground. Ironically I had asked this flight school to teach me the Vuichard Recovery because I had been trained long ago in the conventional recovery technique. That experience certainly calls into question how a flight school can deem itself "specially qualified" to teach this recovery technique. That demonstration placed us in a dangerous situation and resulted in negative training.

This is yet another point that illustrates the safety and efficiency afforded by proper training in a flight training device whose software models the aerodynamics of the specific helicopter model. It allows students to safely practice these reflexes in repetitions to formulate the correct and nearly instantaneous control inputs in the incipient stage. The simulator can fly the helicopter into a VRS condition automatically to enable the pilot to practice recovering from VRS in a more efficient way.

The heavier disk loading in an H125 results in a final descent rate of 4,900 fpm, which is the equivalent of losing eight floors per second. This equates to 53 mph. An AW139 with an even heavier disk loading would plummet out of the sky at 6,600 fpm, which is the equivalent of losing 11 floors per second or a speed of 74 mph. In basic terms, impacting the ground at these speeds is not likely survivable.

The descent rates worsen with altitude. At a density altitude of 13,000 feet, the H125 plummets at a speed of 67 mph (equivalent of 10 floors in a second). The AW139 would plummet at 94 mph (14 floors in a second).

The emphasis in this section of the video is absolutely clear. Due to the tremendous sink rates in the VRS, it is essential to reflexively apply a recovery technique because every second lost results in an enormous loss of altitude. When practicing, recovery should be initiated at the first sign (lightness in the seat) in the incipient stage of the vortex ring.

VRS Envelope

This video highlights a helicopter's susceptibility to VRS when the airspeed range occurs from any direction. For helicopters in the low disk loading category, the airspeed range of susceptibility to VRS is 0-10 kts. For medium disk loaded helicopters, the range is between 0-20 kts. For high disk loaded helicopters, the range expands from 0-30 kts.

Remaining out of the VRS envelope depends on a pilot's accurate assessment of the wind direction. There are many reasons why this isn't as simple as it sounds. This author has cited in previous articles the potentially misleading indications from a wind sock, especially when the wind sock is located where a prevailing wind can cause recirculation zones and shed vortices. Both of these phenomena can cause the wind sock to deflect in a different direction from the prevailing wind flow. Landing approaches in the vicinity of obstacles (buildings, trees, mountain ridges, etc) can expose a helicopter to a micro-climate of vastly changing winds in a short distance.

Is there a sensor that can provide immediate information to a pilot regarding the airflow condition over the nose of the helicopter in a tailwind? This is yet another reason in which the trim string appears to be invaluable.

Vuichard illustrates three ways to enter the VRS envelope. One method is by reducing airspeed at a constant rate of descent, similar to a landing approach. A normal powered descend with a high rate of descent and low indicated airspeed is one of the classic situations leading to VRS.

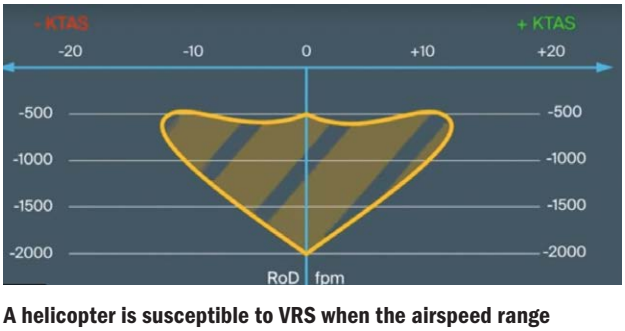
Another entry begins from above, by increasing the rate of descent into the envelope. This can occur when a helicopter can't maintain a hover out of ground effect (HOGE) due to lack of power, or during wildfire suppression efforts when firefighting helicopters are forced to dip their bambi buckets within the tight confines of steep gorges and nearby electrical power cables that are suspended across the canyon.

A third method occurs during a decrease in the rate of descent from a very low power approach or a low-speed autorotation. The final phase of an autorotative landing to power recovery is a classic scenario in which a helicopter is especially close to the VRS envelope. VRS also is a big risk during a downwind approach or downwind quickstop, and a flare in combination with height loss.

After watching this video, the warnings in the Robinson flight manual make much more sense. Rather than merely memorizing the limitation, this video helps a pilot understand how to apply this limitation to real world flying. It is now abundantly clear why it is important to keep descent rate less than 300 fpm when slower than 30 kts.

Next Steps

Many of helicopter aviation's elite have fallen victim to VRS, the invisible phenomenon. Clearly much more needs to be

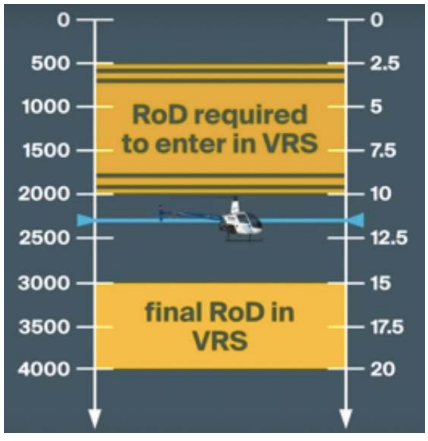


A helicopter is susceptible to VRS when the airspeed range occurs from any direction. For helicopters in the low-disk loading category, the airspeed range of susceptibility to VRS is between 0-10 kts. in combination with a descent rate exceeding 500 fpm.

understood about the human factors involved with it. The prevention and recovery from VRS depends heavily on our sensory, perceptual, memory and motor systems. Unfortunately the role of these human systems haven't been addressed in any meaningful way in the training literature on VRS. Even though Vuichard's recovery demonstrations look simple and elegant, there is plenty of potential for negative habit transfer by unqualified instructors or poor instructional methods, such as what I experienced in the R22.

Simply tossing a student into the seat and saying, "Just apply more collective, apply right cycle (for a helicopter with a counter-rotating main rotor) and left pedal" is a woefully inadequate and uninformed teaching approach. The instruction for upset recovery requires a carefully designed step-by-step approach. This will be especially challenging for those of us "old dogs" who were taught the conventional recovery technique long ago. There is insufficient science-based data to reveal how much practice is necessary to un-do habit patterns learned long ago.

In the interim, EASA is contracting with France's Office National d'Etudes et de Recherches Aérospatiales (ONERA) to conduct an in-depth study to determine the flight conditions at which the VRS starts to develop, as well as to evaluate the effectiveness of the Vuichard recovery technique for at least two different types of helicopters. In addition, the FAA's Flight Test Center is conducting a study on the efficiency of the different vortex recovery methods.



PHOTOS: VUICHARD RECOVERY AVIATION SAFETY FOUNDATION

An R22's descent rate in a fully enveloped VRS would be 3,600 fpm. This equates with losing 6 building floors in a second.

Vuichard emphasizes that "At the end of these studies, the industry must be advised to instruct only one method that really works under all operating conditions. It is absolutely impossible for a human to reflexively apply more than one procedure when feeling a low g at low speed mostly in a critical flight phase." **BCA**

Upon his retirement as a non-routine flight operations captain from a fractional operator in 2015, Dr. Veillette had accumulated more than 20,000 hours of flight experience in 240 types of aircraft, from balloons, rotorcraft, sea planes, gliders, war birds, supersonic jets and large commercial transports. He is an adjunct professor at Utah Valley University.

The Aspen/Pitkin County Airport features one runway.

NIK WHEELER/CORBIS VIA GETTY IMAGESGETTY IMAGES

Aspen Pilots Want to Improve The Airport's Safety Record

A dozen volunteer pilots are lending their skills to support a mission to maximize safety and reduce aviation accidents at the Aspen/Pitkin County Airport.

BY **ROB MARK**

An October 2018 opinion piece in the Aspen Times began with an ominous statement; "The Aspen Airport is rated the most dangerous in the United States." The airport has been the scene of several high-profile fatal accidents.

In 2001, a Gulfstream III approaching Aspen's (ASE) Runway 15 after dark struck sloping terrain just short of the threshold. The impact and post-crash fire claimed the lives of all 19 people aboard. In February 2022, the crew of a Hawker 800 attempted to depart Runway 33 with a gusty 25-kt. tailwind, despite the aircraft's maximum tailwind limitation of 10 kt. The Hawker sailed off the end of the runway destroying the aircraft. Luckily there were no fatalities.

Accidents aren't limited to jets. In July 2021, a Beechcraft G36 Bonanza departed Aspen VFR on a delivery flight to Des Moines, Iowa. The pilot in command held type ratings in a few turbine aircraft, but records could not identify any recent mountain flying experience in a piston airplane. After departure, the Bonanza climbed to approximately 10,100 ft. MSL (3,300 ft. AGL) before turning southeasterly. The NTSB believed the pilot planned to head toward Independence Pass before heading east. Flight through the pass would have required a climb to just over 12,200 ft. MSL. For some unknown reason, while climbing at just 200 fpm through 11,300 ft., the Bonanza turned east, which brought it face-to-face with 13,000-ft. peaks. The Bonanza struck terrain at approximately 11,245 ft. killing both occupants.

Experience has taught local pilots the many challenges of operating from Aspen's 8,006-ft. runway snuggly nestled between peaks climbing to nearly 14,000 ft. both southwest and northeast and 11,000 ft. on the approach to Runway 15. With high terrain in every direction and an operating control tower, ASE is a one-way in (landing Runway 15) and one-way out (departing runway 33). With a field elevation approaching 8,000 ft., pilots quickly learn the importance of precise performance planning. On a warm summer day, density altitudes can easily climb into the five-figure range. Strong gusty winds can also test a pilot and an airplane's metal.

In a recently completed review of National Transportation Safety Board accident data, Aspen pilot Barry Vaughan combed the Board's database for local accidents, some that date back almost 60 years. Vaughan, a retired attorney, is chairman of the Aspen/Pitkin County Airport FlightOps Safety Task Force announced on Dec. 7, 2022, by that County's board of commissioners. A dozen volunteer pilots are lending their combined problem-solving skills to support a common mission, "maximize safety and reduce aviation accidents and incidents at the Aspen/Pitkin County Airport (KASE) and associated airspace." Aspen is home to about 90 aircraft, including a dozen jets.

NIK WHEELER/CORBIS VIA GETTY IMAGESGETTY IMAGES

Privately owned jet planes parked on the apron of Aspen airport during the Christmas and New Year's holiday.

Task force members' experience levels run the gamut from private pilots to flight instructors, charter, and large business jet pilots. A few of the better-known task force members include Daniel Baker, founder of FlightAware who sits on GAMA's executive committee and Tyson Weihs, founder and former CEO of ForeFlight. Weihs is a member of the NBAA board of directors and sits on GAMA's executive committee.

While some might scoff at volunteer pilots—especially those with no formal accident investigation training—being able to create suggestions to improve Aspen's safety record, experienced pilots know the best practical safety training at any challenging airport often comes from local aviators. Vaughan said, "We're going to listen to ideas from anyone about how things could be done better and how we could reach out to pilots who fly in here, often infrequently, to help them be better, safer, more proficient pilots," said Vaughan. His survey of NTSB records discovered more than 40 accidents, most of which were linked to pilot error. Few of those accidents occurred with a locally based pilot in the cockpit.

The task force began its work in December 2022 with a few simple suppositions, like looking for obvious trends that might emerge from past accidents. "We're trying to get our arms around the facts first," Vaughan said. Simple things like, "How many accidents involved controlled flight into terrain, or how many involved low-time pilots, or pilots with low time in type? How many involved weather, and how many were Part 91 or Part 135 operations?" Vaughan emphasized that "the possibilities should not be limited by the poverty of my imagination. One thing I do know is that pilots love to get training, they love to be safe, they love to be proficient."

Another direction is trying to partner with organizations that also focus on flight safety, like NBAA, AOPA, the FAA, GAMA and the ASE tower controllers.

The task force also plans to look at programs created at other challenging airports to improve operational safety. "These might be suggestions we post at the FBO; it could evolve into a video that AOPA runs on its website," Vaughan said. None of the recommendations will become regulatory according to Vaughan. He believes success will only come if the task force's operational suggestions evolve into things pilots want to do.

The task force will be looking at whether technology could be helpful someday. The single instrument approach into Aspen brings small aircraft down to circling minimums of 2,000 ft. AGL and jets to 3,100 ft. AGL. A straight-in RNP approach to Runway 15, currently only available to pilots who complete special training at FlightSafety or CAE, offers a Decision Height of 537 ft. AGL.

Vaughan said the task force is working an aggressive schedule that expects to begin reviewing practical suggestions through the end of February and finalize the most useful ones during March. After presenting the task force's best recommendations to the county board of commissioners in early April, they expect to begin implementation in late April and May. "If anything good comes out of this, it will be because 11 accomplished local pilots rolled up their sleeves, thought through the problems and reached out to our aviation partners to create plans that we can use to help make us all better pilots," said Vaughan.

To offer the Aspen task force your ideas, contact Barry Vaughan at bcvaughan@gmail.com. **BCA**

Rob Mark, a lifelong flight instructor, spent many years as a Part 91 and Part 135 business jet pilot. As a journalist, he's penned five books for McGraw-Hill and twice earned both the NBAA's Gold Wing Award for Outstanding Journalism and the European Aerospace Journalist of the Year.

How To Avoid Misfueling

Following a few straightforward steps before refueling are critical.

BULENTCAMCI/ADOBE STOCK

Ensure that fuel placards are correct, easy to read and located at all filler ports.

BY **MATTHEW ORLOFF**

A line service technician is a lifesaver, a term that isn't used humorously. These are the individuals who literally pull the trigger on something—a fuel nozzle—that if not used correctly, can kill those in an aircraft or innocent people on the ground.

In the context of aircraft misfueling, pilots understand it is ultimately their responsibility to ensure an aircraft is properly fueled. Therefore, many training resources are pilot-centric, but unless a pilot was once a line service technician at one point in his or her career, many do not have familiarity of the line service technician's side of the coin, or how they are trained.

"The first conversation I have when I hire a new line service tech, pretty much immediately after they've filled out their new-hire W2s, is the seriousness of aircraft misfueling," says Ryan Gauger, president of Jet West, an FBO at the Salinas Municipal Airport in Salinas, California. "I always stress to never be fearful of reporting a misfueling right away. The problem can be fixed, and just because fixing it may be expensive, it's certainly worth way more to be able to sleep soundly at night."

Gauger has trained hundreds of rampers over the course of nearly 30 years. He not only is an experienced pilot, but also an experienced line service technician. Full training for a line service technician at Jet West takes about a month and follows guidelines outlined by the National Air Transportation Association (NATA).

NATA offers an online certification course for pilots, FBO managers, customer service representatives and line service technicians to receive training on aircraft misfueling prevention. It takes about 15 minutes. As a pilot, it certainly will not hurt to take the line service technician's version of the course.

In a nutshell, line service technicians are trained to strictly adhere to what NATA refers to as "The Big Three," which consists of fuel orders, selective spouts and grade verification. The three components of a fuel order include the fuel grade, fuel quantity and aircraft's registration number. If any piece of this basic information is absent, a line service technician is not technically authorized to pump fuel into the tanks.

For example, if a fuel order says to pump 500 gallons of Jet A in ABC Aviation's gold-colored 2002 Falcon 900, the fuel order cannot be fulfilled. What's

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Fueling mishaps have decreased since selective spout size and filler port protocols have changed.

missing? The registration number. On a busy ramp in South Florida during the wintertime, there may very likely be more than one Falcon 900 on the ramp, and ultimately the most foolproof way to identify the correct Falcon 900 is by tail number.

Keith Clark, quality control and technical representative at Phillips 66, provided an example of aircraft misidentification that resulted in a fatal crash of a Piper Malibu in February 2015 (see webinar, "Verify Fuel Type: A Pilot's Story," https://event.on24.com/wcc/r/3686923/EE270422072A339C38D95018113490A7?partnerref=INTAVBCAMAG). A Piper Malibu and Meridian are very similar-looking aircraft, except a Malibu takes avgas while a Meridian takes jet fuel. At this particular airport, many Malibus were being converted to turbine aircraft, which takes jet fuel. The size of the fuel opening on the wing was not adjusted during these conversions, which is what led to the line service technician's misinterpretation. The pilot never told the technician what type of fuel to use, and the ticket was never verified. This ultimately caused a fatal mistake only seconds after take-off.

Mitigation against aircraft misfueling has improved over the decades, with advancements that have included selective spout size and filler port protocol (avgas will have a maximum spout diameter of 1.97 in., while Jet A spouts will have spout diameters of 2.66 in.), nozzle color designations (red for avgas, black for jet fuel) and single point fueling, which makes misfueling an aircraft foolproof compared to over-wing fueling. However, despite these advancements, misfuelings continue to happen alongside new challenges that did not exist in the past.

New Concerns

Operating in California, where complicated energy regulations are typically more prominent than in other states, Gauger mentioned how a new misfuelling concern can be found between diesel exhaust fluid (DEF) and Prist, an aviation fuel system icing inhibitor. In other words, Prist is used to prevent water from forming into ice that could block engine filters. It is an additive that is completely harmless to jet fuel, however its appearance, and even the containers it is delivered in, is strikingly similar to DEF, the same fuel that is used to power the fuel trucks at FBOs.

New fuel trucks have DEF requirements that need to be followed, and due to DEF's interchangeable features with Prist, Gauger has appointed one line service technician who is the only authorized person other than himself to oversee changing Prist in the fuel trucks.

With fuel suppliers being at the front lines of quality control issues such as this, FBO managers and line service techs inevitably become the messengers to the rest of

PAPI8888/ ADOBE STOCK

Good communication between line service technicians and pilots is important to ensure the right fuel gets pumped.

the industry as new fueling practices and regulations continue to evolve.

Despite any new challenge however, one thing is not intended to change anytime soon—the simplicity of fulfilling a fuel order. It is not supposed to be hard, which is what can potentially make it dangerous. Therefore, the core of any lesson on aircraft misfueling, no matter who you ask, is communication.

Overcommunicate

"You can never overcommunicate," says Otto Wright, general manager of Modesto Jet Center at the Modesty City–County Airport in Modesto, California. Over the course of his career, he has been involved in fueling operations all over the world, where pilots and the ground handlers who were fueling their aircraft did not speak the same language. In his experience of seeing aircraft misfuelings occur, "bad communication has usually been the primary cause. For this reason, some operators require the pilot to be present during the fueling procedure. After all, line techs know how to fuel an airplane, but not everyone knows how to communicate."

When arriving at an FBO, a pilot would probably rather head into the FBO for some coffee and a climate-controlled setting as opposed to remaining outside during the fueling process. This is a natural tendency, but it cannot come at the expense of lazy communication.

When asked about certain pilot tendencies that annoy line service technicians the most, Wright was quick to answer: pilots who will not talk to them. Unsurprisingly, Gauger also mentioned that friendly pilots make line techs the best they can be. "The best training I ever received as a line guy came from pilots who cared. Those people shaped me into who I am today, and I know they are the ones who do the same for the line service techs here today."

Therefore, the next time your aircraft fuel order is being filled, remember that the people behind the fuel lines are as critical to the success of the industry as the fuel that provides the thrust to your engines. **BCA**

Based in Los Angeles, Matthew Orloff covers business aviation for Aviation Week Network.

Preventing Aircraft Misfueling For Pilots

The air is not the correct place to discover whether you have the right fuel in your aircraft. Every year, aircraft fueling mistakes lead to serious injuries or even death. Human error is the cause, but simple steps can prevent such accidents.

Here are steps pilots should take to avoid the risk of an aircraft misfueling as recommended by the National Transportation Safety Board and Phillips 66.

■ **Communicate**

Be specific. Always tell line personnel your aircraft tail number, type of fuel your aircraft requires, quantity and which tanks to fuel. Do this every time.
Use color-coded fuel order forms. Avgas = red; Jet fuel = black.

■ **Signage**

Ensure that your fuel placards are correct and specify either 100LL or Jet A, are easy to read and are located at all filler ports. Placards can degrade over time. Be sure to replace any that are faded or worn. Make sure that the proper restrictor is installed.

■ **Be alert**

Line personnel may not be aware of fueling requirements on your particular aircraft after a modification, such as the replacement of a reciprocating engine, which runs on avgas, with a turbine engine, which takes jet fuel. Some supplemental type certificates do not require a change in size of the fuel filler port with the changes. As a result, the modifications can lead to fueling confusion as the same model or similar looking aircraft may have different fuel requirements.

■ **Observe**

Observe your aircraft being refueled. Check the grade on the truck before fuel is flowing. Is it correct? If fueling at an FBO you've not before visited, take extra precautions and stay with your aircraft until it is fueled.

■ **Verify**

Check the fuel grade and quantity on your receipt to make sure you received the proper fuel. Many pilots with misfueled aircraft have signed fuel receipts showing the wrong fuel was used. Use the receipt as an added safety check.

■ **Preflight**

Sumping a fuel sample is an important part of a preflight routine. Remember that a visual check of the fuel may not detect whether Jet A fuel and avgas have been mixed, even though Jet A fuel and avgas have distinct odors, colors and evaporation properties. Perform a smell test. Jet fuel has an "oily" odor similar to kerosene, while avgas smells more like gasoline.

Observing these tips will help you avoid such mishaps.

—Molly McMillin

CHRIS GALBRAITH/ADOBE STOCK

CHECKLIST: Aircraft Appraisals

What buyers and sells should consider.

BY **MATTHEW ORLOFF**

ADOBE STOCK/CARLOS YUDICA

Reasons for an aircraft appraisal may extend far beyond simply purchasing an asset or securing financing.

The craft of appraising an aircraft is a complex procedure. Having a basic understanding of the questions to ask an appraiser is important—whether you are the buyer or seller. This guide will help cover all bases.

Step 1: Know When An Appraisal Is Necessary

In most cases, an aircraft should be appraised before being purchased or securing financing. Unless a financial institution requires one, there are some instances when a seller may be better off not conducting an expensive appraisal. However, there is a list of other occasions that warrant an appraisal. These include:

- Refinancing an aircraft.
- Changing an aircraft's insurance coverage based on its value.
- Selling a share of an aircraft (I.e. a NetJets membership).
- Estate planning.
- An aircraft is involved in litigation.
- Taxation purposes, including amending an aircraft's use for either business or pleasure.
- An insurable event, such as damage caused by a ground handling accident.

Before moving on to the next step, it's also best to have an idea what your airplane is worth to begin with. Basic sources to gauge a value can be determined using Aircraft Bluebook or a price index.

Step 2: Selecting A Qualified Appraiser

This step is crucial and can be a bit challenging since there are quite a few options. Things to consider when selecting an appraiser include:

- Ensuring they are accredited by the American Society of Appraisers or through another professional appraiser society. If they aren't accredited, this isn't necessarily a dealbreaker, but make sure they have good experience and the person who is referring you is trustworthy.
- Ensure the appraiser has extensive experience with similar aircraft makes and models. Some are well versed in many aircraft types, but you wouldn't want a piston aircraft specialist appraising a large-cabin business jet. If they don't have competence in a particular aircraft type, at least make sure they demonstrate how they will attain reliable information.
- Ask how long your appraisal will take. The industry standard is about 5-7 days, however appraisers are quite busy and may be challenging to lock down in a timely manner.
- Step 3: Determine The Scope of Work/Type Of Appraisal

There are two major types of appraisals, and based on your budget and appraisers' recommendation, you will choose one of the following:

- Desktop Appraisal: An appraiser uses information provided by the client, such as aircraft logbooks and maintenance schedules, to compare to current market data. This determines a value. It is estimated that more than half, around 60-75%, of all appraisals, are desktop appraisals. This determination is numbers-driven and does not involve a physical inspection of the aircraft, which leads to the next type of appraisal.
- Physical Appraisal: The most precise, expensive and detail-oriented appraisal that involves being hands on in evaluating an aircraft. An appraiser will check the engine, open panels and check the entire aircraft. This will produce cabin layout drawings, aircraft photos and a registration and airworthiness certificate copy. This appraisal builds off data received in a traditional desktop appraisal. In many cases, a bank may require this type of appraisal, as it may catch certain things that slip through the cracks of a desktop appraisal, such as undisclosed damage history. Keep in mind that appraisers may not be certified mechanics, meaning sometimes a physical appraiser acts as nothing more than a formality.
- Pricing Digest Evaluation: This is more of a bonus category and may not even require an appraiser. It is the cheapest and most simple type of appraisal because aircraft pricing is determined based off of published data. Information generated can be very generic and not compatible if an aircraft has more complex features. It also does not account for current market conditions. Think of it as a 10,000-ft. overview.

Step 4: Gather All Information

As mentioned earlier, appraisals should take about a week after you schedule it. When the time comes for the appraisal to be done, you don't want to be scrambling for any missing documents or logbooks. Make sure all these materials are ready when the appraiser arrives. A reliable appraiser will list what needs to be made available beforehand. Make sure whoever handles an aircraft's operations department is on top of it.

Step 5: Know What Your Appraiser Is Looking For

Knowing what your appraiser will be inspecting is a proactive way to ensure your aircraft remains in good shape. This also means any discrepancies will be less likely to catch you off guard. Factors that affect an appraisal price include:

- Year, Make and Model
- Interior and Exterior Conditions
  - Includes paint, carpet and seating.
- Times on the Engine, Airframe, and Auxiliary Power Unit
  - Used to measure performance. High times = less value.
- Avionics
- Airworthiness Directives (ADs)
  - ADs that are not complied with decrease an aircraft's value due to the cost to abide by them.
- Logbooks
- Location
- Environmental factors can cause different effects to aircraft over time. The effects of humid, coastal climates are different than inland, dry climates. Additionally, if an aircraft is based in another country, this can also cause a different set of regulatory roadblocks.

Final Step: Understand The Market

Simply put, there are good times and bad times to buy and sell aircraft, and at the end of the day, the market will have the last word. In a strong market, aircraft sell for more than they are worth, and vice versa in a weak market. **BCA**

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AVIATION WEEK NETWORK

Citation CJ4 Challenges Competitors

Assessing the Market for Cessna's CJ4 Series.

BY **BILL CAREY**

The list price of the Cessna Citation CJ4 has risen nearly $3 million over more than a decade of service, attesting as much to its modernization and market appeal as to the cost of living.

Flown by professional pilots as well as by owner-operators, the CJ4 entered the market in 2010 as the largest of the CitationJet family of light twinjets, the first of which launched more than two decades earlier.

It was more than just an extended, improved member of the CJ family, coming, for example, with a newly designed swept wing modeled after that of the larger Citation 680 Sovereign. "Cessna Aircraft just released the final performance numbers on the Citation CJ4 and the results are turning heads in São José dos Campos, Brazil," the headquarters of Embraer, BCA reported in January 2010. "[T]he CJ4 is a far more advanced aircraft than the CJ3, embracing several new airframe technologies, plus it has better cabin systems and more baggage volume. Ninety percent of the aircraft is 'clean sheet,' according to Norm Baker, CJ4 program manager."

The Model 525C Citation CJ4 can carry two crew and up to nine passengers. Its maximum range with NBAA IFR reserves, two crew and five passengers is 2,002 nm. Max cruise speed is 453 ktas. At maximum takeoff weight (17,110 lb.), the CJ4 needs 3,410 ft. of runway to take off and climb to its service ceiling of 45,000 ft. in 29 min. Payload available with usable fuel weight (5,828 lb.) is 1,122 lb.

Collins Avionics Innovations

Powering the CJ4 are two aft-mounted Williams FJ44-4A turbofans, each producing 3,600 lb. of thrust. The jet's Collins Pro Line 21 flight deck features four, 8-by-10-in. portrait-configuration LCD screens. Two center-mounted multi-function control display units are used to program the flight management system and tune radios. The CJ4 was the first light jet fitted with Collins' RTA-4112 MultiScan weather radar, which provides turbulence detection and alerting capability to 40 nm with overall range to 320 nm.

Parent company Textron Aviation announced the Cessna Citation CJ4 Gen2 in February 2021. The Gen2 iteration features passenger-centric improvements, including a new stair and folding handrail, premium seating options and enhanced ambiance lighting. The cabin includes an upgraded wireless cabin management system for passengers to stream entertainment and to wirelessly control cabin lighting, temperature and window shades from their wireless devises.

TEXTRON AVIATION

The Collins Pro Line 21 avionics suite of the Citation CJ4 Gen2.

"With the CJ4 Gen2, we focused on a design that enhances passenger comfort with an elevated cabin to match the performance capabilities already trusted by Citation CJ4 owners," said Christi Tannahill, senior vice president of customer experience. "Developments in technology have allowed us to introduce new design elements. A first for Citation light jets are the CoolView Skylights and a vanity option, which give our customers the atmosphere of a large aircraft with light jet performance capabilities."

At the end of 2022, the global CJ4 in-service fleet comprised 338 jets, of which 262 (77.5%) were based in North America, according to the Aviation Week Fleet Discovery database. Two other CJ4s were in the possession of a non-operator. There were 50 CJ4 Gen2 jets in service, 38 based in North America.

The factory-new list price of a 2010 CJ4 was $8.43 million, which had increased to $10.95 million 10 years later, according to the Aircraft Bluebook. The list price of a 2022 CJ4 Gen2 was $11.3 million.

CFS Jets, an International Aircraft Dealers Association accredited dealer based in Cornelius, North Carolina, in late December counted five CJ4 transactions pending, nine jets advertised for sale and several others becoming available in 2023. Early model-year (2010-11) CJ4s typically sell in the upper $6 million range; later models (2013-20s) sell from upper

NIGEL PREVETT/AW&ST

The Citation CJ4 entered the market in 2010 as the largest of the CitationJet family of light twinjets.

$7 million to $10 million, and very late models were tracking close to factory-new list price, says CFS Jets Partner David Monacell.

Textron Aviation's pre-owned sales department in January reported eight CJ4 and four CJ4 Gen2s listed for sale. Model year 2021 Gen2s have been selling in the low $11 million range; year 2022 models have been selling in the mid-to-upper $11 million range, the department said—approximating or even exceeding the Bluebook list price.

CJ4s compete for sales with the Embraer Phenom 300/E and Pilatus PC-24 light jets. "Most clients view the Phenom 300 as the closest direct competitor," Monacell advises. "The [Pilatus] PC24 is an interesting, recently introduced alternative, and there are a variety of considerations if the client wanders into an airplane requiring two crew."

The CJ4 cabin, stretched from its predecessor, the CJ3, measures 58 in. wide, 57 in. high (from the ceiling to a dropped centerline aisle) and 17 ft., 3 in. long. There are five windows on the left side of the fuselage and six on the right. The jet's pressurization system provides a cabin altitude of 7,800 ft. at FL450.

Cabin Configurations

CJ4 interiors are configured for eight or nine passengers. The eight-seat cabin has a single, side-facing seat opposite the entry door; double-club seating for four passengers; a single forward-facing row of two seats behind the club section; and an externally serviced, belted lavatory aft. In the nine-seat cabin, a two-seat couch replaces the single seat opposite the entry door. If the jet is flown single-pilot, the right seat is available for another passenger, increasing capacity to nine or 10 passengers.

"The CJ4 has floor tracking seats in addition to full-movement pedestal seats with 180-deg. swivel capability," noted Textron Aviation. "There is over 33 in. of leg room when a seat is fully tracked back—no other light jet offers this much leg room."

Legacy CJ4s featured the Collins' Venue cabin management system, which controls cabin lighting, window shades and entertainment systems. "This is the first narrow-cabin Citation to have a temperature controller in the main cabin and the first small Citation to have electrically powered window shades," BCA reported in 2010.

"Historically, the CJ4 had the best fit and finish in its class; in recent years competitors have made strides closing this gap," Monacell says. "It is most noticeable in comparing early CJ4s to competitors."

The basic inspection interval of the CJ4 MSG-3 scheduled maintenance program is 600 hr./12 months. The engine time between overhaul is 5,000 hr. with the Williams International TapAdvantage Blue program.

TEXTRON AVIATION

The CJ4 Gen2 iteration features passenger-centric improvements, including premium seating options and enhanced ambiance lighting.

Owners should expect $1,559.42 per hr. in direct operating costs (including fuel, engine program, typical maintenance), according to Textron Aviation, using 2022 data.

BCA's 2022 Operations Planning Guide estimates CJ4 Gen2 direct costs of $4,219 for a 1,000 nm mission, based on a nationwide average Jet-A fuel cost of $6.94 per gallon at the time of publication. Direct costs include mission fuel consumed, maintenance labor, parts and reserve costs apportioned to the actual flight time for the mission length. **BCA**

The Full Story of The CVR

An inside look at the cockpit voice record and how NTSB uses them in investigations.

BY **ROBERT SUMWALT**

0733:34 Tower:
Eastern 212, cleared to land, 36.

0733:55 Captain to First Officer:
All we got to do is find the airport.

0733:58 Sound of impact.

There's a certain mystique surrounding the cockpit voice recorder (CVR). There was even a theatrical play, Charlie Victor Romeo, aptly named for the phonic initials of CVR, which used CVR transcripts to recreate the final moments of six flights. In 2004, Time placed Charlie Victor Romeo on its Best Plays of the year list. Years later, Charlie Victor Romeo was made into a film and premiered at the 2013 Sundance Film Festival.

I really don't get it. I can tell you from experience of having to listen to scores of CVRs, there's nothing entertaining about listening to one. Eerily, the CVR recording of USAir 405 revealed that minutes before the crash, the crew spoke my name while referring to an article that I had written.

Perhaps I had read too many accident reports to ignore its presence. The above-cited final seconds moments of Eastern 212 always resonated with me. The crash happened just months after I started flying. News broke of the pilots' casual, nonchalant conversation as they performed a non-precision approach on that foggy morning in Charlotte, North Carolina. It was damming. In the final moments of flight, the pilots conversed amongst themselves about the then-Arab oil embargo, buying cars, trying to identify a local amusement park, the economic recession and the stock market. They then plowed the DC-9 into a corn field 3 miles from the runway. Seventy-two lives were lost.

As a newly minted private pilot, I was struck with that casual attitude. When I moved to the flight deck of an airliner some years later, I was keenly aware that there was quarter-sized microphone on the overhead panel, designed to capture every audible word spoken and sound in the cockpit. Perhaps that knowledge prompted me to be a more disciplined pilot, knowing that I didn't want my family reading of my unprofessional behavior just before my demise.

Early in my airline career, I also found that not everyone was too pleased about the CVR requirement for airlines--a requirement that had been in place since the mid-1960s. One captain I flew with insisted on placing a rubber crutch tip over the microphone. I can only guess that his motivation was that if we crashed, he didn't want Big Brother knowing what we had been discussing before we bit the dust.

Before analyzing a CVR, the NTSB forms a group to create a transcript of the recorder's contents. The group is led by an NTSB CVR group chairman and typically has a representative from the FAA, the aircraft manufacturer and the company whose aircraft crashed. If the organization's pilots are represented by a union, a pilot representative would typically be part of the group, too. That arrangement led to my first official duty of listening to CVRs.

In 1994, a Boeing 737-300 operating as USAir 427 crashed outside of Pittsburgh in 1994. I was an ALPA representative on the NTSB's human performance group. We spent excruciating amounts of time listening to, and trying to analyze, precisely what was going on in that cockpit before it plunged into a Pennsylvania hillside. A few years later, a US Airways Fokker F-100 was struck by lightning, resulting in loss of both hydraulic systems. The crew did a nice job getting the plane on the ground, but the airplane veered off the runway upon landing. The nose gear collapsed in the mud adjacent to the runway. Fortunately, there were no serious injuries. As a current and qualified captain on the airplane, I wa s asked to serve as the ALPA rep on the CVR group. And, of course, during my 15 years as an NTSB board member, I listened to many recordings as part of my duties.

The CVR's crash-hardened casing is required to withstand an impact of 3,400 Gs. It must also be capable of surviving 1,100 deg. C for 30 min. The downside is that because it's so robust, getting into a damaged casing to retrieve the crash-protected memory case can require considerable effort.

Once accessed, the original recording is copied onto a server. Officials will quickly audition it to see if there is information that needs to be urgently related back to investigators in the field. If a press briefing is being conducted on scene, the spokesperson may characterize what is being done in the cockpit, but the actual words from the CVR aren't disclosed at this time.

NTSB

NTSB CVR specialists Joe Gregor and (kneeling) Sean Payne remove CVR from the 2019 crash involving Atlas Air flight 3591, a 767-300 in February 2019. Because the recorder had been submerged in water before being located, to prevent oxidation it is immersed in water for transport to NTSB recorders lab in Washington, DC.

Guarded Listening

Access to the CVR is tightly controlled at NTSB. Even as NTSB chairman holding a top-secret security clearance, I was not able to access the recorders lab without an escort. There are three soundproof CVR audition rooms in the NTSB recorders lab. Only a small handful of people are ever allowed to listen to a CVR. Each person who listens must sign a CVR audition log and a CVR nondisclosure agreement beforehand. If there is a leak, it had to come from one of those people.

Notes are allowed, but only on a blue piece of paper that is distributed by NTSB. At the end of each day, that exact number of pieces of paper must be collected and destroyed. Cell phones must be left in storage lockers outside of the audition room.

At the beginning of the CVR group meeting, before starting the transcription process, the recording is played in its entirety without stopping. Group members listen through high-fidelity headphones.

The transcription process is done the old-fashioned way; the recording is played phrase by phrase, sometimes word by word, and the group tries to determine what sounds and words were heard. As you can imagine, oftentimes certain words, phrases and sounds are replayed until there is clear understanding of the content. While the recording is being played, the NTSB group chairman types what is heard. That content is displayed on monitors directly in front of each group member. Consensus on transcribed content should be achieved before moving on. Discussion that appears totally unrelated to the accident is often not transcribed, but instead, will be reflected in the transcript as "non-pertinent conversation." People's names are replaced with @ for privacy. In the USAir 405 crash, my name was depicted as Robert @. Expletives are replaced with #. One recording I listened to involved the crash of a Learjet 35A at Teterboro. That one had over 110 "expletive deleted" between takeoff and 26 minutes later when the aircraft stalled and crashed.

Through use of sound spectrum analysis, investigators can use the CVR to identify or confirm the source of sounds. This is often done by recording a sound from an exemplar aircraft and then comparing those sound signatures to ones heard on the CVR.

In the 2019 crash of an Atlas Air Boeing 767-300 freighter outside of Houston, for example, investigators confirmed that a click heard on the CVR was, in fact, consistent with the sound signatures of the go-around switch being activated in the accident aircraft. When a Bombardier Learjet 60 overran a runway in South Carolina in 2008 following a rejected takeoff, because the aircraft was not equipped with a flight

data recorder, investigators used sound spectrum analysis to determine engine RPM. They also calculated the airplane's initial acceleration and ground speed by measuring the time between tires rolling over the grooved runway.

Recording Not Released

The CVR group's transcription of the recording becomes the official record of the CVR's contents. By law, NTSB is prohibited from releasing the actual audio recording. This is the result of events following the August 1988 crash involving Delta 1141 at DFW Airport. NTSB found the pilots failed to set the flaps before takeoff and crashed immediately after liftoff. Following a year-long Freedom of Information Act battle with a local Dallas TV station, a judge ordered NTSB to release the actual recording. It was played on the air. To put it mildly, it was a bombshell. There was nearly 8 min. of what the official NTSB transcript described as "non-pertinent conversation between the flight crew and flight attendant" who was visiting the flight deck during taxi-out.

However, the actual recording revealed that content wasn't non-pertinent at all. It revealed the extent of the crew's unprofessional and casual attitude. "We forgot to discuss about the dating habits of our flight attendants so we could get it on the recorder in case we crashed. Then the media would have some kind of a juicy tidbit," one crew member said. "We gotta leave something for our wives and children to listen to."

In response to the release of the cockpit recording, ALPA revolted. Congress reacted by passing a law prohibiting NTSB from releasing it. However, once the NTSB is through with the actual recording, they return it to the owner/operator of the aircraft. There is no prohibition on that entity releasing it. In fact, oftentimes the actual recording is used in litigation. It's not unheard of to have a recording played in open court, although it's more common for a judge to hear it privately in chambers. The law judge will then determine if it can be played in the courtroom in front of the jury and spectators.

As a side note, in the final report of Delta 1141, NTSB apparently decided those CVR comments weren't "non-pertinent," after all. It concluded: "Extensive non-duty related conversations and the lengthy presence of the flight attendant in the cockpit reduced the flightcrew's vigilance in ensuring that the aircraft was properly prepared for flight."

If there's any lesson from all of this, it's a simple one. It's one that I always tried to remember: As a professional pilot, it's always good to be cognizant of the CVR. Contrary to what the pilots of Delta 1141 said, you don't want to leave something like this for your wife and children. **BCA**

Robert Sumwalt was a member of the NTSB from 2006-2021, including being chairman from 2017-21. Before that he managed a corporate flight department for a Fortune 500 company, and previously was a pilot for US Airways and Piedmont Airlines.

ROBERT SUMWALT

NTSB investigators prepare to listen to the CVR of UPS flight 1354. Before the audition begins, the door to the room is secured and all personal devices are stored in a locker outside. (Typically, no outside papers are allowed in. In this case, it's all NTSB investigators and the papers on the desk are approach charts for the approach being flown).

2116:23 CAM-1	man I just ah short runway goin' that fast, whew.
2116:30 CAM-2	did you read that article .hat Robert @ wrote in Flight Crew View about Vee one?
2116:35 CAM-1	yeah I th.nk I have.
2116:36 CAM-2	it's an excellent article to have.
2117:03 CAM-1	leavin' LaGuardia @ man that's a monday morning flight. that'll probably be jammed.

NTSB

Except from CVR transcript of USAir 405, which crashed in March 1992 at LGA. Notice at time 2116:30, the FO stated: "Did you read that article that Robert @ wrote in Flight Crew View about V1." I had written an article in Pro Pilot that was reprinted with permission in USAir's flight crew publication, Flight Crew View.

ALAMY/REUTERS/GARY WIEPERT

A Continental commuter Dash 8 Q400 on a snowy runway at Buffalo Niagara International Airport in 2009.

Ice Contaminated Tailplane Stall

ICTS was a highly topical subject for pilots in the 1990s and 2000s but is not much discussed anymore.

BY **ROGER COX**

Do you give much thought to experiencing Ice Contaminated Tailplane Stall (ICTS) in your airplane? I didn't think so. ICTS was a highly topical subject for pilots in the 1990s and 2000s but is not much discussed anymore. Still, uncertainty about the likelihood of an ICTS event remains.

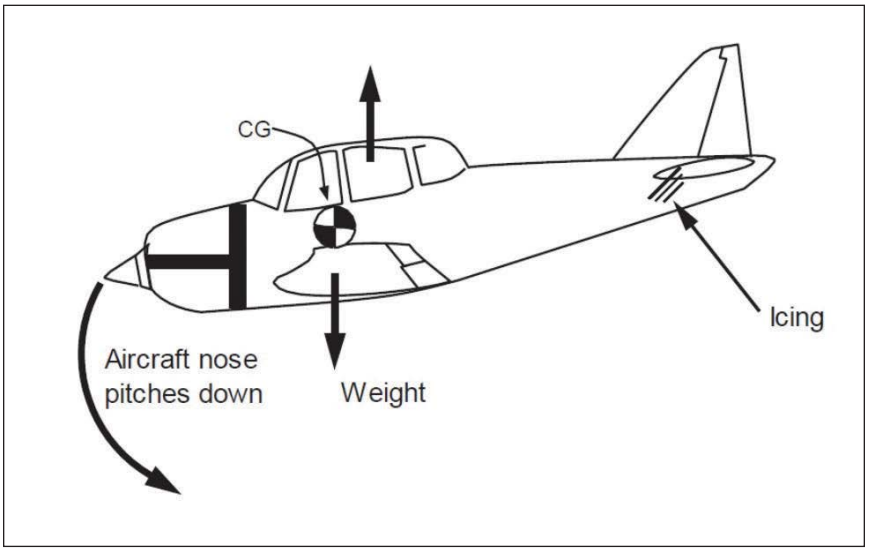
A lot has been done to address the issue, but if you're an FAA official you may not have heard much about it. There's some history and some good news.

ICTS was only one part of major concerns about aircraft structural icing that came about because of a series of icing-related accidents and incidents between 1997 and 2001. After an ATR-72 crashed near Chicago in icing conditions in 1994 and an Embraer EMB-120 crashed near Detroit in icing in 1997, the NTSB made aircraft icing a priority subject. "Airframe Structural Icing" was on its agency's Most Wanted List from 1997-2002, and "Reduce Danger to Aircraft in Icing Conditions" was on the list from 2003-10.

Most of the airplanes involved were turboprops, but jets were not immune. They tended to be of the regional airline or business/corporate size. For example, an Air Canada Bombardier CRJ-100 crashed on an attempted go-around in 1997, with wing icing as a factor. Another EMB-120 was involved in a frightening loss of control incident near West Palm Beach, Florida, in 2001, and icing was found to be the culprit.

A result of all the emphasis on icing was a flurry of research by the FAA and other entities. NASA produced a couple of videos in 1998-99 on aircraft icing. They had great production values, the prestige of NASA and were widely viewed by pilots, often in recurrent training. I remember watching one of these videos, even though the big jets I was flying rarely experienced the kind of icing problems encountered by turboprop pilots. I thought it was good information, even if a little overwrought.

FAA



Pitchover due to tail stall as depicted in FAA Advisory Circular 91-74B

One subtopic of the videos had an effect far beyond the real scope of the potential problem: ICTS. Even though there were very few documented cases of crashes, ICTS seemed to be a very real problem. The video segment was fascinating and yet there was no real training for ICTS and no recovery procedure for it in flight manuals. Pilots were left with an uncertain and ambiguous impression. How would you know what type of stall you were experiencing—normal aerodynamic or tailplane? The recovery actions were opposite of one another.

The Colgan Air Flight 3407 accident on Feb. 12, 2009, brought home how misleading the training could be. The accident airplane—a DHC-8-400—was a twin-engine turboprop. Could it have been experiencing ICTS? The answer was clearly no. That airplane had been shown by its manufacturer to be immune from ICTS. But when those of us doing the investigation interviewed a cross-section of Colgan pilots, they all remembered vividly the ICTS part of the videos they had seen in training.

We wondered if the possibility of experiencing ICTS had been a subconscious influence on the accident pilots as they were trying to recover from the aerodynamic stall the captain himself had induced. Both pilots had seen one of the videos multiple times. Was it possible they were attempting a tailplane stall recovery? When we studied the airplane's performance and auditioned the cockpit voice recorder, we concluded they were not.

Nonetheless, the videos were a problem. It turned out that for most airplanes, most of the time, the videos represented negative training. ICTS events are rare, very rare.

To address and eliminate confusion about ICTS, we wrote NTSB Safety Recommendation A-10-25: "Identify w hich airplanes operated under 14 Code of Federal Regulations Part 121, 135 and 91K are susceptible to tailplane stalls and then (1) require operators of those airplanes to provide an appropriate airplane-specific tailplane stall recovery procedure in their training manuals and company procedures and (2) direct operators of those airplanes that are not susceptible to tailplane stalls to ensure that training and company guidance for the airplanes explicitly states this lack of susceptibility and contains no references to tailplane stall recovery procedures."

The FAA was overwhelmed by the volume of work needed to respond to the Colgan safety recommendations and the accompanying laws passed by Congress and its response to the ICTS recommendation took time. The agency issued airworthiness directives on 10 airplanes about which the FAA had suspicions in 2010. It reviewed the entire subject by 2013 and identified airplanes susceptible to tailplane stalls. It directed POI inspectors to have their air carrier pilots stop watching the NASA video.

The FAA published Notice N8900.267, a focused review of ICTS training, in 2014. In 2016 the agency said that nearly all airplanes certified under Part 25 and most certified under Part 23 had been evaluated and found to be not susceptible. Some other types had made design changes or changes to procedures and limitations to prevent tailplane stall. Flown within their certified envelope, these airplanes are not going to experience a tail stall.

The NTSB was satisfied and closed out its recommendation as having had acceptable action in 2016.

A big question remained. Working pilots wanted to know what airplanes remained out there that were susceptible to ICTS. The FAA was mum for a long time, but now there's list of airplanes that are not susceptible to ICTS and which should not have training for the condition. **BCA**

- That list can be found at: https://www.faa.gov/sites/faa.gov/files/aircraft/air_cert/design_approvals/small_airplanes/Pilot_training_exceptions.pdf. It's a very long list and includes most of the types formerly suspected of being vulnerable.
- In addition, FAA produced a new video, CRC-508, "Ice Contaminated Stall" in 2016, that is worth a watch: https://www.youtube.com/watch?v=NBX84bF2d4U
- Finally, for those who want in-depth knowledge about aircraft icing, read FAA Advisory Circular 91-74B, "Pilot Guide to Flight in Icing Conditions." There are two small sections devoted to ICTS. https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1028388

A former military, corporate and airline pilot, Roger Cox was also a senior investigator at the NTSB. He writes about aviation safety issues.

Below Minimums

Raytheon Hawker 800XP hard landing at Farmingdale, NY.

N412JA after a hard landing.

NTSB

BY **ROGER COX**

The minimums for the ILS approach to runway 14 at Republic airport (FRG) in Farmingdale, New York are 200 ft. above the runway and 0.75 mile visibility. A Raytheon Hawker 800XP crew tried to fly that approach when the visibility was 0.25 mile and almost made it.

The approach proceeded normally until the very end. The first officer (FO), who was flying, could not see the runway well enough to know when to flare. The airplane hit hard, the airplane was severely damaged and the FO suffered debilitating injuries.

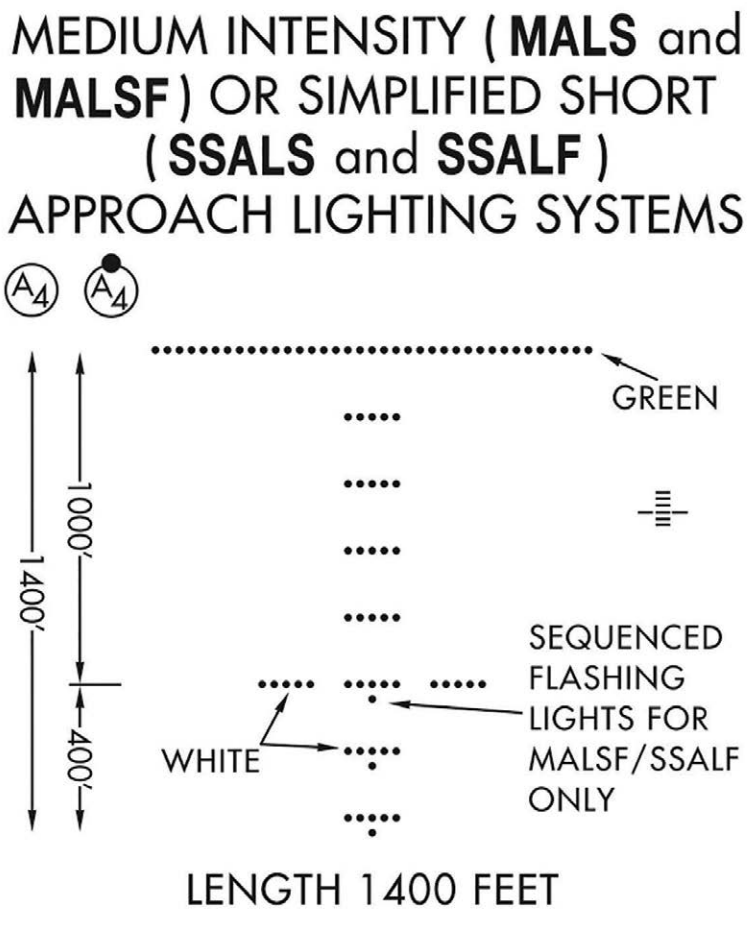
The accident points to the difficulty of adjusting expectations after the approach has already been briefed. The two pilots expected the visibility to be 0.75 mile; that's what was reported on the automatic terminal information service (ATIS). When the visibility dropped after they had commenced the approach, they had to decide quickly to continue or abandon the approach. The Part 91 "look see" logic drew them on.

The crew began their duty day at noon on Dec. 20, 2020. They flew six passengers from Westchester County Airport (HPN) to Ocean Reef Airport (07FA) in Florida, then flew back to their home base at Farmingdale after stopping at Opa Locka (OPF) for fuel. The trip to Florida was Part 135; the return was a Part 91 positioning flight. Only the two pilots were aboard. It was the last day of a four-day trip.

It was already dark in New York when the flight took off. The Hawker jet, N412JA, was fueled to 7,000 lb. at OPF and the planned burn for the 2-hr. and 35-min. flight was 4,081 lb. The captain filed an alternate, Teterboro (TEB), but he expected FRG to be 800 ft. overcast and 6 miles visibility when they arrived. A diversion seemed unlikely.

According to the NTSB, the nearest terminal forecast (TAF) was for JFK airport, 17 nm west of FRG. That forecast was winds variable at 4 kt, 6 miles visibility, few clouds at 700 ft. and a broken deck at 2,500 ft. The New York area forecast said "patchy fog will have to be monitored closely overnight."

Arriving from the south, the flight was routed by SARDI intersection and



AERONAUTICAL CHART USERS' GUIDE

A MALSF approach lighting system diagram.

Calverton VOR, descending to 7,000 ft. MSL. The two pilots discussed conditions at both TEB and Islip (ISP) and went over the go-around procedure. It was "go around, go around, thrust, flaps 15, positive rate gear up, FMS NAV FLCH." They discussed the normal minimums for the approach. According to the approach chart, the decision altitude (DA) for the ILS-14 was 277 ft., which was 200 feet above touchdown, and the minimum visibility required was 0.75 mile.

At 2018 EST, about 17 min. before landing, the crew tuned and monitored the FRG ATIS. It was: "information X-Ray, 0053Z, winds 040 deg. at 3 kts., visibility 0.75 mile with mist, ceiling 200 ft. overcast, temperature 1 deg. C, dewpoint 0 deg. C, altimeter setting 30.04, runway condition code 5-5-5, 100% wet."

Conditions were worsening.

At 2023, New York Approach Control told the flight to expect vectors to the ILS to runway 14, and the crew set up and briefed the approach. The briefing included a Vref of 117 kt. The likely approach speed was 122 kt.

As they neared the localizer, they extended the flaps to 15 deg.

At 2031:32 New York Approach said, "Talon flight nine forty one four miles from FRIKK turn left heading one seven zero maintain one thousand six hundred until established on the localizer cleared I-L-S runway one four approach."

After the read back, at 2032:17, New York Approach said, "Talon flight nine forty one contact Republic tower one one eight point eight." The captain acknowledged and a moment later the FO called for the landing gear down.

When the captain checked in with Republic Tower, he reported still outside of FRIKK, the final approach fix. The tower cleared the flight to land. They added "last aircraft uh about five minutes ago reported mins uh bases right at the mins."

The crew extended the flaps to 25 deg. as the glide slope came alive. Just at that moment, the tower said "uh new weather's comin' out looks like visibility has dropped a little bit to one-quarter and uh fog indefinite ceiling two hundred temperature one dewpoint minus one altimeter three zero zero three."

That patchy fog the weather service warned about in its area forecast was arriving.

There was about a 10-sec. delay before the captain replied, "understood Talon flight nine forty one." Then in quick order, the two pilots agreed. The captain said, "all right we're part ninety one we're inside the fix," and "we'll continue." The FO concurred but said "we will be ready to go." Flaps were set to full.

At 2033:33 the FO said "I'm inside, you're outside." The captain agreed and completed the landing checklist except for autopilot and yaw damper.

At 2033:41 an electronic voice driven by the radar altimeter announced "one thousand." The captain made his own callouts, starting with 500 ft. above the set decision height of 200 ft. AGL. After calling out "one hundred" and at the same time as the electronic voice called out "minimums," he said at 2034:56 "all right I got lights," and the FO said "continuing."

Four seconds later the captain said, "there are the rabbits do you see 'em?" and "red terminating bar lights," and the FO said "landing."

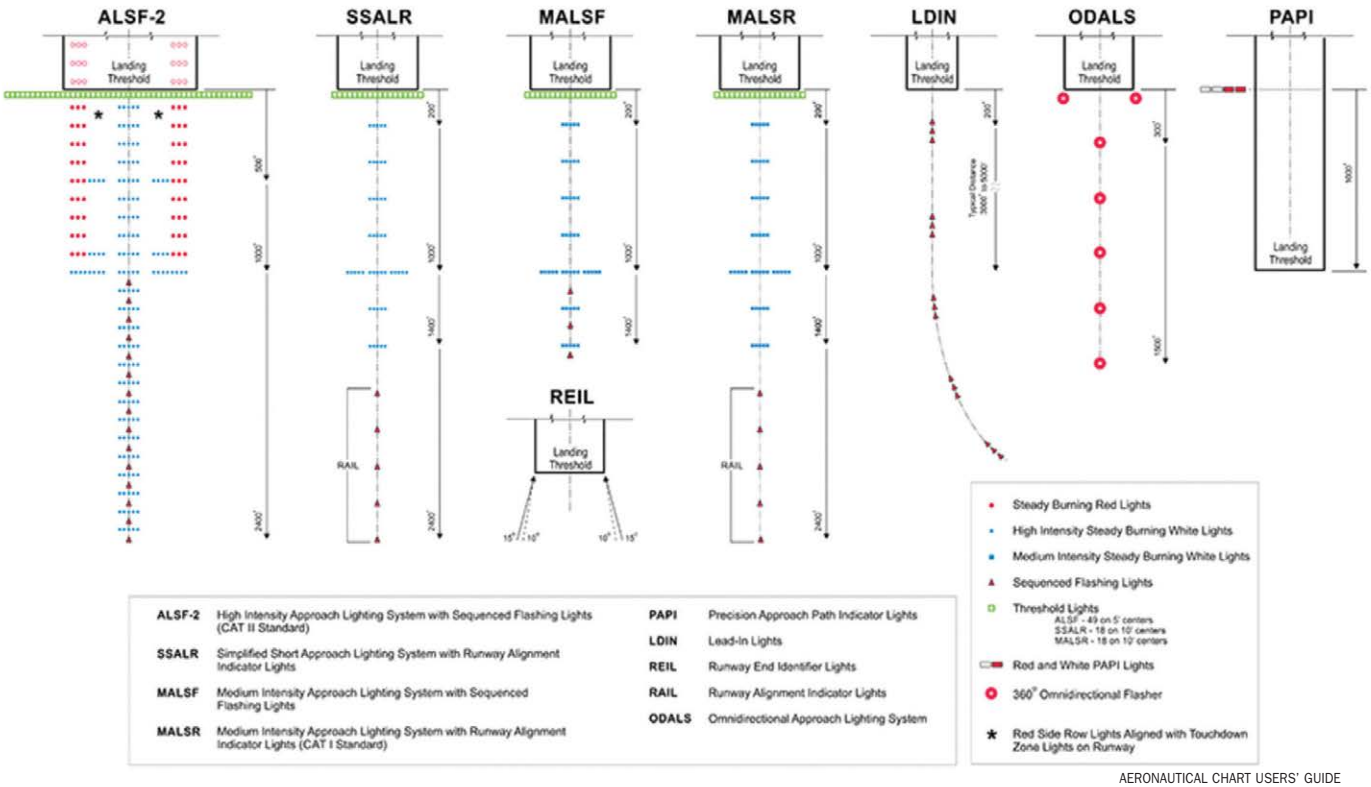
Runway 14's approach light array, a medium intensity MALSF system, does have three sequenced flashing lights (rabbits), but does not have red terminating bars or, for that matter, any red lights at all.

Passing 100 ft., the captain said, "there's the runway" and the FO said, "give me lights." He did not call out seeing anything.

The FO disconnected the autopilot as the airplane passed 50 ft. and began reducing engine thrust. As the airplane passed 30 ft., the captain called out "flare, flare, flare"! then "to the left, to the left, you're sliding!"

The airplane was below 20. Ft. when the FO called out "take it, take it." The captain did not take control of the airplane. He called out "go around go

Visual Guidance Lighting Systems



AERONAUTICAL CHART USERS' GUIDE

around go around," and the FO repeated "go around go around thrust flaps 15." The FO pressed the TOGA switch and advanced the thrust levers to full thrust. The command bars came to a nose up position, and engine data later showed the engines spooled up to 90-95% N1, but the airplane continued to sink. The captain recalled that the airspeed was between 110-115 kts.

At 2035:27 the airplane impacted the right side of the runway. All three landing gear broke off and the airplane slid off the runway to the right, spinning around and finally stopping about 1,500 ft. beyond the landing point. The captain shut down the engines, made a MAYDAY call on the radio and worked with first responders to evacuate the airplane.

The Investigation

As is common in limited investigations, NTSB investigators did not travel to the scene. An FAA inspector from the Farmingdale FSDO responded to the accident scene, took photos and documented the wreckage. That inspector was a party to the investigation, along with the operator, Talon Air, and the engine manufacturer, Honeywell. Talon Air's director of operations completed the NTSB form 6120, from which some of the final report's details were drawn.

The Raytheon Hawker 800XP, manufactured in 2001, had accumulated 12,731.5 hrs. at the time of the accident. Data downloaded from the engine's digital electronic control units showed there were no engine malfunctions, and the NTSB accepted the statements from Talon Air and the crew that there were no mechanical issues with the airplane.

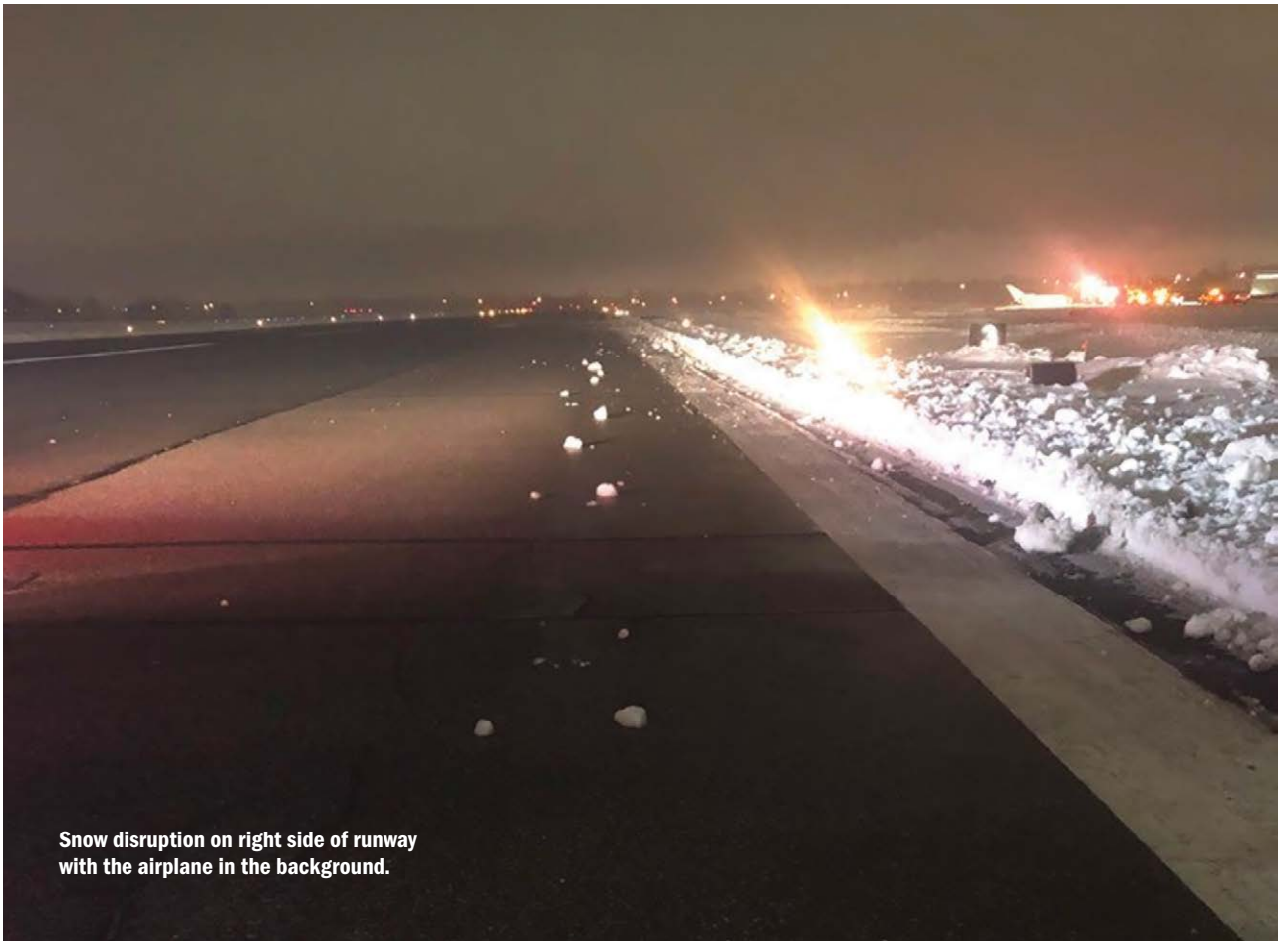
The airplane's cockpit voice recorder (CVR) was recovered and sent to the NTSB's vehicle recorder lab. The FAA inspector and a Talon Air captain, along with the NTSB's recorder specialist, formed a CVR group and auditioned the recording. The quality of the recording was excellent. The investigator in charge (IIC) decided that only 7 min. of the 30 min. recording should be transcribed. The remainder of the recording was summarized by the recorder specialist.

The airplane was not equipped with a flight data recorder (FDR) and ADS-B data was not used in the investigation. The facts in the case seem pretty clear without them, except for the movement of the pilot yokes on the attempted go around.

The 37-yr.-old captain held multiengine ATP and CFII certificates and had accumulated 4,188 total flight hrs., 2,060 of which were in the Hawker jet. He told investigators that most of his time was in the Hawker 900, with about 100-250 hrs. in the 800 model. He said he had logged about 2,300-2,400 hrs. in Part 135 operations. There were no restrictions or limitations on his first-class medical certificate.

The captain said he completed his pilot training in 2006 and was hired by Talon Air in May 2019. His employment in the interim was not stated. He was not asked about his experience or training in flying approaches below Category I minimums.

The FO was 63 yrs. old and held an ATP and a Hawker 800/900 type rating. There were no limitations on his first-class medical certificate. He had about 10,000 total flight hrs. and reported 4,100 hrs. on the Hawker, of



FAA AND NTSB

Snow disruption on right side of runway with the airplane in the background.

which 2,500 was in the 800 model. He had transferred to Talon Air from another company one month before the accident and had only been line flying with them for two weeks.

The two pilots had not flown together before the accident trip, but both told investigators they worked together well. Both reported being healthy and well rested. Both had flown the ILS runway 14 approach many times and both had received company training on rejected landings from 50 ft. and missed approaches.

A note on the FRG ILS-14 approach plate says, "autopilot coupled approach NA below 310." The CVR showed that the FO left the autopilot engaged to about 50 ft.

Meaning of 14 CFR 91.175

Every instrument rated pilot has had to learn what's said in 14 CFR 91.175, "Takeoff and landing under IFR." Unlike 14 CFR 135.225, which pertains to Part 135 operations, and 14 CFR 121.651, which pertains to airline operations, the Part 91 regulation does not prohibit pilots from beginning an instrument approach when the ceiling and visibility are below prescribed minimums. When you are operating under Part 91, you are allowed to "look and see" if conditions are good enough to land.

That doesn't mean you can land. You still have to comply with the prescribed DA/DH or minimum decision altitude (MDA), and you can't go below it until you meet three criteria: you must be able to descend at a normal rate (not dive at the runway); the flight visibility must be at least as good as the minimums for the procedure; and you have to clearly see at least one of 10 specified elements of the runway environment.

One of those 10 elements is the approach lights. Just seeing approach lights alone is not good enough to descend below 100 ft. To do that you have to see red terminating bars or red side row bars, and they only apply where there are ALSF 1 or 2 light arrays.

When you are approaching a runway that doesn't have an ALSF 1 or 2 light system and you are relying only on the lights, you can't go below 100 ft. You are going to have to find one of the other nine elements to descend below the DA or MDA.

It is possible for pilots operating under Part 135 or 121 to continue an approach when ceiling or visibility has fallen below minimums. If you have already begun the final approach segment when you hear the new, lower weather report, you can continue to the DA or MDA. At that point, you have to comply with the same three conditions that apply to Part 91.

What is commonly taught to professional pilots in flight simulator training is that if you do see one of the 10 elements listed in 91.175 (c) (3) you may continue and land. The flight visibility requirement of subparagraph (c) (2) is forgotten, superseded by the pilot's view of one of the elements of the runway environment.

I respectfully disagree. The regulation doesn't become void the moment you see the threshold. The problem is figuring out how flight visibility translates to runway visibility. Flight

visibility is what is seen from the cockpit in flight, and is measured by what prominent objects can be seen.

A pilot may be tempted to say the flight visibility is 0.75 mile, for example, but if he can't see about 4,000 ft. ahead when at minimums, it's doubtful he has adequate visibility for the approach. A MALSF light system, such as is installed at FRG, is 1,400 ft. long. When the sequenced flashing lights are first visible, the pilot should probably be able to see up to 2,600 ft. of the approach end of the runway.

The regulation is clear enough, but overly optimistic interpretation of the visibility by pilots in a fast moving airplane can quickly increase the risk of an accident.

Conclusions and Comments

Whether you're in a car, truck or plane, when you're on that last mile after being gone four days, you're looking forward to being done. Our Hawker crew was homeward bound.

When they left OPA, they expected the ceiling and visibility to be 800 ft. and 6 miles at FRG, and the area forecast warning about patchy fog was not strong enough to alter their plan. However, the ceiling and visibility was gradually falling as the flight continued to its destination. The crew had a natural bias to continue. Plan continuation bias is the desire to continue with the original plan in spite of changing conditions and growing evidence that you should reconsider. It explains the crew's mindset as they descended into Long Island.

Had the ceiling and visibility remained at or above the prescribed minimums, the crew in all likelihood would have landed successfully. When they got the news that the ceiling was now indefinite at 200 ft. and the visibility was 0.25 mile, they took about 10 seconds to absorb the information and make the decision to continue. They were only about 2 min. from touchdown.

Ten seconds was not enough time to consider how to fly what could be in effect a Cat II approach. They needed to verbalize when the autopilot would be disconnected, what the approach lights would need to look like, how much of the runway surface would need to be visible in order to land, and who would initiate and conduct a go-around.

When the captain called out the red terminating bar lights, he was saying what he expected to see, not what was there. Human performance experts say expectation bias is when we have a strong belief or mindset towards something we expect to see or hear, and act according to those beliefs.

When the FO said in a post-accident interview that he saw REIL lights, he still believed those lights were there, but they weren't. On the CVR, he never called out seeing anything. Investigators know that people often remember things that didn't actually happen.

When the FO suddenly and unexpectedly relinquished control of the airplane below 20 ft., he caught the captain by surprise. The captain declined to take control of the airplane; doing so would have been a violation of the company's "positive transfer of controls" policy. As a result, it appears that neither pilot pitched the airplane up to a go-around attitude.

Given that the FO was new to the operation, it's not surprising that their crew coordination broke down at the last minute. Their crew resource management training wasn't sufficient to ensure they both had an accurate shared mental model of how to conduct the approach with such low visibility.

The NTSB's probable cause was "The flight crew's delayed decision to initiate a go-around after the approach had become unstabilized, which resulted in a hard landing."

I would add that the "look see" nature of Part 91.175 is an invitation to error. Weather conditions can change faster than your expectations. A safer policy would be to break off the approach and proceed to your alternate as soon as the visibility drops below minimums. **BCA**

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Marketplace

By Matthew Orloff

Payment Processors Aim To Simplify Business Aviation Transactions

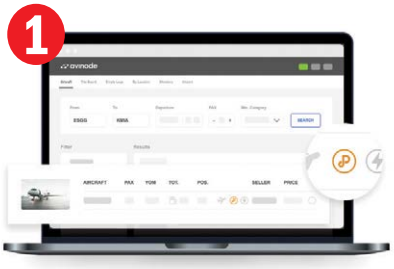
Options for general payment processing providers are plentiful, however the list becomes dramatically shortened when seeking out a company that specializes in business aviation. The following companies do just that.

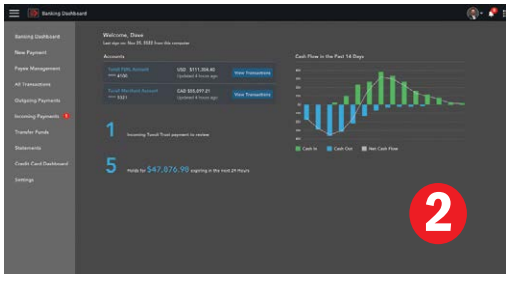
1. Recognizable Brand

Company: Paynode

Product: A relatively new extension of the Avinode Group, Paynode plans to revolutionize business aviation payments in the same way its sister company, Avinode, revolutionized aircraft sourcing over 20 years ago. Those who have an Avinode membership have access to Paynode, allowing an integrated transition between sourcing and payments. Paynode can handle all types of payments in one space, including credit card and wire transfers. If both the paying and receiving parties are set up with Paynode, then payments can be done instantaneously without a processing delay. The system can handle the 20 most common global currencies, eliminating the need to deal with multiple bank accounts. The company even mentioned how money held in a Paynode account can be used to pay employees. Moving into 2023, the company aims to allow payments to be completed easily by the end retail client themselves, as opposed to just between brokers and operators, further simplifying business aviation's payment processes.

https://marketplace.aviationweek.com/company/paynode





2. Mobile Friendly

Company: Tuvoli

Product: As a sister company to FlyEasy Software and Everest Fuel brands, Tuvoli is the payment leg that was specifically designed for private aviation. Customers can send payments and sellers can send secure checkout links from their mobile devices, allowing payments to be made quickly while on the go. Started by Directional Aviation, Tuvoli is utilized by companies under the OneSky Flight brand, including Sentient Jet. The platform can be integrated with accounting software such as QuickBooks Online and Sage to take a burden off accounting departments. Tuvoli also has a built-in sales CRM and has no credit card limitations for either transaction size or monthly spend volume.

https://marketplace.aviationweek.com/company/tuvoli

3. Crypto Compatible

Company: Ecommpay

Product: Ecommpay is a British payment solutions company that caters to multiple industries, but it does have a specialty product for private aviation. A way it stands out from the crowd is by allowing crypto payments that can be converted straight to USD, EUR or GBP currencies. The platform also allows payments to be made with Apple Pay and Google Pay. The introduction of these payment methods is the company's response to curbing issues surrounding the high cost of flights and low transaction limits of many banks and acquirers, which often leads to clients needing to split payments that cause high-rejection rates by anti-fraud systems. The company says payments can be made quickly, with generated e-invoices taking no more than 15 seconds to process.

https://marketplace.aviationweek.com/company/ecommpay

4. Risk Aware

Company: Vector Payments

Product: Like many other payment processing companies, Vector Payments caters to a variety of different industries, but its services for private jet charter is focused on the high-risk nature of the transactions. According to the company, Vector Payments was created to provide credit card processing to high-risk businesses. Simply put, certain credit card processors were created more in-line to purchase a meal as opposed to a jet charter. The two main risks the company acknowledges that it is prepared to deal with are high processing amounts and chargebacks. Chargeback rates exceeding 3% is something many low-risk processing companies dread, and when that 3% represents thousands of dollars due to the price of private flying, then many other payment processors may be discouraged to do business with you. Chargebacks may happen for any reason a flight is cancelled.

https://marketplace.aviationweek.com/company/vector-payments

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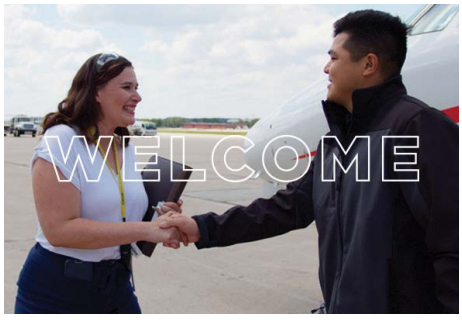

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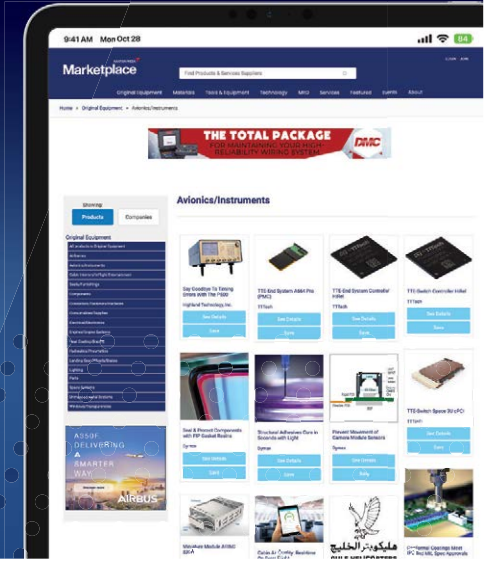

Rene Banglesdorf
Guest Columnist

Mechanic Shortage Essentials

Actions to retain and recruit maintainers.

WHILE PILOT SHORTAGES ARE OCCUPYING THE HEADLINES, executives at airlines and repair stations are quietly fretting about the lack of pipeline development in the technicians that keep their aircraft running smoothly and in compliance with safety standards.

According to the 2022 Aviation Technician Education Council (ATEC) Pipeline Report published in late November, the pandemic is estimated to have cost the industry at least 5,000 new mechanics, creating an even bigger challenge in the talent pipeline shortage.

"The number of prospects in the mechanic pipeline needs to grow by at least 20% to meet industry's needs," says ATEC President and WSU (Wichita State University) Tech Aviation Program Dean James Hall. "National enrollment at A&P schools is only growing at about 2% per year, so we have a lot of work to do."

The report suggests an increase in high school pipeline programs could be one answer—especially as programs within the schools raise community awareness and participation. ATEC-member aviation maintenance technician schools (AMTS) recently completed a successful pilot of its Choose Aerospace aviation maintenance curriculum, which will formalize matriculation into A&P (Airframe & Powerplant) programs. The council has a goal of enrolling 10,000 high school students by 2027.

Ryan Goertzen, AAR's vice president maintenance workforce development, oversees staffing-based initiatives for the aviation services provider that serves commercial airlines and governments around the world. Goertzen has created partnerships with local communities to involve students who wouldn't otherwise consider aviation.

One of AAR's initiatives started with a six-week sheet metal class in partnership with Olive-Harvey College and south Chicago high schools that has since turned into pathways into college degree programs. The public-private partnership was key in facilitating this pipeline development opportunity, Goertzen says. From an initial conversation between a public official and AAR's CEO to enrollment in the program took just four months, indicating we can begin alleviation of this problem relatively quickly by working together.

Another area where improvements are being made but must continue is in legislative efforts for military-to-civilian-aviation transitions. Expanding access to A&P test prep courses and training not only provides relief to the civilian talent shortage but also eases career transitions for veterans entering the commercial workforce. Protecting or expanding the applicable uses for the GI Bill is critical.

Stacey Rudser, president of the Association for Women in Aviation Maintenance, indicates the potential challenges run deeper than pipeline development. As an experienced line supervisor, Rudser reports that working conditions are "getting rough" with higher-than-normal turnover throughout the industry and the opportunity cost of onboarding new employees, even experienced ones, with operations-specific protocols. "Before the pandemic, the average age of an aircraft technician was 57," Rudser says. "With airlines offering early retirement packages, and a good number of technicians accepting them, we're facing an irreplaceable loss of knowledge."

The release of older mechanics from airlines has triggered new hiring practices with demand for technicians increasing. Instead of a traditional path from progressing from training to an MRO, contract job or regional airline then airline, some of the major carriers are hiring A&Ps before they have even graduated from school. This leaves smaller carriers, FAR Part 135 operators, manufacturers and repair stations scrambling for talent.

She further believes retention is key to both ongoing morale and continued operational safety.

"Leadership needs to pay attention to on-the-job training," Rudser says. "As not every senior mechanic wants to be a mentor, bringing some of those retirees back to conduct technical and professional development might be helpful."

Additionally, she recommends better communication and flexibility as retention tools.

- Appropriately allocating manhour scheduling for the level of experience of the technician levels out performance expectations, giving newer technicians benchmarking opportunities without feeling inadequate or frustrated.
- Ensuring there is a clear path of advancement for technicians who stay with the company communicates the value placed on long-term relationships.
- Establishing financial incentives for technicians to obtain additional skills is both fair and important. Larger companies have labor unions that negotiate equitable pay scales. Smaller companies benefit from following that practice—and following through with what they promise—as delayed promotions or pay raises are a significant cause of job disengagement.
- Creating a mechanism for more flexible scheduling while maintaining competitive pay helps workers with dependent-care responsibilities, whether for children or other family members.

While the aviation technician pipeline is by no means robust, on the bright side, efforts are being made to address recruitment. **BCA**

René Banglesdorf is the founder and CEO of The Aviation Collective, where she helps aviation companies hire and retain the best talent through executive coaching and workplace culture consulting. Banglesdorf served on the U.S. Congress-chartered and FAA-appointed Women in Aviation Advisory Board, is a 20-year aviation professional and holds a private pilot license.

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