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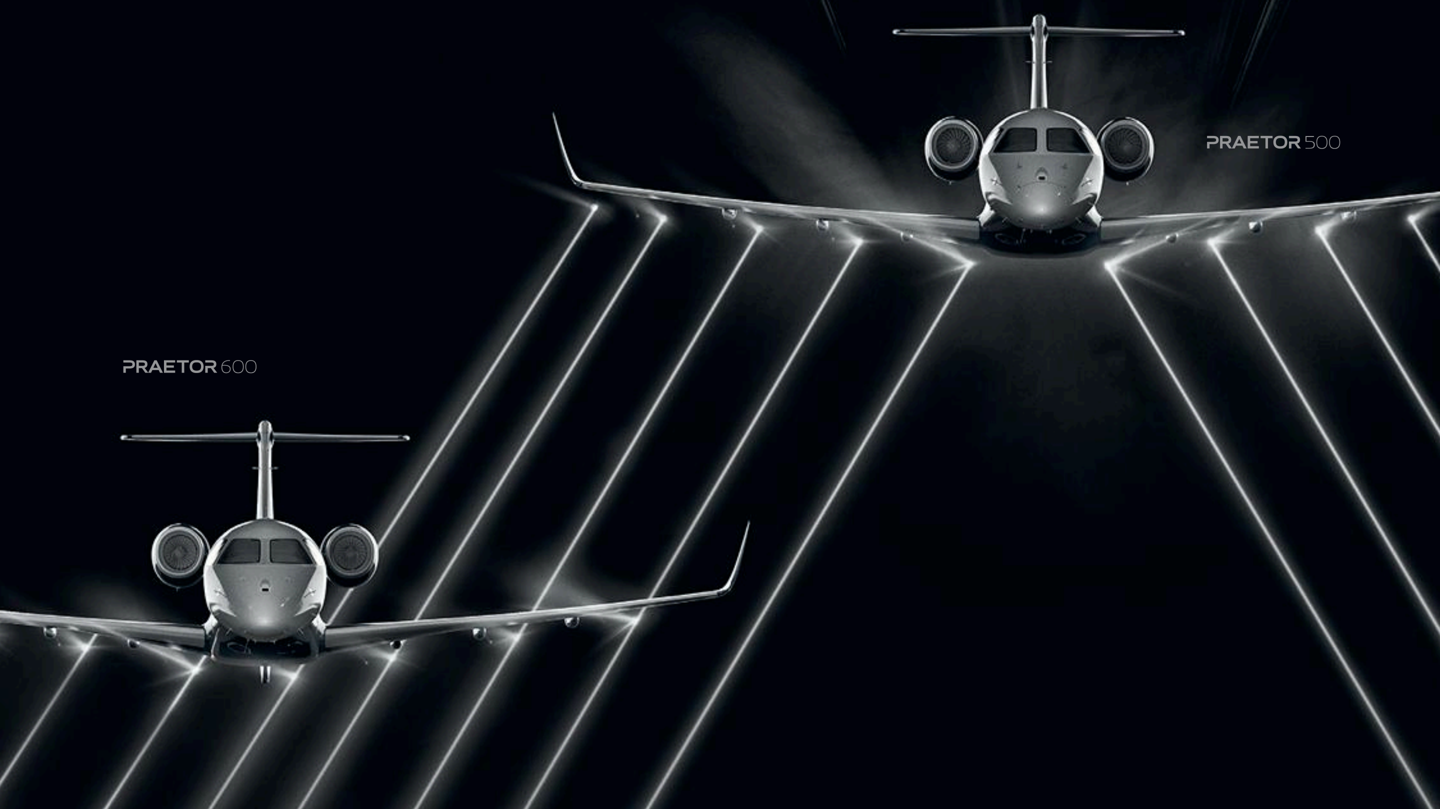

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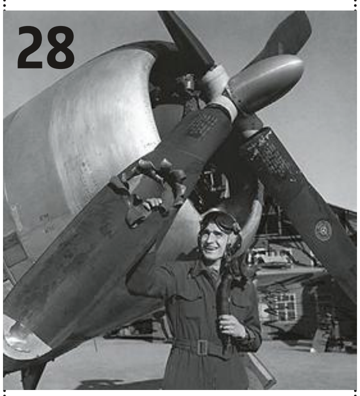

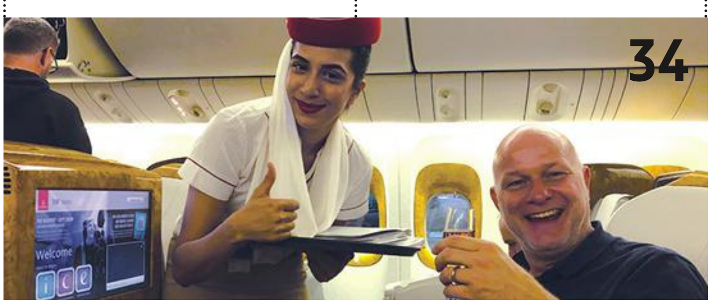

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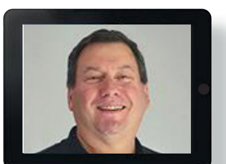

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A Year to Accelerate

> **"Our core remains strong,** thanks to **our commitment to invest** in top-notch editorial and data teams"

OUR INDUSTRY CONTINUES TO INNOVATE, EVOLVE AND expand globally. That's nothing new: The aviation, aerospace and defense world has been transforming itself and society since we started covering it more than 102 years ago.

But last year and 2019 will go down as an intensive era of change, growth and investment in our business. During the past 12 months, BCA and its partner brands within the Aviation Week Network have invested in talent, technology and our services portfolio to remain in step with accelerating demand for more and better content. Our team has grown by 78%, most of that in the Asia-Pacific region and other fast-growing aviation markets. More than half of the Aviation Week Network team is now based outside North America — a milestone we have long pursued. Here are a few highlights:

CAPA - Centre for Aviation recently joined the Aviation Week Network, significantly expanding our intelligence, data and event capabilities and providing a boost of talent, experience and customers in the Asia-Pacific region. We are honored to be working with founder Peter Harbison and Managing Director Derek Sadubin to support their team's growth and expand our global footprint together. The CAPA information and data memberships and global airline and corporate travel summits are incredible complements to services you can access from our fast-growing air transport portfolio.

Routes/ASM also joined our family, catapulting us into a leadership role in serving the needs of airline and airport executives with strategic and network planning events.

The Routes events team and ASM consultants join Air Transport World, Aviation Daily, Aviation Week & Space Technology, Inside MRO, and CAPA, combining to make our portfolio a powerful partner in enabling the expansion of airline services globally.

Big Data headlined our technology investments as we launched new real-time aircraft utilization, fleet analysis and forecasting. This added to an already robust set of aircraft, contract and content databases to serve the industry's insatiable hunger for more and better data to guide critical decision-making and drive growth.

You also will benefit from new offerings coming online throughout 2019:

All of our websites will be relaunched on a single, cutting-edge information and media platform, simplifying and integrating your ability to easily find the content you need. The Business Aviation, Aerospace, Air Transport, Defense & Space and MRO and communities will each have their own destination to find content and connect with products and services. We also are streamlining the log-in and customer-service experience—yes, we've been listening!

Aviation Week Intelligence Network (AWIN), the premium content and digital curator of all of our data, directory and intelligence resources, also will be relaunched, providing simple and robust dashboards tailored to your market sector and information preferences and featuring powerful new search tools.

New events are launching, including Urban Air Mobility (April 9-10, Atlanta), Aerospace and Defense M&A (Nov. 6, Beverly Hills) and TakeOff (Oct. 28-29, Orlando Sanford International Airport), a new network-planning event for regional airports.

Meanwhile, our core remains strong, thanks to our commitment to invest in top-notch editorial and data teams that lead coverage of the industry from bureaus all over the globe. We are dedicated to staying ahead of your need for high-quality, trusted and actionable information and connections. I believe these latest enhancements will carry forward Aviation Week's first century of momentum.

If I have piqued your curiosity about any of these new developments, please reach out with an email to me to find out more: **hamilton@aviationweek.com**

Here's to a successful 2019!

Greg Hamilton
President, Aviation Week Network

William Garvey
Editor-in-Chief
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Promising Alternatives

Different kinds **of go-juice**

WHILE THE EXTREME LEFT'S "GREEN NEW DEAL" IS A DEADMAN'S hand — high-speed rail to supplant all air travel; elimination of combustible engines; making all buildings energy efficient in a decade — its broad intent of protecting our environment is worthy. And focusing strictly on aviation, opportunities exist for reducing the carbon emissions produced in powered flight.

A Jan. 18 conference held at California's Van Nuys Airport (KVNY) brought intense focus on the subject of emissions as it pertains to business aviation, and specifically those operating aircraft that burn Jet-A.

ISTOCKPHOTO/LCHOLAKOV

First, some background. Given that a portion of the general public regards business aviation users as elitist and their flying of dubious legitimacy, it behooves the industry to avoid being regarded as polluters as well. To that end, in 2009, the General Aviation Manufacturers Association (GAMA), in partnership with the International Business Aviation Council (IBAC), set forth three industry goals for mitigating business aviation's environmental impact:

- Improving fuel efficiency by 2% per year from 2010 to 2020.
- Achieving carbon-neutral growth from 2020 onward.
- Halving carbon dioxide (CO_2) emissions by 2050 as compared to 2005.

Those sponsoring and supporting the gathering clearly were in agreement that — apart from developing ever more fuel-efficient engines — the key to meeting those ambitious targets is adoption of Sustainable Alternative Jet Fuel (SAJF).

SAJF is derived from a variety of things ranging from cooking oil and solid municipal waste to purpose-grown biomass and agricultural residues. An earlier survey of operators revealed that many were utterly opposed to putting such a fuel in their multi-million-dollar flying machines, and that reaction was part of the reason for the KVNY gathering.

Speaker after speaker emphasized that SAJF was 100% Jet-A, pure and simple. It is a "drop in" fuel requiring no alteration to aircraft, engines, storage or delivery systems. It's safe and has no impact on aircraft performance — though there's some evidence that it's even more efficient and cleaner than the fossil-based version.

Moreover, it can be produced continually without depleting any natural resource — *i.e.,* petroleum — and, taken through its full life-cycle of source production, refinement, delivery, use and the photosynthesis of its emissions, the total CO_2 produced can be reduced by 50% or more.

That SAJF is widely endorsed by business aviation leaders was underscored by their presence at the event. They included David Coleal, president of Bombardier Business Aircraft and chairman of GAMA's Environmental Committee, and Gary Dempsey, president of the National Air and Transportation Association, along with top executives from almost every jet builder, aviation advocacy group and fuel providers.

In addition to convincing skeptical operators of the fuel's benefits, the challenge is finding and affording SAJF. Both Gulfstream and Bombardier use it in their fleets, but they have to arrange shipping from a West Coast refiner. The event's organizers were worried that delivery of SAJF to the FBOs at KVNY might not arrive in time — it did, and Gulfstream, Bombardier and Embraer used it in conducting demonstration flights.

While KVNY is the first general aviation airport in the U.S. to offer SAJF on a trial basis, only one other airport in the country — Los Angeles International (LAX) — has a regular supply. That scarcity impacts price. According to a recent *Wall Street Journal* report, the per-gallon cost of "biofuel" for airlines ranges from $4.50-$8.50, as compared to $1.87 for traditional Jet-A.

According to GAMA President and CEO Pete Bunce, it is vitally important to build demand for SAJF since the fuel is "integral to achieving industry climate emissions goals."

As it happened there was another aviation leader in Van Nuys that day with quite a different approach to reducing aircraft emissions. George Bye was eager to provide a status update on the Sun Flyer 2, his eponymous company's electric-powered training aircraft project, which had attracted a major investment from the Subaru SBI Fund.

The aircraft, which on Feb. 12 flew with the Siemens 57-lb., 90-kW SP70D motor, promises to significantly impact the training market.

Priced at $349,000, it has a 3.5-hr. endurance and recharging rate of 20 min. per flying hour. It will be virtually silent, vibration free and emit no CO_2 at all. Moreover, its operating costs are expected to be a fraction of those of standard trainers. Unsurprisingly, Bye claims operators have placed orders for 226 units.

Bye hopes the Sun Flyer 2 will earn FAR Part 23 certification by the fourth quarter of 2020 — to be followed by the $449,000 Sun Flyer 4.

SAJF and electric power: two promising approaches to an environmental concern without having to ride a choo-choo. **BCA**

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NEWS / ANALYSIS / TRENDS / ISSUES

▶ **WITH THE BATTLE AGAINST ATC PRIVATIZATION BEHIND IT,** the NBAA is turning its attention to the industry's pressing shortage of pilots, mechanics and other professions. The need is immediate, NBAA President and CEO Ed Bolen said in a presentation during the NBAA Regional Forum in West Palm Beach, Florida, on Feb. 6. The issue will require bringing new people into the industry and it "means keeping the people we have." In its efforts to grow the workforce, the NBAA is taking lessons learned from its fight to turn back an attempt to privatize air traffic control, which included involvement at a grassroots effort, Bolen said.

The NBAA is focusing on attracting college students to make sure they are aware of the opportunities. Other organizations are targeting students in grade school, middle school and high school. Lee Aerospace in Wichita knows the need all too well. The company has had to turn down work because of a shortage of aircraft and powerplant mechanics, Malissa Nesmith, vice president of marketing, said during a break at the company's exhibit during the forum. "The only thing that's limiting our growth is not being able to find the talent fast enough," Nesmith said. It's not for lack of trying, she added. "There's so much demand for people right now." The NBAA is providing videos on the industry and other tools for use in the classroom and promoting internships, mentorships and best practices, Bolen said. **About 250 students were in attendance at the NBAA regional event, which attracted 150 exhibitors and 35 aircraft on static display.** Business aviation provides what young people are looking for: a chance to see the world, meet new people and do new things, Bolen said. It also meets their need to be involved with technology and with their desire to give back. "Business aviation gives young people an opportunity to experience life," Bolen said. "Our young people want to be part of a community. They want to belong. We can offer that."

▶ **CONCERNED THAT EXPLOSIVES CONCEALED INSIDE AN** unmanned aerial vehicle (UAV) could pose a danger to first responders attempting to find its registration number, the FAA now requires owners to display their registration number on an outside surface. The rule took effect on Feb. 23. When the requirement to register drones was introduced in 2015, the FAA allowed the number to be placed in an enclosed compartment accessible without using tools. This was because many small drones — particularly quadcopters — were considered too small to provide an external surface large enough for the registration number to be readably displayed. "Subsequently, law enforcement officials and the FAA's interagency security partners have expressed concerns about the risk a concealed explosive device might pose to first responders upon opening a compartment to find a drone's registration number," the agency said. The FAA "believes this action will enhance safety and security by allowing a person to view the unique identifier directly without handling the drone." — **Graham Warwick**

▶ **HONEYWELL AEROSPACE IS CLOSING ITS LONGTIME OFFICE** at Wichita Dwight D. Eisenhower National Airport and moving repair and overhaul operations from there 170 sm northeast to Olathe, Kansas. The move is to centralize operations and better serve customers, Honeywell said. The transition will take place by year-end. **The change affects about 175 of the 190 to 200 employees at the Wichita office,** a source said. Honeywell's office in Olathe also provides repair and overhaul services. Employees may apply for positions in Olathe, and Honeywell will offer severance and outplacement assistance to those who are eligible. Honeywell and its predecessors have operated repair services in Wichita for decades under Sperry, Bendix Aviation and Allied Signal.

Jet-A and Avgas Per-Gallon Fuel Prices
February 2019

Jet-A

Region	*High*	*Low*	*Average*
Eastern	$8.71	$4.44	$6.26
New England	$7.71	$3.86	$5.22
Great Lakes	$8.26	$3.86	$5.53
Central	$7.63	$3.47	$4.91
Southern	$8.21	$4.20	$6.02
Southwest	$6.76	$3.25	$5.24
NW Mountain	$7.79	$3.30	$5.27
Western Pacific	$8.19	$3.60	$5.89
Nationwide	**$7.91**	**$3.75**	**$5.54**

Avgas

Region	*High*	*Low*	*Average*
Eastern	$8.40	$4.55	$6.40
New England	$7.45	$4.40	$5.84
Great Lakes	$8.59	$4.69	$6.01
Central	$7.69	$4.31	$5.33
Southern	$8.19	$4.25	$6.11
Southwest	$6.99	$3.91	$5.50
NW Mountain	$8.46	$4.60	$5.78
Western Pacific	$8.52	$4.80	$6.21
Nationwide	**$8.04**	**$4.44**	**$5.90**

The tables above show results of a fuel price survey of U.S. fuel suppliers performed in February 2019. This survey was conducted by Aviation Research Group/U.S. and reflects prices reported from over 200 FBOs located within the 48 contiguous United States. Prices are full retail and include all taxes and fees.

For additional information, contact Aviation Research/U.S. Inc. at (513) 852-5110 or on the internet at www.aviationresearch.com

For the latest news and information, go to **aviationweek.com and bcadigital.com**

Bombardier Wins Global 7500 EASA Approval

Bombardier's Global 7500 has earned European Aviation Safety Agency (EASA) certification, which follows approvals from Transport Canada and the FAA. In addition, Bombardier has completed its acquisition of the Global 7500 wing program from Triumph Group. It will continue to operate the production line in Red Oak, Texas, with current employees supporting the program.

Leonardo Envisions AW609 Certification by Year-end

By year-end, Leonardo hopes that after a decade in the making its AW609 commercial tiltrotor will finally be awarded certification and go on to steal a lead in the expected market for high-speed rotorcraft. Further, the European manufacturer envisages a family of tiltrotor platforms from small unmanned systems to a 20-seater. Now, the company is gearing up for its Next Generation Commercial Tiltrotor Technology Demonstrator, which aims to further technologies that will help to develop and scale that lineup of tiltrotors.

DIAMOND AIRCRAFT GROUP PLANS TO DOUBLE aircraft production and increase its staff at its facilities in Austria and Canada in 2019 as demand increases, the company said recently. The news comes a year after Wanfeng Aviation Industry in China acquired Diamond Aircraft Industries in Austria, Diamond Aircraft in Canada and Austro Engine. "We do not see the takeover of Diamond just as an investment opportunity," said Liqun Zhang, Diamond Aircraft Austria CEO. "We are here for the long term and want to grow Diamond on its existing sites." He went on to say that Diamond's headquarters in Wiener Neustadt, Austria, has been named the global lead and technology center and will be developed further over the coming years. The Austrian manufacturing operation plans to increase production from 90 aircraft to almost 200 a year. This year it also will increase its staff there from more than 600 to 800 due to the production increase. And the company is also doubling production in its Canadian facilities in 2019 to 150 units. That facility, which employs more than 300, also plans to hire an additional 100 people in 2019.

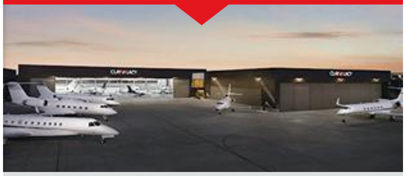
BRITISH UNMANNED AIRCRAFT DEVELOPER BLUE BEAR SYSTEMS Research has begun flights along a corridor established in the U.K. for beyond-visual-line-of-sight (BVLOS) testing in conjunction with Cranfield University. Blue Bear said it has performed so-called extended-visual-line-of-sight patterns within the Cranfield air traffic control zone as part of work to set up the National BVLOS Experimentation Corridor (NBEC) that the two organizations announced last August. The corridor is being established to test technologies that will enable unmanned aircraft to fly in non-segregated airspace. The aim is ultimately to extend the size of the NBEC, from Blue Bear's headquarters in Oakley, England, to the university-operated Cranfield Airport, about 12 sm away. Once established, the NBEC will be open to other companies and research organizations looking to test BVLOS UAVs and traffic management systems. Later, part of the corridor will be enabled with 5G mobile communications technology under a U.K. government testbed program. With future plans to enable the entire corridor, 5G is seen as an enabling technology for both unmanned air and ground vehicles. — **Tony Osborne**

THE EUROPEAN AVIATION SAFETY AGENCY has approved a Rolls-Royce request to transfer design authorization from Britain to Germany as a precaution against a possible no-deal Brexit. EASA documentation, published Jan. 16, details that the British aero-engine company made the request in June 2018, with EASA confirming that the documentation will be transferred to Germany by this month. Under the agreements, design approvals for all the company's U.K.-produced airliner engines will be transferred to Germany, including those for the RB211 family, as well as the Trent 500-1000 families. The engine manufacturer announced in 2018 that it was planning to carry out the transfer over concerns about a potential no-deal Brexit, which could see Britain fall out of the numerous European aerospace regulatory regimes, including EASA, when it leaves the EU on March 29. The company has called the move "precautionary and reversible." But many companies are accelerating costly contingency plans and moving assets out of the U.K. into Europe. Design approvals for Rolls-Royce's business jet engines were already held in Germany, largely as a result of its BMW Rolls-Royce joint venture that built the BR700 family of engines between 1990 and 2006, when BMW exited the partnership. — **Tony Osborne**

Boeing Makes 'Significant Investment' in Aerion

Boeing reports having made a "significant investment" in supersonic business-jet developer Aerion to accelerate development of its Mach 1.4 AS2. Terms of the deal were not disclosed. The Seattle planemaker is to provide engineering, manufacturing and flight test resources, as well as "strategic vertical content," to bring the 12-passenger AS2 to market, according to a company statement. The content is not specified but involves "capabilities from our vertical business."

Clay Lacy Opens 24/7 MRO Facility at Van Nuys



Clay Lacy Aviation has opened a new round-the-clock aircraft maintenance, repair and overhaul facility for its FAR Part 145 repair station at Van Nuys Airport (KVNY) outside Los Angeles. This facility provides light and heavy maintenance and repair services, avionics and cabin entertainment upgrades and installations, interior design, modifications and refurbishing, and 24/7 AOG support for the Southwestern U.S. The new operation employs more than 70 technicians, avionics experts, interior craftsmen and support specialists.

SIKORSKY HAS SIGNED AN AGREEMENT WITH ON-DEMAND helicopter service provider Blade that will give the Lockheed Martin company access to data on the urban air mobility (UAM) market. Under the agreement, Associated Aircraft Group (AAG), Sikorsky's private charter and fractional ownership subsidiary, will provide and operate a dedicated S-76C+ helicopter for New York-based Blade, which will also have access to AAG's fleet of S-76s in the Northeast U.S. "Additionally, the agreement establishes a working group to explore how AAG can leverage Blade's consumer, cockpit and operator technology platform," according to a Sikorsky statement. Blade enables customers to use a mobile app to book a seat, charter an aircraft or crowdsource a complete flight from heliports in Manhattan. Most trips are corporate flights to New York-area airports. Others are to corporate campuses in Connecticut, as well as longer flights to Boston, Philadelphia and Washington, says Will Heyburn, Blade's head of corporate development. Blade works with FAR Part 135-licensed helicopter operators. The agreement with Sikorsky is different, says Heyburn. "Lockheed Martin and Sikorsky want to study urban air mobility, and we are the only people in the U.S. doing it today. We fly the exact routes future UAM vehicles will fly, so they can learn the use cases," he says. "We will share all the data and they will use the insights to plan future vehicles." — **Graham Warwick**

ACCORDING TO THE HEAD OF EMBRAER'S EXECUTIVE AIRCRAFT division, a potential partnership between Embraer and Boeing would, if approved, benefit his division, which would then become Embraer's largest. For Embraer's business jet segment, the partnership would mean a stronger supply chain, a larger capital stream, investment opportunities and more "synergies," Michael Amalfitano, president and CEO of Embraer Executive Jets, said during the Feb. 6 NBAA Regional Forum in West Palm Beach, Florida. "It's all upside." Shareholders were to vote Feb. 26 on whether to approve the deal, which is also subject to regulatory approvals. Under the proposed partnership, Boeing would purchase 80% of Embraer's commercial business and set up a separate joint venture to sell KC-390s. The two firms unveiled their plans in July 2018. The deal is expected to close by the end of 2019.

THE INTRODUCTION OF THE SINGLE-ENGINE CIRRUS SF50 Vision Jet has prompted the FAA to propose a change in regulations associated with obtaining an initial transport pilot (ATP) certificate. **A proposed rule removes what the FAA calls an "unnecessary multiengine training requirement" for pilots seeking an initial ATP concurrently with a single-engine airplane type rating.** Current regs require pilots to complete training in an FAA-approved course that includes ground and flight simulator training in a device that represents a multiengine aircraft. "Because of the way the regulations are written, the requirement for training in a multiengine airplane has the unintended effect of applying to a pilot seeking a type rating for a single-engine airplane concurrently with an ATP certificate," the FAA said in an NPRM published in the *Federal Register.* "When the training requirement became effective in 2014, there were no single-engine airplanes that required the pilot to obtain a type rating prior to serving as pilot in command." However, the certification of the Vision Jet in 2016 changed that. The proposed revision does not impact pilots of multiengine aircraft. The FAA argues that safety would not be reduced because a pilot would still be required to obtain training and testing appropriate to a single-engine type rating.

THE NTSB RELEASED ITS BIENNIAL "MOST WANTED LIST" of safety improvements on Feb. 4 and among them was a recommendation to hold FAR Part 135 air charter, air medial and other operations to the same requirements that apply to scheduled airlines. It said all such operators should implement a safety management system (SMS), something the FAA has required of airlines operating under Part 121 since 2018. The board also called on Part 135 operators to implement flight-data monitoring (FDM) of their operations to identify and correct deviations from company procedures and train pilots to avoid controlled flight into terrain (CFIT). Such training is required for Part 135 helicopter operations but not for fixed-wing operations. "A number of Part 135 operators do operate with a high level of safety, NTSB Chairman Robert Sumwalt said. "But we have investigated crashes that have killed people — paying passengers and crewmembers — and as a result of those investigations we have found that there are ways that Part 135 operators could improve. We feel that paying passengers should have the same levels of safety they would [have] if they were to get on a commercial airline." NTSB preliminary aviation statistics from 2017 show 51 total accidents involving Part 135 commuter and on-demand carriers, with eight fatal accidents and 16 fatalities. The Safety Board reported 38 accidents involving Part 135 operators in 2016, nine of which were fatal, involving 27 overall fatalities. — **Bill Carey**

OWNERS AND PILOTS OF TWO DAHER TBM TURBOPROPS recently completed milestone, 2,700-nm flights over the South Pole, marking the first legs in earning the Polar Diamond Circumnavigator Diploma bestowed by the Fédération Aéronautique Internationale. The recognition has been awarded only once. One of the pilots, Sebastian Diaz from Santiago, Chile, flew his TBM 850 with his father, 88-year-old Patricio, a licensed pilot, and his son, Sebastian Jr., who served as copilots. The other TBM owner, Dierk Reuter from Chicago, flew with his son, Alex, on his TBM 930. The two aircraft left Jan. 1 from Punta Arenas in Chile and overnighted at Teniente Rodolfo Marsh Martin Airport on King George Island, before reaching the South Pole the following day and making the return journey.

ACCORDING TO *GLOBES*, AN ISRAELI BUSINESS NEWS periodical, the board of government-owned Israel Aerospace Industries (IAI) has approved the development of an advanced model of Gulfstream Aerospace's G280 super-midsize business jet, which it manufactures under license. It said IAI will invest $80 million in the jet and Gulfstream will invest a matching amount. As previously reported by *The Weekly of Business Aviation,* IAI's plan to manufacture various types or new versions of its current products is part of the company's strategy to increase the sales of its business jet manufacturing department, part of IAI's new aviation group. The group, which started operations in January, intends to accelerate the company's effort to become a partner on the design and production of a new business jet along with other initiatives. **The general agreement with Gulfstream is part of Gulfstream's effort to keep the G280 production line in operation.** Gulfstream launched the G280 in 2008. Deliveries began in 2012. To date, the company has manufactured 166 G280s, including airframes currently being completed for customers, according to the Aviation Week Network.

Bell 407GXi Earns China Approval

The Bell 407GXi light single helicopter has received type certification from the Civil Aviation Administration of China. The aircraft is equipped with a Garmin G1000H NXi integrated flight deck and a dual-channel FADEC Rolls-Royce M250-C47E/4 turboshaft engine. Deliveries to Chinese customers were to begin right after the lunar new year on Feb. 5. The aircraft received FAA certification in October.

FAA Issues Waiver to State Farm to Fly BVLOS Drones

State Farm has received a long-term FAA waiver to fly drones beyond the operator's visual line of sight (BVLOS) and over people, activities the agency currently restricts. In January, the insurance company announced what it called the first such national waiver to operate drones for damage-assessment flights after natural disasters through November 2022. Previous waivers the company received were temporary authorizations to fly drones BVLOS and over people following Hurricanes Florence and Michael last fall.

JETEX FLIGHT SUPPORT IS ONE OF THE WORLD'S fastest-growing FBO chains with 29 facilities worldwide and more to come, but its Jetex Dubai facility remains its showpiece. The FBO was opened adjacent to Al Maktoum International Airport in the United Arab Emirates in 2017 and provides the expected services, from flight planning to NOTAMs, weather briefings, fuel and ground handling. However, Jetex Dubai also goes well beyond the expected. The 16,145-sq.-ft. facility, with 538,195 sq. ft. of ramp parking, is located in the VIP terminal. Amenities range from Rolls-Royce flight-line pickup for guests to private dining areas, shower facilities and a lavish cigar lounge. And on more the personal side, attentive hospitality teams escort passengers to the lounge upon arrival. There, dedicated customs and immigration officers ensure formalities are taken care of, "typically in 10 min. or less." The FBO's interior features a new biophilic design reflecting nature. The result is a tranquil, organic environment in which three, free-standing wooden structures beckon the tired traveler to cocoons where they can recline and relax. Minimalist indoor landscaping and natural light blend with flower beds and trees to invoke an ambience akin to that of a Japanese Zen garden. **The innovative interior design of Jetex Dubai encourages exploration,** creating a sense of discovery and wonder for guests, explained Jetex CEO and President Adel Mardini. "These are emotions evoked by travel; emotions that we wish to encourage by making each stage of the passenger journey as smooth and enjoyable as possible." Among the more remarkable amenities at Jetex Dubai are two EnergyPods from MetroNaps of Edgewood, New York. In a quiet room, they offer a partially enclosed, zero-gravity mini-chamber that features music and quiet vibration, and encourages 15 to 20 min. of sleep in semi-privacy. According to MetroNaps, the concept was developed around research indicating that that a 20-min. nap is beneficial for well-being as well as productivity. Jetex was selected as the official FBO of the 2017 Dubai Airshow and the same year was crowned FBO of the Year at the annual Aviation Business Awards ceremonies. **In 2018, it served as the official FBO for the Middle East & North African Business Aviation Association (MEBAA) air show** in Dubai. Jetex is also the only FBO within the Middle East/North Africa region to hold IS-BAH Stage 2 and Safety 1st certification from the International Business Aviation Council and the National Airport Transport Association. Jetex continues to expand and, according to Mardini, the company plans to open its 50th facility in 2020.— **Kirby Harrison**

ORLANDO-MELBOURNE INTERNATIONAL AIRPORT OFFICIALS in Melbourne, Florida, are seeking developers to build an upscale hotel with airfield access. The airport has experienced an increase in air service and major corporate tenants, spurring a need for meeting and lodging space, it said. It will be among only a handful of airport fly-in hotels in the nation. The hotel must also partner with an FBO at the airport. The Melbourne Airport Authority has set aside 12.45 acres with coastal water views for the project. Four airlines serve the Melbourne Airport, including Delta Air Lines, American Airlines, Porter Airlines and Elite Airways. Monthly passenger counts at the airport increased by double-digit percentages in the fourth quarter of 2018, closing out the calendar year at 489,240, the highest in a decade. Airport operations grew 26.5% last year. The trend is expected to continue, the airport said. More than 1,000 employees work in the aerospace industry around the airfield. Proposals must be received by 2 p.m., March 15.

Avfuel Brands FBO in Turks and Caicos

Avfuel has added Blue Heron Aviation in the Turks and Caicos Islands to its network of independent FBOs. Blue Heron features a state-of-the-art, 7,000-sq.-ft. building built in a contemporary design and 12 acres of paved aircraft parking able to accommodate up to a Boeing 757-200. Its services include in-house customs and immigration, concierge services, aircraft cabin cleaning, catering, coffee and ice, foreign newspapers, dishes, laundry, a luxury lounge and conference room. Blue Heron opened in 2014.

Lynx FBO Network Acquires Fort Lauderdale FBO

Lynx FBO Network has acquired the FBO assets of World Jet Inc. at Fort Lauderdale Executive Airport (KFXE) in Florida. The acquisition will mark Lynx's seventh FBO location. "We see this expansion into the Florida market, and in particular South Florida, as an integral part of our growing network of FBOs," said Lynx President and partner Chad Farischon. Lynx will be making significant investments in the newly acquired facility, including a refresh of the facility grounds and the design and development of a new FBO terminal.

Leslie Weinstein

Manager, True-Lock Aviation Fasteners, Boise, Idaho; and Founder, Turtles Fly Too (turtlesflytoo.org)

A Florida native who has overseen businesses ranging from ranching and real estate to engineering, Weinstein launched True-Lock in 1997 to correct military bolt failures. As it happened, the same technological logic worked on airplane landing gears as well, and after much back-and-forthing with aircraft manufacturers and the FAA, the company was awarded supplemental type certificates (STCs) for its after-market wheel fastener systems on a wide variety of general aviation aircraft. And although he never progressed beyond soloing as a student pilot and now lives a long way from any ocean, Weinstein is equally passionate about aviation and the welfare of sea turtles. Yes, turtles.

TAP HERE in the digital edition of ***BCA*** to hear more from this Interview or go to **aviationweek.com/fastfive**

Questions for Leslie Weinstein

1

Yours is an unusual resume. Can you explain?

Weinstein: Many things hold my interest and as a result, I've pursued a variety of businesses, all of which were pretty successful. During the Gulf War the Abrams M1 tank was key to the coalition's success. However, I learned that the bolts on its track system were failing and either keeping tanks out of action or exposing their crews to enemy action. Well, I had been on the SAE task force that developed standards for axle/spindle bolts for commercial trucks and buses and thought there had to be a mechanical answer and that I might come up with a solution. And I did. That was the start of True-Lock.

2

Tanks and airplanes are way different things. How did True-Lock get into aviation?

Weinstein: Later, I was going into a coffee shop in Boise, Idaho, looked up and saw Ed Stimpson, the former head of the General Aviation Manufacturers Association, sitting there. I was caught completely by surprise; I'd no idea he lived there. I knew him from childhood; my father, Nathan "Sonny" Weinstein, had done legal work for Ed and they both were involved with Embry-Riddle. Well, we got to talking and that afternoon I was in Ed's house spreading some of my True-Lock parts on his kitchen table. I asked if he thought there might be aviation applications, but he was skeptical, saying the manufacturers almost never changed their ways. Well, I got a call from an aircraft ski manufacturer that wanted our technology and we were on our way. Ed called to congratulate me. Since then we've been awarded 1,500 STCs.

3

Now, about those turtles . . .

Weinstein: I grew up on the Atlantic coast near St. Augustine. As a kid, I was fascinated by the female turtles that crawled ashore at night to dig and build nests on the beach and lay their eggs. I remember lying on the beach beside one of the turtles, stretching out my arms, and realizing the sea creature was bigger than me. To protect those eggs, I started digging them up and moving them to a seaside property owned by my father, burying them there and protecting the new site with chicken wire. I figure I've been stepfather to thousands of hatchlings. And as adults those turtles return to that spot year after year to lay their own eggs. Because of this commitment, my wife and I donated the $2 million property for turtle conservation and study that has become the first sea turtle conservation easement.

4

How's that connected to aviation?

Weinstein: Because of True-Lock, I know a lot of aircraft operators. Because of my land donation, the sea turtle world knows me. One day I got a call from a sea turtle vet who said the number of turtles cold stunned by a sudden drop in water temperature had overwhelmed the New England Aquarium and they needed to be transported immediately to rehab facilities in the south. Could I help? I started calling operators and soon had a fleet of light aircraft collecting the turtles in banana boxes with heat pads and flying south. That time they transported a total of 600 turtles.

5

And that continues?

Weinstein: Absolutely. Our volunteer, 501(c)(3) non-profit organization, Turtles Fly Too, both transports turtles and educates the public about these unique animals. We conduct about 15 to 20 flight missions per year. So, the little sea turtle, an endangered species, and general aviation, another endangered species, have come together to rescue each other. That's the way I see it. BCA

Richard N. Aarons
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Deviations from SOPs

An approach **under known icing conditions** leaves an Embraer business jet seriously damaged

BY **RICHARD N. AARONS** bcasafety@gmail.com

BFU

A Belgium-registered Embraer EMB-500 business jet was severely damaged when it stalled during the flare phase of a final approach to Runway 07L at Berlin-Schönefeld Airport (EDDB), impacted the ground and came to a stop at the right edge of the runway. The two pilots and the passenger were uninjured, but the accident brought attention again to the EMB-500's deice system and pilot training. The causes of the accident, according to German air safety investigators, were:

The crew conducted the approach under known icing conditions and did not activate the wing and horizontal stabilizer deice system, which was contrary to the Standard Operating Procedures (SOPs).

The accident was investigated by Germany's Bundesstelle fur Flugunfalluntersuchung (BFU) — the German Federal Bureau of Aircraft Accident Investigation. The cause, said the BFU, was "ice accretion on wings and horizontal stabilizer and infringement of the required approach speed . . . the aircraft entered an abnormal flight attitude during the flare phase and crashed."

A major contributing factor was the crew's "insufficient knowledge of the connection between the ice protection system and the stall warning protection system (SWPS)."

The chartered EMB-500 departed from Kortrijk-Wevelgem Airport (EBKT), Belgium, at 0738 hr. on an IFR flight plan to Berlin-Schönefeld with three souls on board — the pilot in command (PIC), the copilot and one passenger. The copilot was the pilot flying (PF) and the PIC was the pilot monitoring (PM).

Prior to engine start, the pilots had checked the SWPS and determined its proper function. Taxi, takeoff and initial climb were normal. At 0742, while climbing through FL 070, the crew activated engine anti-ice systems on both engines for 46 sec. Forty seconds later, the pilots activated the autopilot. By 0813, the airplane was cruising at FL 390.

The PIC tried several times to obtain ATIS for the destination airport on the appropriate frequency after 0823 without success, until 0833 when the flight was ready to descend (TOD) 140 nm from Schönefeld.

Two minutes later, the PIC explained to the copilot that he assumed Runway 25R would probably be in use at Schönefeld.

At 0840, ATC cleared the flight for the RUDAK 5S arrival to Runway 07L. The pilots began to set up the navigation system for the approach. At about 0842, when the flight was 76 nm from destination, the PIC started to listen to ATIS but was interrupted by ATC communications and a frequency change. At 0843:36, the Bremen Radar controller said: "Bremen identified. Hello, proceed direct 12 mi. final for runway zero seven left Schönefeld."

The copilot called for the descent checklist while the airplane was descending through FL 200. The PIC asked her to wait while he listened to ATIS Information Z and made notes. The ATIS recording noted moderate icing reported below 3,000 ft. The PIC made handwritten entries to the operational flight plan for the ATIS weather data and for the approach at a final segment speed (Vfs) of 130 kt. and a landing reference speed (Vref) of 96 kt. According to the CVDR data at that time the OAT was about -18C.

The PIC then gave the copilot the following information: cloud base, 1,400 ft.; visibility, 4,800 meters in mist; and barometric air pressure (QNH), 1,018 hPa. At 0847, the pilots conducted a 2-min. approach briefing including details of the approach and go-around procedures.

At 0850:12, while the airplane was descending through FL 097, the copilot asked again, "Descent checklist?" The PIC answered, "Stand by." Approximately half a minute later the controller cleared the flight to "descend altitude 4,000 ft. on QNH one zero one eight." This was acknowledged. Subsequently, the pilots completed the checklist. The PIC said: "Landing speeds?" The copilot answered with the words: "Set by me." The PIC asked: "Icing conditions?" the copilot answered: "Negative, no visible moisture."

At 0851:12, the PIC added: "Below 10,000. The signs are on and temperature is not negative. I am going to wait

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a little with the anti-ice." At that time the CVDR recorded an OAT of -1C. At 0853:58, the crew extended the flaps to Position 1.

At 0854:11, the controller instructed the crew to fly a heading of 050 deg., and cleared it to descend to 3,000 ft. and to fly the ILS Yankee approach for Runway 07L. The PIC requested the copilot to "keep some speed because ATC won't like it if you will slow down everything behind us."

At 0855, the aircraft intercepted the extended Runway 07L centerline at 3,000 ft., some 13 nm from the threshold. The controller radioed the crew: "Maintain speed at 170 kt. or greater to 4 mi. final," and the PIC answered, "Actually we have 175, madam, and we will maintain it until 4 mi. final." Then the PIC said to the copilot, "You see, they don't like that, you slow down everyone behind us." He added, "I'm going to set 175 if you agree." The copilot answered in the affirmative. Then the PIC selected a speed of 175 kt. on the automatic flight control system (AFCS).

At 0855:32, the PIC activated both engine anti-ice systems saying, "Yes, adding the engines because it is negative again, they have said it, moderate icing below 3,000." According to the CVDR, OAT was about -1.5C. The selection on the AFCS was reduced to 170 KIAS. At that time the aircraft was at 3,000 ft. AMSL at the top of a cloud layer. At 0857:05, the copilot said: "on the glide, gear down," then the landing gear was extended, and the airplane descended into the clouds.

At 0857:25, the controller said: "wind one zero zero degrees, 4 kt., now zero niner zero degrees 7 kt., runway zero seven left, cleared to land. Vacate the runway to the right." The PIC answered: "Cleared to land and we will vacate to the right. . . ."

At 0857:41, as the airplane was at about 2,250 ft., the copilot asked: "Can I go to 130?" The PIC answered: "You must remain at 170 until 4 mi. Then you still have enough time to position the flaps. No problem." (According to the CVDR, between 0853 and 0858, the PIC had requested the copilot to keep high speed nine times.) Subsequently, the PIC began to complete the approach checklist with the items "external lights," "fuel crossfeed" and "altimeter setting." At the checklist item "icing conditions?" the PIC said, "It is still on."

At 0858:30, when the airplane was about 4 nm from the runway threshold, the PIC said to the copilot: "OK, OK, you can start to reduce now." At that time the aircraft descended through 1,470 ft. above the airport level (AAL) and began slow down. Five seconds later the PIC added: "slightly ground contact."

At 0858:44, the copilot said: "Ahm, 4 nm, flaps two." Speed was 163 KIAS. The PIC acknowledged the instruction and extended the flaps to Position two. Eleven seconds later the copilot said: "Autopilot disconnect." The autopilot was disengaged and then the PIC said: "OK, that can be set off, runway in sight, everything can be set off." Afterward, engine anti-ice systems 1 and 2 and windshield anti-ice systems 1 and 2 were shut off. The airplane was at 1,000 ft. AAL at 151 KIAS.


BFU

The ice accretion was about 4 cm wide and had a milky, rough, crystalline appearance and a slightly concave form.

At 0859:13, the copilot asked the PIC to fully extend the flaps: "Can you set it to 4F please?" The airplane was at 800 ft. AAL. At the same time, the copilot set the speed on the AFCS to 96 KIAS. At 0859:29, the flaps were fully extended, altitude was approximately 640 ft. AAL, and speed was falling through 121 KIAS. Fifteen seconds later, the CVDR recorded the synthetic announcement "500." Speed was about 114 KIAS and remained at that level for the next 30 sec. The PIC said: "Landing checklist: Yaw damper is . . . gear down three greens, flaps are full, landing clearance update." Then he radioed the controller: "Just to confirm cleared to land?" During this radio transmission, at an altitude of about 250 ft. AAL, speed began to decrease again.

At 0900:17, the synthetic announcement "Minimums, minimums" was recorded. Immediately afterward, the PIC radioed the controller again: "Just to confirm cleared to land?" This was acknowledged as the airplane passed 162 ft. AAL with at a speed of 106 KIAS.

At 0900:24, at a speed of 102 KIAS, pitch attitude was increasing through 0 deg. The recorded glideslope deviation showed the airplane had begun to deviate downward. The speed decreased during the following 9 sec. to about 90 KIAS, and the pitch angle increased to about 6 deg. nose-up. The recorded angle of attack (AOA) on the left sensor had increased to 17.2 deg. and the one on the right to 15.8 deg. At about 0900:33, at approximately 30 ft. AAL, the airplane began to roll left and, within 2 sec., reached a bank angle of 30 deg., and normal acceleration decreased from approximately 1 G to approximately 0.8 G. At the beginning of the roll, the CVDR recorded the exclamation "Oh, oh" of both pilots and 2 sec. later impact noises. Then the CVDR recording ended.

The pilots stated later that the left wing had suddenly dropped and touched the runway during the flare as the aircraft crossed the threshold. Subsequently, the airplane rolled right, the right main landing gear hit hard and collapsed, and the aircraft slid along the runway toward the right runway edge where it came to a stop 447 meters from the threshold beyond the right runway edge marking but still on the asphalt area. There was no fire. The occupants evacuated safely without injury, but the aircraft was substantially damaged.

The outer 2 meters of the left wing were bent upward by about 10 deg. The lower surface of the wing, the left aileron and the outer rear end of the left flap showed scratch marks and deformations. The right flap was deformed. The right main landing gear had fractured and folded back. Parts of the landing gear had penetrated the upper surface of the wing. The wheel of the right main landing gear was destroyed. About 20% of the wheel rim and parts of the flap track and carriage had been abraded.

Representatives of the local aviation supervision office arrived at the site a few minutes after the accident and photographed an ice accretion of up to 10 mm at the nose, the entire length of both wing leading edges, the leading edges of the horizontal stabilizer, and the front end of the landing gear components. Three hours after the accident the ice accretion was still visible. (See photo)

The ice accretion was about 4 cm wide and had a milky, rough, crystalline appearance and a slightly concave form with strongly developed feathering at the upper and lower edges. In addition, the upper and lower surfaces of the two wings showed a lamellar ice accretion. There was no ice accretion on the left wing, where the impact had caused a bend.

The Crew

The 48-year-old PIC held a Commercial Pilot License (CPL-A) initially issued by the Belgian Civil Aviation Authority (BCAA) and valid for single-engine-piston land and the EMB-500. He held an instrument rating along with flight and class instructor ratings. His Class 1 medical certificate was up to date.

The PIC had a total flying experience of approximately 4,500 hr., of which 800 hr. were flown in type. He had conducted about 400 landings in type, 30 of which were in the last 90 days. Prior to reporting for duty on the accident day, he had a rest period of more than 36 hr.

The 22-year-old copilot held a Commercial Pilot License with ratings for multiengine and single-engine land and the EMB-500. Her Class 1 medical certificate was valid. She had a total flying experience of about 260 hr., 32 hr. of which were in type. Within the last 90 days she had conducted 22 flights. In the last 30 days she had flown 29 hr. She had conducted about 20 landings in type, all of them within the last 90 days. Prior to reporting for duty she had a rest period of 14 days.

Investigation and Analysis

BFU investigators photographed the ice accretion on the wing along with the pilot's view of that wing from the cockpit. The also reviewed the data from the central maintenance computer (CMC) that included crew alerting system (CAS) and maintenance messages of the accident flight and the function and time of activation and d-activation of the wing and horizontal stabilizer deice systems.

The recorded data confirmed that about 16 sec. prior to impact the pitch angle began to increase, speed continued to decrease and the airplane dipped below the ILS glideslope. Approximately 2 sec. prior to impact, the airplane suddenly rolled left at approximately 15 deg. per second.

"The sudden roll movement with subsequent loss of altitude at an AOA where normally the aircraft should still fly is characteristic for stall behavior with icy aircraft structure [rime]," said the BFU. The leading edges of the wings and horizontal stabilizer and all other fronts of the aircraft showed ice accretion. The documented ice accretion showed characteristics of rime and clear ice. "Rime and the double horn structure of the ice accretion influence the aerodynamic characteristics of a profile very strongly," said the BFU. Lamellar ice accretion on the upper and lower surfaces of the wings (runback ice) consisted of a mixture of rime and clear ice.

The investigation revealed no indications of malfunctions of the ice protection system, the SWPS or any other technical irregularities of the aircraft.

"Due to the low altitude, the flat impact angle and the relatively low speed the occupants remained uninjured," said the BFU. "Only the aircraft was damaged."

The BFU examined the pilot actions and found them wanting. Here's the BFU discussion:

In the 10 min. of cruise flight prior to reaching the TOD, the crew had tried several times in vain to listen to destination ATIS but did pick up the information prior to descent.

The CVDR recordings and the handwritten notes of the PIC prove unambiguously that by listening to ATIS (late in descent) he had been informed about the weather conditions during the approach and at the destination airport. Still, during the preparation of the aircraft for the approach, VAC, VFS and VREF values were set on the FMS, which did not take into consideration the reported icing conditions in the vicinity of the airport. During completion of the descent checklist the PIC asked, "Landing speeds?" The copilot answered, "Set by me" without explicitly stating the speed values. The PIC did not ask either. The copilot's answer "negative, no visible moisture" to the PIC's question regarding icing conditions shows that the pilots checked in this phase.

At 0855, the flight arrived at 3,000 ft., the initial altitude for the ILS approach, and the crew received the instruction to keep speed at least 170 kt. or higher. The PIC accepted the high speed and selected 175 kt. on the AFCS. In general, with an aircraft of this type it is possible to reduce speed by 10-20 kt. per nm during the approach. In this case the excess speed was reduced by approximately 17 kt. per nm. The acceptance of the high speed resulted in a late landing configuration and also in an increased pilot workload during the final approach phase. The requested value of at least 170 KIAS at a distance of 4 nm to the threshold was above the requirements in the company's operating manual (OM) for a stabilized approach. "The BFU is of the opinion that the PIC, who had listened to the traffic situation via radio, wanted to fulfill the wish of ATC. It is highly likely that he was convinced that, contrary to the stipulations in the OM, landing with increased approach speed would be successful."

The PIC stated that he had switched on the engine and windshield anti-ice systems when the aircraft had entered the clouds from above. His words (to the copilot), "Yes, adding the engines because it is negative again, they have said it, moderate icing below 3,000," prove that he had monitored the temperature indication on the PFD and was aware of the prevailing icing conditions. Even though the conditions (temperature below 5C and visible moisture) were met, the PIC did not switch on the wing and horizontal stabilizer deice system.

Approximately 2 min. prior to the accident at about 2,000 ft., the PIC started to complete the approach checklist. The SOP stipulated that this checklist be completed at the beginning of the approach, when the altimeters are set to QNH. "The BFU is of the opinion that it is highly likely that the PIC's remark "it is still on" when completing the item 'icing conditions' refers to the still engaged engine anti-ice systems 1 and 2."

The recorded conversations of the pilots and the flight data show that about 2 min. prior to the accident, at a distance of about 4 nm to the runway, speed was reduced in order to configure the airplane for landing. In this phase the copilot disengaged the autopilot.

The PIC stated that as the airplane was descending through the clouds, he had visually checked for ice accretion on the outer third of the left wing that could be seen from position. He said he had not seen any ice. However, said the BFU, it is not plausible that the ice accretion determined during the investigation appeared only after leaving the clouds. The PIC's statement that he had conducted a visual check of the left wing cannot be confirmed with the CVDR recording of this flight phase. "The BFU is of the opinion that with only a fleeting look at the wing it is possible that he could have overlooked the milky-white ice accretion on the silver-gray deice boots. It cannot be ruled out that he did not take a look at all. The recorded data show that the engine anti-ice system was switched off."

Approximately one and a half minutes prior to the accident, at a speed of 134 KIAS, the copilot asked the PIC to fully extend the flaps and selected a VREF of 96 KIAS. Once the flaps had fully extended, the altitude was about 640 ft. AAL.

"It is highly likely that, triggered by the synthetic announcement [500] at 0859:44, the PIC realized that immediately prior to landing not all checklists had been completed and said: 'Landing checklist: Yaw damper is . . . gear down three greens, flaps are full, landing clearance update."" He asked via radio about the landing clearance, even though it had been issued about 3 min. earlier. "The BFU is of the opinion that the reason for it was very likely that the PIC had forgotten the landing clearance due to the many tasks that still had to be coped with prior to landing. During the PIC's radio transmission with the controller, at an altitude of about 250 ft. AAL, the copilot reduced the speed of the aircraft further."

When, at an altitude of 200 ft., the synthetic announcement "Minimums, minimums" sounded, the PIC was still in communication with the controller regarding the landing clearance.

About 15 sec. prior to the accident, at approximately 150 ft. AGL, the copilot began to flare the airplane and continuously increased the AOA. In this phase the airplane began to deviate downward from the ILS glideslope. Neither of the two pilots mentioned this. The copilot was looking out the window and concentrated on reducing the speed to the value intended for overflying the threshold. "The BFU is of the opinion that this shows that the PIC concentrated on the communication with the controller and was distracted from monitoring the copilot."

The airspeed then dropped below the VMC for icing conditions, stipulated in the AFM, and below the VREF the pilots had selected.

Aerodynamic stall resulted from the continuously increasing AOA. Up until the impact, the sudden roll movement and the descent could no longer be recovered.

Based on visibility and the altitude of the cloud base, IMC prevailed within the control zone. The upper limit of the cloud cover was at approximately 3,000 ft. MSL and the cloud base at 1,400 ft. AAL. For about 3 min. the airplane had been in this cloud layer. During this time period distinct ice accretion had formed at the leading edges of both wings and the horizontal stabilizer and the fronts of other components.

The controller's instruction to maintain speeds of more than 170 kt. up to 4 nm prior to touchdown should ensure traffic flow and separation between the different aircraft. However, due to the PIC accepting the speed instruction of the controller, configuration for landing occurred very late.

"The BFU is of the opinion that the CVDR recording indicates that the work relationship between the very experienced PIC and the copilot, who was at the beginning of her flying career, resembled more a relationship between flight instructor and student pilot. The recordings also show that the copilot had been highly stressed during the approach, especially during

Accidents in Brief

Compiled by Jessica A. Salerno

Selected accidents and incidents in January 2019. The following NTSB information is preliminary.

▶ **January 29 — About 1330 central** standard time, a Cessna 172S (N565SP) and a second Cessna 172S (N52243) collided in midair about 6 mi. south of the Grand Prairie Municipal Airport (GPM), Grand Prairie, Texas. Both airplanes sustained heavy damage. The flight instructor and student pilot onboard each airplane were not injured. The first airplane, N565SP, was registered to LLP Leasing Group, LLC, and the second airplane, N52243, was registered to Skymates, Inc. Both airplanes were operated by Skymates Flight Academy as FAR Part 91 instructional flights. It was VFR and neither flight was operated on a flight plan. The local flights both originated from GPM about 1230. The flight instructor of N565SP reported that they were returning to GPM after practicing takeoff and landings at Mid-Way Regional Airport (JWY), Midlothian, Texas. He recalled noticing the other airplane in his peripheral vision approaching from the left immediately before the collision. He did not have time to react to avoid the collision. He was able to maintain control of the airplane and subsequently landed at GPM without further damage to the airplane. The airplane sustained damage to the left wing, aileron and flap.

The flight instructor of N52243 reported that they were returning to GPM from the practice area south of Joe Pool Lake when he saw an airplane on the right. He did not have time to avoid the collision, estimating the impact occurred within one second of observing the airplane. He immediately reduced engine power and entered a descending left turn. He maintained control of the airplane and continued to GPM, subsequently landing without further damage. The airplane sustained damage to the right wing and right side of the engine cowling and windshield.

▶ **January 27 — At 1634 CST a Beech** A36 (N36PS) lost engine power during a practice instrument approach to Fort Worth Meacham International Airport (FTW), Fort Worth, Texas. The airline transport certificated pilot made an off-airport forced landing in a field 5 mi. southeast of FTW. The pilot sustained minor injuries, and the passenger was seriously injured. The airplane sustained substantial damage to the forward portion of the fuselage. The Beech was registered to and operated by the pilot. VFR conditions were reported at the airport about the time of the accident, and no flight plan had been filed for the flight that originated from Angel Fire, New Mexico (AXX) and was destined for Arlington Municipal Airport (GKY), Arlington, Texas.

The FAA inspector who responded to the site reported sumping clear, bright fuel from the airplane that was free of contaminants. The fuel gauges indicated slightly more than 1/4 in the left fuel tank; the right tank was empty. This was confirmed by visual inspection of the tanks. The fuel selector was positioned on the left tank. The pilot told the inspector the part where she flew the airplane manually."

According to the company's operating manual, ATIS should be obtained well before reaching TOD and the approach briefing should be conducted. In this case the pilots could not obtain ATIS of Berlin-Schönefeld Airport before leaving cruise level. The reason is that the airplane was well outside the designated operational coverage of the ATIS frequency (60 nm at FL 200). The reception of ATIS was delayed even further due to the necessary radio transmission with air traffic services, which the PIC conducted without involving the copilot. These factors resulted in the approach briefing being conducted considerably later than stipulated.

Prior to the approach briefing, the PIC had informed the copilot about the weather conditions at the destination airport, but neither mentioned temperature and dewpoint nor the reported icing conditions.

During the descent and approach the crew did not complete any of the stipulated checklists until significantly later than the required time. According to the OM, the approach checklist should be completed after the altimeter setting has been changed to QNH or QFE. In this case it only occurred during the final approach at about 1,900 ft.

"The BFU is of the opinion that this deviation from procedures increased the workload of the crew in general and in particular for the inexperienced copilot. During the critical phase of the final approach, the delayed completion of the Before Landing Checklist resulted in the PIC concentrating on his communication with the controller and in the distraction from his other tasks, especially monitoring the adherence to the speed parameters by the copilot."

Part of the preparation of the airplane for landing is to select the correct approach and final approach speeds and VREF. The meteorological data on ATIS (temperature, dew point, clouds, visibility and the report about observed moderate icing conditions) made clear that the ice protection system including wing and horizontal stabilizer had to be switched on. With his remark "Yes, adding the engines because it is negative again, they have said it, moderate icing below 3,000" the PIC referred to it again but only activated the windshield anti-ice and the engine anti-ice system of both engines.

The fact that the crew, despite knowledge of icing conditions, did not switch on the wing and horizontal stabilizer deice system, had two effects: (1) The ice accretion on the wings and horizontal stabilizer was not removed; (2) the stall warning and protection system became ineffective.

"The BFU is of the opinion that, historically, the deice boots were designed to be a purely reactive system to remove ice accretion. Pilots had to realize and monitor ice accretion in order to then activate the deice boots and remove the ice. In the present case, the deice system was designed to be used as a proactive measure and not just a reactive system, because the activation of it influences the stall warning and the stick pusher [SWPS] as well as the approach planning.

"The BFU is of the opinion that the assessment of the CVDR recordings showed deficiencies in regard to the

that before departing AXX, both fuel tanks were 3/4 full. When the engine lost power, he switched the fuel selector valve "to the other tank" and attempted to restart the engine, but to no avail. He lowered the landing gear prior to landing.

▶ **January 21 — About 0912 EST, a** Douglas DC3C (N467KS) crashed while departing from Stoltzfus Airfield (OH22), Kidron, Ohio. The captain and first officer were killed and the airplane sustained substantial damage. The airplane was registered to Priority Air Charter LLC and operated by AFM Hardware Inc. under Part 91. It was VFR for the positioning flight, which was destined for Akron-Canton Regional Airport (CAK), North Canton, Ohio.

A witness at OH22 noticed the airplane lift off about a third of the way down Runway 19. Soon after becoming airborne, white smoke was noticed coming out of the left engine. The airplane began to veer to the left and did not climb normally. The witness watched the airplane descend over a building until he lost sight of it. The airplane struck power lines and trees before hitting the ground and came to rest about 200 yd. from the end of Runway 19. The main wreckage was upright and oriented on a northwesterly heading, with the fuselage separated forward of the wings. The left wing was broken aft and upward and the inboard leading edge of the right wing was crushed aft. The left engine was broken aft and outboard of the wing's leading edge. The right engine was broken downward at the nacelle. The nose of the airplane was located forward and left of the airplane main wreckage. The airplane wreckage was retained for further examination.

▶ **January 17,— About 1650 CST, a** Beech A-36 (N2021T) crashed 1 mi. north of the Gillespie County Airport (T82), Fredericksburg, Texas. The pilot was fatally injured, and the airplane was destroyed by a post-crash fire. The airplane was owned by and operated by Big Fuga, LLC Part 91 personal flight. It was VFR and no flight plan was filed for the local flight that originated at Bulverde Airpark (1T8), San Antonio, Texas. An aircraft in the area of T82 advised Houston Air Route Traffic Control Center (ARTCC) they heard a "Mayday" call from a Bonanza whose engine was on fire.

▶ **January 12 — About 1130 CST, a** Canadair CL-600-2A12 (N813WT) owned by a limited liability company and operated by an airline transport pilot, crashed following a runway excursion at the Ox Ranch Airport (01TX), Uvalde, Texas. The captain, first officer, flight attendant, and 6 passengers on board were not injured and the airplane was heavily damaged. The airplane was operated as a Part 91 charter flight. VFR prevailed and an IFR flight plan was filed for the cross-country flight that originated at Addison, Texas, and was destined 01TX. A representative for the airport reported that the airplane on landing hit hard and the tire either popped or the landing gear tore off. About two-thirds of the way down Runway 35, the airplane slid off the right side of the runway. The airplane proceeded through a ditch and struck a perimeter fence before coming to a stop. The right main and nose landing gear were collapsed and damaged. There was also damage to the right wing, right inboard flap, nose of the airplane, and the vertical stabilizer. **BCA**

Gaithersburg Accident

The BFU took note of the December 2014 accident at Gaithersburg, Maryland, involving an EMB-500 in which the airplane stalled in icing conditions. At impact the pilot, the two passengers and three other persons were fatally injured. The aircraft was destroyed.

In June 2016, the NTSB issued the investigation report (NTSB/AAR-16/01)and came to the following conclusion:

The probable cause of this accident was the pilot`s conduct of an approach in structural icing conditions without turning on the aircraft`s wing and horizontal stabilizer deice system, leading to ice accumulation on those surfaces, and without using the appropriate landing performance speeds for the weather conditions and airplane weight, as indicated in the airplane`s standard operating procedures, which together resulted in an aerodynamic stall at an altitude at which recovery was not possible.

The NTSB discussed three possible scenarios that may have resulted in the pilot not activating the wing and horizontal stabilizer deice system:

▶ The pilot was concerned about the landing distance.
▶ The pilot forgot to activate the deice system.
▶ The pilot did not correctly assess the effect ice accretion has on the performance of an aircraft.

As a result, the NTSB issued a total of three safety recommendations. It was recommended that the FAA and the General Aviation Manufacturers Association (GAMA) develop a system that automatically warns pilots that the ice protection system should be activated.

To the NBAA it was recommended to develop improved training programs with the focal point on risk management during winter flight operations and the use of ice protection systems. **BCA**

application of CRM principles. These deficiencies become noticeable in: cooperation, communication, leadership behavior, situational awareness, mutual monitoring and the decision-making process."

While the airplane had been in descent to 3,000 ft., the PIC had requested nine times within 5 min. that the copilot maintain a high speed in order to not slow down the following traffic.

"The BFU is of the opinion that the fact that the copilot repeatedly tried to reduce speed indicates that on the one hand she tried to adhere to the SOPs and on the other hand wanted to establish the approach parameters (speed, flap position, etc.) she had learned during her training, and conduct a standard ILS approach.

"The CVDR recordings did not contain any indications that the pilots had discussed whether the copilot had viewed herself capable to conduct the approach, given that she was inexperienced on the type and in regard to flying in icing conditions. The BFU is of the opinion that part of good CRM would have been that the PIC notices and communicates these facts so that a timely decision could be made if a change of PF and PM or special support during the approach were necessary."

As the airplane was entering the clouds, the pilots should have realized that the wing and horizontal stabilizer deice system had to be switched on. Neither of the two pilots mentioned that according to the SOP the requirements were met or had questioned the decision.

In the flare phase both pilots allowed the airspeed to drop below VMC for icing conditions, stipulated in the AFM, and below the VREF the pilots had selected.

"Past investigations of various landing accidents determined that a landing accident is often preceded by an unstabilized approach," said the BFU. Criteria for a stabilized approach were developed as an aid for pilots to avoid landing accidents. Non-adherence to these criteria at a Safety Gate (1,000 ft. in IMC or 500 ft. in VMC) should result in the termination of the approach. Operators had established this as standard procedure. The correct flap position and the correct speed were part of these criteria. "In the present case the airplane had not been in landing configuration when passing 1,000 ft. AAL, and in 500 ft. AAL not all criteria for a stabilized approach were met, because the Before Landing Checklist had not yet been completed. According to the stipulations in the OM the pilots should have initiated a go-around at the latest upon reaching 500 ft."

The controller's request of the crew to approach with at least 170 KIAS was at the upper limit of the usually given speeds. "The BFU is of the opinion that this speed did only insufficiently consider the aircraft type. The Manual of Operations Air Traffic Services (MO-ATS) of the air traffic service provider only contained the provision to give pilots speed values of no less than 150 KIAS. The controller's wording "Maintain speed 170 kt. or greater to 4 mi. final" was more an instruction than a request.

Even though the crew could have declined this request, and according to their SOPs should have, the PIC accepted, and the copilot did not intervene. "The BFU is of the opinion that this behavior indicates that the pilots did not view this SOP as mandatory."

Causes

The causes of this accident, according to the BFU, were:

▶ The crew conducted the approach under known icing conditions and did not activate the wing and horizontal stabilizer deice system, which was contrary to the SOPs.
▶ Due to ice accretion on the wings and horizontal stabilizer and infringement of the required approach speed, the aircraft entered an abnormal flight attitude during the flare phase and crashed.

BFU Recommendations

The BFU made several recommendations following its investigation, including one to the European Aviation Safety Agency (EASA) in cooperation with the Brazilian aviation authority Agência Nacional de Aviação Civil (ANAC), should ascertain that the aircraft manufacture of the EMB-500 renders the syllabus for the acquisition of the type rating more precisely "to the effect that pilots unmistakably understand the importance and operation of the ice protection and the stall warning protection systems of the EMB-500." **BCA**

Dodging the Golden BB

There's **good luck and bad,** and neither is a strategy

BY **JAMES ALBRIGHT** james@code7700.com

Lt. Edwin Wright looking over flak damage to his P-47 Thunderbolt following a mission over Münster, Austria, October 1944.

There is a theory in military aviation that enemy flak, anti-aircraft rounds, or even missiles don't matter because only one is meant for you. And if it was your time to go, the "Golden BB" bearing your name was going to get you no matter what action you try to avoid it. (For our international readers: a "BB" is a pellet fired from a pellet gun.)

My theory is a little different. I do believe there are Golden BBs out there, but they don't bear anyone's name. Rather they adhere to a first come, first served policy. Your job as a professional pilot is to learn how to dodge them. And after you do, it is your duty to teach others the lessons you have learned.

So, all this begs the question, how do you dodge that Golden BB if you can't see it coming? Well, you have to be observant. And you can study cases in which a Golden BB found its mark. Keep in mind that Golden BBs never travel alone. Just because someone else got hit, doesn't mean there isn't another identical round looking for another victim.

The Takeoff Data Golden BB

There have been a few transport category aircraft lost over the years because of improperly computed takeoff data; perhaps the worst example was MK Airlines Flight 1602. On Oct. 14, 2004, this Boeing 747 cargo flight took off from Windsor Locks-Bradley International Airport (KBDL) near Hartford, Connecticut, loaded with lawn tractors. The total gross weight was 240,000 kg (529,109 lb.).

The aircraft landed, refueled and took on an additional cargo of lobsters at Halifax International Airport, Nova Scotia, Canada (CHYZ). The total gross weight then was 353,000 kg (778,231 lb.), but the pilots failed to enter the new weight into their laptop computer, only updating the weather and airport. They ended up using a reduced thrust setting as a result. When the aircraft failed to lift off at the computed rotation speed, the pilot pulled back farther, resulting in the aft fuselage contacting the runway.

The Boeing finally became airborne 670 ft. beyond the paved surface, but the aft fuselage struck an earthen berm and separated on impact. The rest of the aircraft continued in the air for another 1,200 ft. before striking the terrain and bursting into flames. All seven people on board were killed.

MK Airlines, a now-defunct cargo hauler based in Ghana, required its crews to verify the computer-generated numbers. One method would be to verify the numbers using Volume 2 of the Boeing 747 AFM, which would have been time consuming. Another method, which the accident report seems to indicate was an acceptable means of compliance, was to have a second

MK Airlines Boeing 747 9G-MKJ, Oct. 10, 2004, four days before its crash.

ADRIAN PINGSTONE

crewmember use the laptop to verify the first crewmember's work. A more likely method would be for the pilots to simply look at the numbers and agree that they were "about right."

In the case of the accident airplane, the differences in the numbers should have been apparent. Between 240,000 kg and 353,000 kg, the target thrust setting was very close: 1.33 versus 1.30. But the correct V1, Vr and V2 values were substantially higher: 150 knots and not 123; 161, not 129; and 172, not 137. Fatigue, of course, may have affected each pilot's judgment.

You may argue that the range in speeds for a cargo Boeing 747 are much greater than for a business jet where the largest factor is fuel and is unlikely to render a V-speed off by 30 kt. But if you examine your performance manual, you should find that you, too, can be placed in an unflyable situation because of improperly computed takeoff data.

For aircraft whose variability in speeds and thrust settings are small, "that looks about right" may be a valid verification method. But a better method would be to have an independent source of takeoff data. If you are using computer software developed by the aircraft's manufacturer, it may be prudent to also run data from another source, such as the aircraft's quick reference handbook or performance manual. Even the iPad application method is better than just glancing at the numbers and saying, "that looks about right." You might argue that both sources are derived from the AFM, but this gives you a second chance at data entry and recording and doubles your chances of detecting an error.

The Takeoff Configuration BB

There are all sorts of checklist items that, if missed, can kill. You might argue that flight is a dynamic environment and we can be excused for missing a step here and there while flying. But what about those items you miss while still on the ground? There have been several transport category aircraft lost because the pilots forgot to set their flaps, or mis-set their stabilizer or rudder trim prior to takeoff. It may be necessary to go beyond the checklist to dodge these Golden BBs.

Consider the case of Pan American World Airways Flight 799 in 1968. The three-pilot crew of this cargo Boeing 707 was distracted by having to manage a controlled departure time and had poor checklist discipline leading to the flaps being set, then retracted, and then forgotten prior to takeoff. The aircraft's takeoff configuration warning wasn't triggered because the cold temperature during a refueling stop in Anchorage, Alaska, allowed takeoff thrust before reaching the minimum throttle angle needed to activate the warning microswitch. The aircraft stalled after lifting off and crashed, killing all three crewmen on board.

Since this crash there have been at least 22 more crashes of transport category aircraft due to pilots forgetting to set their flaps prior to takeoff. But modern checklists and warning computers have made this a problem of the past, right? The NASA Aviation Safety Reporting System (ASRS) provides evidence to the contrary.

In 2016, an airline captain opted to taxi single-engine because of the substantial taxi distance to the planned departure runway. When the flight was offered a closer runway while taxiing, the first officer was tasked with starting the second engine, making an announcement to the cabin, and completing the checklist. The captain entered the new performance data into the FMS and accepted the takeoff clearance from the tower.

The first officer then asked the captain, "Do you want me to tell him [Tower] we need a little more time?" The captain responded, "No, everything's set, just finish up the taxi and before-takeoff checklists."

In the words of the F/O: "The takeoff appeared to be progressing normally through 80 kt. It was some time after that when I saw the captain move his right hand off the thrust levers and to the flaps selector, changing it from eight to 20. It took me a moment to process what I was seeing and

JAMES ALBRIGHT/BCA

Takeoff data verification using Aircraft Performance Group iFlight Genesis tailored for a Gulfstream G450.

then I concluded that he must have realized that, perhaps, the FMS actually did indicate that 20 was required even though he had told me to leave them set at eight. By this time, I believe that we may have been at a very high speed and possibly nearing V_1.

"I had no idea what to say in this case other than, 'Shouldn't we abort?' But, before I could say anything, the captain quickly went to idle thrust and applied hard braking."

A USAir Boeing 737 ended up in Flushing Bay while trying to takeoff from New York's LaGuardia Airport (KLGA) on Sept. 20, 1989. There is circumstantial evidence that a cockpit visitor could have rested his foot on the cockpit center console and pushed the rudder trim knob. The pilots failed to check the trim when they accomplished the "stabilizer and trim" checklist item. The captain and F/O made other mistakes during the takeoff roll and subsequent abort.

No matter the causes, the pilots didn't pay enough attention to the rudder trim prior to takeoff. Two of 57 passengers were killed as a result.

Since that fatal accident, there have been several cases of transport category aircraft failing to rotate when the pitch trim was not correctly set for takeoff. There has been at least

NTSB

USAir Flight 5050, September 1989

one case of another transport category aircraft unable to maintain directional control because the rudder trim wasn't correctly set.

A common theme in many of these incidents in which the flaps or trim were not set is that pilots either skipped the checklist item or saw what they expected — that is, that the flaps or trim were set even though they were not. The solution, of course, is greater cockpit discipline when it comes to accomplishing checklists. As for seeing what you want to see, the so-called "expectation bias," I recommend adding tactile and aural senses when it comes to all aircraft configuration changes. Putting your hand on an unset flap handle will improve your odds of realizing the flaps are in the wrong position. (See "Pointing and Calling," *BCA*, July 2017, page 54).

The Single-Engine Taxi BB

In my four-engine past, we routinely shut down our inboard engines in the Boeing 707 after landing to cut down on noise. In the Boeing 747, we sometimes taxied for takeoff with only the outboards to lessen the possibility of ingesting FOD from the lower-hanging inboards. But back then in our U.S. Air Force operations we had a flight engineer who could devote 100% of his attention to the task.

However, I've never delayed engine start prior to takeoff with only two pilots in the cockpit. My rationale is to have both pilots maximize their attention span outside the airplane while it is moving on the ground. The thought that we would actually forget to start the remaining engine(s) before takeoff never entered my mind. But, incredibly, that does happen.

Single-engine taxi (SET) is a common practice for some airlines operating two-engine aircraft. If you multiply the delay times at some airports by the sheer number of daily operations, you end up with significant fuel savings. But the Golden BB waiting for these airlines will evaporate any savings after a single airplane and its passengers are lost.

I've heard of a couple of airlines whose crews made it to the runway and were cleared for takeoff without an engine running. In most cases, the crew figured it out. Here is a recent example reported through the ASRS:

"We pushed off the gate starting engine No, 2. We taxied out with the plan to start the No. 1 engine [later in the taxi] after we saw the lineup. We then switched over to Tower. Just as we were pulling up to stop they cleared us on to the runway, so I ran the before-takeoff checklist just reading through it and the captain answering. I was the flying pilot so I said set thrust and he said thrust set."

"I stated twice that I was using a ton of rudder when he said that we do not have engine No. 1, abort takeoff. We did not travel far, took a breath and did the checklist. We then started engine No. 1, went through all of the checklist from delayed engine start and on, very diligently. We then called Tower and proceeded to taxi back to the runway and took off."

But it gets worse. I've heard from pilots at a major U.S. airline operating MD-80 series aircraft that the carrier had eight incidents in the last few years of pilots forgetting to start the second engine during SET and making it to the runway with takeoff clearance. In one case, the crew ended up aborting doing about 90 kt. And yet this airline continues the practice of single-engine taxi before takeoff. I asked a pilot at another major airline operating the same kind of equipment about this. He said they do not allow single-engine taxi because of the distraction during high workload periods and the chance of forgetting to start the second engine.

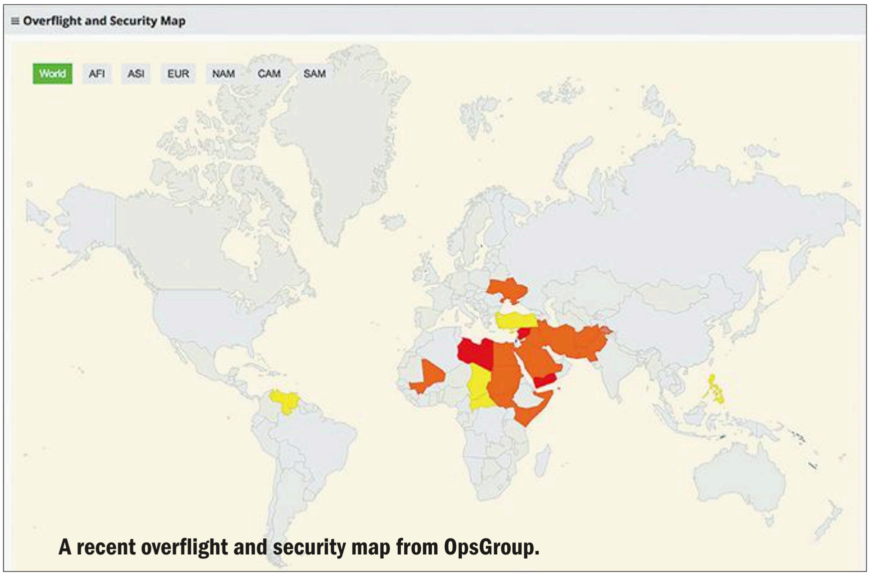
In these examples the aircraft did have some kind of warning system and the crews were provided with electronic messages that something wasn't right. I've read about 20 of these reports in which something distracted the crew before they got to the runway and they accepted their takeoff clearances with something left undone or unstarted. Most of those who were using SET procedures had the option to taxi on two engines but believed they had enough time and a margin of safety to taxi single engine.

The NOTAMs Golden BB

Think back to the last time you flew into Los Angeles, San Francisco, Chicago, Atlanta or New York Kennedy airports. Did you carefully read every NOTAM? What follows are two airport examples and the Golden BBs with each — one hit its mark and the other came within 14 ft. of creating the single largest civil airplane disaster in history.

Let's say you were flying across Europe following a line of other airliners and noticed this NOTAM for a country in the middle of your flight:

A1493/14 NOTAM
Q) UKDV/QARLC/IV/NBO/E /260/320/4820N03716E119
A) UKDV
B) 1407141800 C) 1408142359EST
E) SEGMENTS OF ATS ROUTES CLOSED: T242 NALEM MASOL M996 ABUGA GUKOL G476 MASOL OLGIN W533 TOROS KUBIR L32 NALEM KW P851 LS NESLO A83 LS DIMAB L980 GANRA TAMAK W538 GANRA FASAD W633 LUGAT MAKAK L69 LAMIV GONED W644 DON GETBO



A recent overflight and security map from OpsGroup.

OPSGROUP.COM

M70 BULIG TAMAK B493 PODOL FASAD L984 BULIG FASAD W531 KOVIL PW M136 MEBAM DON M995 OLGIN PENAK L140 KOVIL FASAD. FM FL260 UP TO FL320

First question: Do you understand what it is telling you? It is basically saying the airspace bounded along those routes is closed between FL 260 and FL 320.

Second question: If you are flight planned to fly over this airspace at FL 330 (above the NOTAMed airspace), would you consider flying around it regardless, even if it meant adding 30 min. or so to your flight? Thirty-one operators (including Emirates, KLM, Lufthansa, Malaysian and Singapore Airlines) overflew the airspace. Eight operators (including British Airways, Air France and Qantas) flew around it.

Third question: If I told you that three days prior to your flight a large aircraft was shot down at high altitude and the day prior a second one was downed, would that change your answer to question two?

If you fly internationally, I recommend you subscribe to the OpsGroup for their Overflight and Security Map, available at https://ops.group/dashboard/airspace/ so you aren't at the mercy of the International NOTAM system for figuring out what airspace is hostile and what airspace is not. But even if you don't fly internationally, there are threats domestically that you need to be wary of.

On July 7, 2017, about 2356 Pacific Daylight Time, Air Canada Flight 759, an Airbus A320, Canadian registration C-FKCK, was cleared to land on Runway 28R at San Francisco International Airport (KSFO) but instead lined up on parallel Taxiway C, where four air carrier airplanes were awaiting takeoff clearance. The Air Canada flight descended below 100 ft. AGL before the crew realized their error and initiated a go around. (See "A Near Catastrophe," *Cause & Circumstance, BCA,* December 2018, page 28.)

These pilots screwed up, no doubt about it. They lined up on the taxiway thinking it was Runway 28R. Their error resulted from their unawareness that Runway 28L was closed for major construction. Why didn't they know? It was right there in the NOTAMs — that is, the 52nd NOTAM behind 18 mentions of cranes, five out-of-service lights, three closed aprons and an internet reference to a Letter to Airmen warning against wrong surface landings.

I've been saying for a long time that the single purpose of NOTAMs is to protect everyone except the pilot. If someone misses a turn because of an out-of-service light, the bureaucrat in charge of lights will be off the hook. Contemplating the carnage that could have occurred in San Francisco, NTSB Chairman Robert Sumwalt, a former airline captain, said the NOTAMs were, "Just a pile of garbage."

You can help yourself avoid a wrong surface landing by always backing up a visual approach with lateral and vertical guidance. (See "Oops, Wrong Airport," BCA, January 2018, page 40). Until the NOTAM system is fixed, you can also avail yourself of the many commercial applications that color code and categorize the important NOTAMs to help them stand out.

Game Plan for Dodging Golden BBs

When the Golden BB finds its mark, lives can be lost, aircraft destroyed and reputations tarnished. Then come the recriminations, investigations and corrective actions. If

Air Canada 759 about to overfly three airliners on a San Francisco taxiway.

NTSB

The 117 NOTAMs during a typical KLAX to KSFO flight.

you manage to dodge that BB, none of that happens. But perhaps we should take advantage of having dodged the Golden BB and do the investigation and take the corrective action as if it had hit its mark. That could inoculate you from the next one headed your way.

Consider the case of Air Florida and a hypothetical twist to its fate in 1982. The company started 10 years earlier using two Boeing 707s from Pan Am and grew to the point where it had a fleet of 58 aircraft and a substantial presence on the East Coast of the U.S. All of that came to an end with the crash of Air Florida Flight 90 during takeoff from Washington, D.C.'s National Airport (KDCA) in January 1982.

The crew of this Boeing 737 made a number of foolish decisions in what seemed like an effort to avoid a second deice application and a misunderstanding of the causes and effects of airframe and engine icing. The airline's lack of experience in dealing with long ground delays during icing conditions as well as the crew's inexperience with winter operations contributed to the loss of the airplane and the deaths of 74 of the 79 crew and passengers on board.

The Air Florida brand did not survive the crash. All of this is true. But for our hypothetical, let's say the pilots had the presence of mind to firewall the throttles as soon as the stick shaker went off. They could have just barely cleared all obstacles and would have survived had they done so. Would that have been enough for Air Florida to make the changes to their company procedures and crew training to prevent future Golden BBs from finding their targets?

Now let's apply this hypothetical rewriting of history to current, everyday operations at your airport. We often hear about line technicians fired from their jobs because they towed an airplane into a hangar door or another aircraft. In many of these cases the line person was at the nose of the aircraft, driving the tug, looking at wingtips from a distance or guessing at tail positions. In the end, the tech loses his or her job and the operator hires a replacement.

At that point, there are two possible outcomes. In some cases, the news of the firing is considered enough to warn everyone to be more careful next time. This usually works, for a while at least. But in other cases, the operator realizes the action that damaged the $50,000 winglet could easily have been damage to a $5 million engine or might have resulted in serious injury to a person.

Wise operators will realize it will be cheaper in dollars and better for their reputation to hire additional people to ensure they have wing walkers when towing aircraft. They recognize that the first dodged Golden BB required a bit of luck and that dodging them in the future will require thought and skill. There is a method to dodging Golden BBs.

(1) Go public.

They say confession is good for the soul. It will certainly help the individuals involved in a near incident to take the lessons to heart. But it will do more than that. It will help others to realize that this could happen to even the best people and it isn't something to be dismissed as a rare event that will only bite the inexperienced. Furthermore, it will get others involved when it comes to finding solutions.

(2) Consider what could have happened.

Once you've identified the dodged Golden BB, it will be tempting to think all you need to do is promise yourself to be more careful next time. But what if the circumstances leading to the problem in the first place are systemic — that is, they are part of your normal processes and are bound to happen again? What is to prevent you from falling for these circumstances again, or to others who are unaware of the problem in the first place? The only way to address the problem with the seriousness it deserves is to consider just how bad it could have been. You can easily imagine the obvious: injuries to people, fatalities, damage to the aircraft or loss of the aircraft. But it can be far worse if the aircraft ends up in a populated area.

(3) Take corrective actions as if the Golden BB had not been dodged.

Armed with the knowledge that things could have been much worse, you will be prepared to expend time, effort and money to ensure the dodged BB in question will never reach its target. An aircraft accident will have to be reported to the NTSB, as a start. The company will come under intense public scrutiny. The company may suffer loss of the aircraft and the people on board. If the company survives, things will have to change. So, why not make those changes before anything of this magnitude happens in the first place?

(4) Implement your safety management system and consider a threat error management (TEM) program.

Your first reaction to a close call may be, "Whew!" Your next reaction should be, “Why didn’t we catch this sooner?” That is precisely why you need a TEM program. You should come up with ways to trap the errors that led to your close call. But once you’ve done that, you aren’t actually done. Every “Plan B” needs to be watched closely for future modifications. The threat is evolving. Your Plan B needs to evolve too.

(5) Understand that you don’t know what you don’t know.
Has the airplane ever surprised you? Did it react contrary to what your best systems knowledge and procedural expertise would have predicted? Me, too. Some operators shut down an engine after landing thinking it will save wear and tear on the brakes. But carbon-carbon brakes wear very little after landing.

(6) Stack the odds in your favor where you can.
The best checklists are short and have the most important items up front. Old-school checklists were designed for cockpits with a crew of three or more, where one crewmember’s total focus is on the checklist. Expecting a two-pilot crew to run a very long taxi checklist while negotiating with ground control and all the other moving obstacles on the tarmac is asking too much. You can fix that. A G150 operator tells me they moved 17 items from the taxi checklist (when they are moving) to the after-start checklist (when the parking brake is set). That’s a great way to dodge a Golden BB!

(7) Give the bean counters something big to count.
I get the impression that many of the pilots bitten by the need to operate SET are enthusiastic supporters of the practice. The airline’s management figured the amount of time spent with two engines at idle waiting for takeoff was much costlier than just one, and that’s a big debit on the balance sheet. Nobody in the accounting department can think of something for the other side of the ledger. I can suggest one for you: the cost of the airplane and the lawsuits sure to follow if you find yourself at 90 kt. wondering why you need so much rudder. Other pilots have dodged that Golden BB successfully. But let’s add to your woes a contaminated runway and a crosswind. Now you might not be so lucky.

So, do you believe there is a Golden BB out there with your name on it? Regardless of your answer, doesn’t it make sense to do everything you can to dodge it and the one coming right after it? Assuming you agree, then you need to take the corrective action that would have become necessary had the Golden BB found its target. **BCA**

JAMES ALBRIGHT/BCA

Auditing a Career

Proof that you can contribute to business aviation **after exiting the flight deck**

BY **JIM CANNON** jim.cannon@sundogav.com

Helmut Gottschalk, my auditing partner, on an Emirates flight from Dubai to Singapore.

JIM CANNON (4)

It's 9:53 p.m. over the Andaman Sea on Nov. 9; 12:53 a.m. on Nov. 10 in Singapore; 8:53 p.m. in Dubai; and 11:53 a.m. the morning before in Sunset, South Carolina, my home base — all of them waypoints on this special air marathon.

Firmly ensconced in seat 47F on Emirates Flight 355 from Singapore to Dubai, cruising at 554 mph (Mach 0.83) at FL 400, this is my first flight on an Airbus A380-800. Westbound chasing the sunset that we will never catch, I have just helped conduct three International Standard for Business Aircraft Handling (IS-BAH) audits in six days, which involved three nights in hotels, and now I'll spend my third night in flight heading from Dubai to Washington Dulles International Airport (IAD) on another Emirates A380. This assignment has taken me halfway around the world and back again.

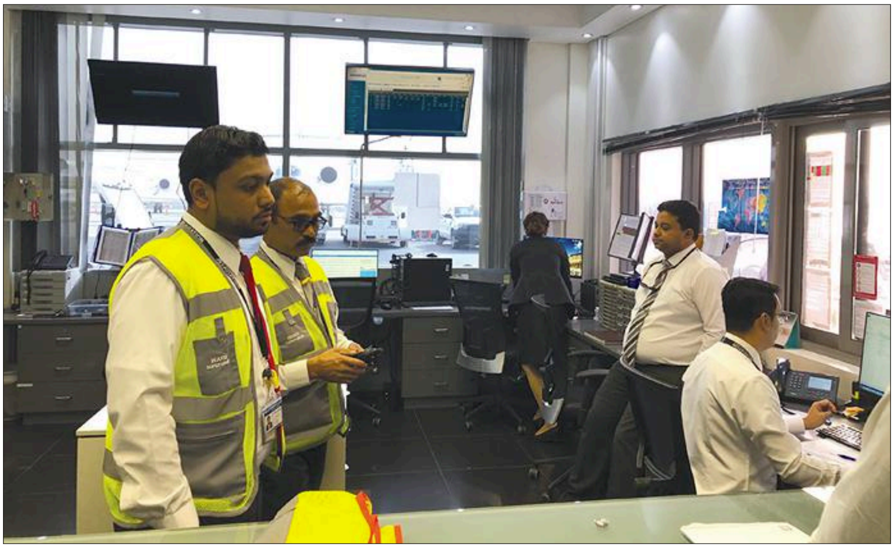
When I retired from the cockpit of a beautiful Gulfstream GIV-SP in 2008, I thought it might be important to me to remain engaged in some other aspect of business aviation, a community that had given so much to me since I began my career in 1967. Within a year, I became qualified as an International Standard for Business Aircraft Operations (IS-BAO) auditor. The decade that followed has been an amazing mixture of exploration and learning. In 2014, I was additionally certified to conduct IS-BAH audits.

IS-BAH was introduced in July 2014 by the International Business Aviation Council (IBAC). The program is designed to provide ground-handling service providers (GHSPs) with a means of measuring their conformity to a focused set of standards put forward by the International Civil Aviation Organization (ICAO) and business aviation best practices, concentrating on the development and progression of the GHSP's safety management system. Akin to IS-BAO, IS-BAH's intent is to assure business aviation operators that the FBO or handler they are using is striving for excellence and continual improvement in its oversight of service and safety.

This particular audit plan called for two auditors — me as lead auditor in partnership with Helmut Gottschalk, co-managing director with AeroEx.eu — to fly to Dubai and assess Jet Aviation's two FBOs' conformity with IS-BAH on Nov. 6 at Dubai International Airport (DXB) and on the Nov. 7 at Al Maktoum International Airport (DWC). Then on to Singapore during the night of the 7th, to arrive on the morning of the 8th and out to Seletar Airport (XSP) for a one-day audit of Jet's FBO at that location. My home return was scheduled for 9:00 p.m. on Nov. 9 from Singapore through Dubai to Dulles.

Jet Aviation Europe, Middle East and Asia had applied to become an IS-BAH registered FBO at the Stage 2 level in summer 2018. The General Dynamics-owned chain had contracted with AeroEx.eu, a Swiss business aviation auditing firm, to conduct the IBAC-mandated number of audits that would verify conformity to IS-BAH for its regional network. Joel Henks, co-managing director, reached out to me

Jet Aviation ramp at Dubai International Airport.



Ramp Services Office of Jet Aviation at Dubai International.

and curiosity as to my continued viability within an industry I truly love. This particular assignment also reminded me of my flying days, which included many trips through Dubai on the way to Singapore. My first flight to Singapore took place in fall 1974. I had joined the W.R. Grace flight department based at New York's Westchester County Airport (HPN) earlier that year and I was assigned to a 21-day round-the-world trip that October. Seletar was a little country airport back then and tightly controlled by the Singapore military, whose validation of our landing permit request had arrived several weeks prior to departure. That's all ancient, BPC history, that is before personal computers gave us the opportunity to communicate instantly with the world.

Instead of uploading an entire flight plan for a flight via the FMS, the Litton LTN 51s onboard the GII would only accept nine waypoints and No. 9 was always the destination airport. Each waypoint entry was made via insertion of full latitude and longitude coordinates. Weather forecasts as well as winds aloft data were typically based on information that was often more than 24 hr. old. Updated weather was received over HF when airborne via published VOLMET frequencies.

Bustling Seletar Airport now offers FBO services to business aviation operators through Jet Aviation and four additional handling service providers. The airport has been transformed from the old "colonial days" when a GII was the most capable means of international business aviation travel. In similar fashion, Dubai International was simply a runway in the desert adjacent to the Persian Gulf.

As for that sunset, it appeared just behind us during the approach into Dulles. Good morning! **BCA**

after they were awarded the contract and asked if I would take the assignment as lead auditor. I had previously worked with AeroEx.eu during fall 2016, conducting Stage 1 IS-BAH audits of Jet Aviation's handling operations in Jedda and Riyadh, Saudi Arabia. I was therefore familiar with the company's Ground Operations Manual, Standard Operating Procedures and Emergency Response Plan.

The Dubai and Singapore audits, although aggressively scheduled, were efficiently conducted through a comprehensive documentation conformity review prior to the actual audit dates. With the documentation completed in advance, Helmut and I split up at each site to uncover evidence of conformity through records review, interviews, facility inspections and airside observations. I completed the necessary paperwork and submitted all of the audits for review to the IS-BAH audit review team when I returned to South Carolina. The 14.5-hr. flight from Dubai to Dulles provided ample time to fulfill that obligation. It was truly amazing when we landed at IAD to realize that I was aboard an A380 that represented the 100th delivery to Emirates Airlines.

The capability of commercial aircraft to conduct extreme long-haul flights is matched today by business aircraft from manufacturers including Bombardier, Dassault, Embraer and Gulfstream. In reflecting on the days when I was just starting out in business aviation, our Gulfstream GII was certainly capable of conducting a circumnavigation of the globe, but in 6:20-hr. intervals. And doing so took quite a bit of advanced planning, communication via cable and telex for not only landing permits but overflight clearances, fuel uplifts and catering requests. The EU did not exist then, which necessitated obtaining permission from every national aviation authority in Europe to overfly their sovereign territory.

It's been so interesting to reinvent myself and I look upon this latest assignment with a mixture of challenge

A teambuilding poster in the lobby of Jet Aviation Dubai.

Tracking Tires

BY **MAL GORMLEY** malgormley@gmail.com

Aircraft tires are amazingly rugged. They're designed and built to handle a range of extreme conditions — arguably among the most demanding confronting any vehicular system.

Consider a single trip. The tires are motionless as crew and passengers board. The main door closes and the tires begin to roll, slowly at first but soon taxiing and turning at high speed. Next is throttle-up and the wheels become a blur of runway acceleration. Once airborne, they're tucked away for hours in a frigid, low-pressure compartment. Then, they're slammed onto the tarmac and spin up so rapidly they burn off a cloud of rubber, followed shortly by heavy braking, which raises their temperatures even more as the adjacent brakes translate the airplane's mass and momentum to near-incandescent heat. Then comes a lengthy taxi to the tarmac. Rinse. Repeat.

Aircraft tires deserve frequent, loving attention if they're going to be this reliable, day-in, day-out. The consequences of ignoring them can be tragic, as was horribly demonstrated on Sept. 19, 2008, in Columbia, South Carolina.

Accident Sequence

Near midnight, eastern daylight time on Sept. 19, 2008, a Bombardier Learjet Model 60 (N999LJ) owned by Inter Travel and Services, Inc., and operated by Global Exec Aviation, overran Runway 11 during a rejected takeoff at Columbia Metropolitan Airport, Columbia, South Carolina (CAE). The captain, the first officer, and two passengers were killed; two other passengers were seriously injured. The non-scheduled domestic passenger flight to Van Nuys, California, was operated under FAR Part 135. Visual meteorological conditions prevailed, and an IFR flight plan was filed. The following summary is excerpted and edited from the NTSB final report on this accident, "Runway Overrun During Rejected Takeoff, Global Exec Aviation, Bombardier Learjet 60, N999LJ, Columbia, South Carolina September 19, 2008."

As reported by witnesses, the beginning of the accident airplane's takeoff roll appeared normal. The airplane accelerated from about 12 kt. at 2354:51 to about 131 kt. at 2355:10.5, when the first officer stated, "V1." During this time frame, the airplane's acceleration and engine operation were consistent with the airplane's expected performance during a normal takeoff. Less than 2 sec. later, however, when the airplane was more than 2,500 ft. down the runway (with about 6,100 ft. remaining), the CVR captured the beginning of a loud rumbling noise. The airplane's location on the runway at the onset of the noise correlated with the location where the first pieces of right outboard main landing gear (MLG) tire were found. Thus, the onset of the loud rumbling noise likely resulted from pieces of the right outboard tire separating from the wheel and striking the underside of the airplane and was likely accompanied by shaking and vibration of the airframe.

From this point forward, the accident sequence can be divided into two distinct segments. The first segment involves the captain's initiation of the high-speed RTO, which was a high-risk event. The second segment of the accident sequence involves the uncommanded forward thrust emergency related to the uncommanded stowage of the airplane's thrust reversers.

During the takeoff, when the first tire failed and the rumbling noise began, the first officer stated, "go," then "go, go, go." The airplane's ground speed at the time was about 137 kt., and, as shown by runway gouging and tire skid marks, the airplane veered to the right and across the runway centerline. Only debris from the right outboard tire was found at the runway location that coincided with the timing of this event; thus, the runway marks were likely created by the right outboard wheel rim contacting the runway surface and the skidding of the still-intact right inboard tire. (The airplane was initially left of the runway centerline before it veered.)

In the next second (2 sec. after the onset of the rumbling sound), the captain asked, "go?" At this point in the takeoff roll, the airplane neared its peak ground speed of about 144 kt. (extrapolated data show that it may have reached about 150 kt. within the next second) and began shedding fragments of a landing light and other pieces (which likely separated after having been impacted by fragments of the right outboard tire). The timing of the captain's question to the first officer coincided with the captain reducing engine power for about 1 sec., then increasing it for about 1 second before decreasing it again, about which time the first officer stated, "no? ar-right . . . what the [expletive] was that?" The entire RTO procedure, up to this point, spanned about 5 seconds since the onset of the rumbling noise from

An aircraft's tires are critical safety items for every pre- and post flight inspection. **Ignoring or abusing them** can cause lots of expensive damage.

tire fragments, first from the right outboard tire and then from the right inboard tire.

Although there is no indication that either the captain or the first officer knew what type of problem occurred, each reacted to it differently. The first officer's statements to "go" suggest that, despite being unaware of the type of failure that occurred, he relied on his training and recognized that, once the airplane's speed passes V1, the appropriate response is to continue the takeoff for nearly all anomalies except when airplane controllability is in serious doubt. Both the captain and the first officer were trained that continuing the takeoff under such circumstances offers several safety advantages over an RTO, such as more time to analyze the situation, the ability to reduce the airplane's gross weight and to use landing flaps, the ability to prepare for vibration and directional control problems on landing, and the availability of more runway on which to stop the airplane.

About 4 sec. after the captain made the second engine power reduction, the airplane's engine N1 decreased to about 7,300 rpm, the captain made the comment "full out" (likely referring to full deployment of the thrust reversers), and wheel brakes were applied (as indicated by CVR sound evidence). Extrapolated ground speed information estimated that the airplane decelerated to about 128 kt. Debris evidence showed that, at this point, all of the MLG tires had failed (within about 9 sec. of the first tire's failure).

For our purposes here, however, we'll focus on the aircraft's tires and maintenance. For further information on other aspects of the accident, see the Safety Board's final report.

While the factors contributing to the crash were several (see "Beating Murphy's Law," *BCA,* October 2018), the deadly sequence began with failure of a right main tire.

Among the items of concern highlighted by the NTSB's post-accident investigation were the aircraft operator's tire maintenance practices.

Damage observed on fragments from all four of the accident Learjet's main gear tires, such as abrasion marks on the inner liner and heat damage to the rubber and nylon materials, was consistent with tire overdeflection. Two tire operating conditions can result in such overdeflection: overloading and underinflation. Under either condition, excessive flexing of the sidewall generates high internal temperatures and weakening of the sidewall plies, leading directly to failure.

In this accident, after the first tire failed, the remaining three tires failed in sequence from right to left. The investigation found that the accident airplane's tires were subjected to internal heating damage from operating while severely underinflated, which made each tire particularly susceptible to failure. However, the investigation also examined the possibility that the effects of adjacent tire loading after the loss of one tire can overload and potentially contribute to the failure of properly inflated tires. The investigation determined that, after the loss of one tire, the other tires could become subjected to loads not specifically accounted for in the tire's certification.

The tire design and testing requirements of FAR Part 25.733 may not adequately ensure tire integrity because they do not reflect the actual static

GREENVILLE PD

Debris evidence showed that, at this point, all of the MLG tires had failed (within about 9 sec.of the first tire's failure).

Blurred Responsibility

Inconsistencies in tire pressure checks were found in the FAA's Feb. 26, 2009, response to Bombardier Learjet regarding its Model 60. In the letter, the FAA stated that checking the tires on that model is preventive maintenance, and as such pilots would not be permitted to do it as part of a preflight check.

However, the NTSB noted that, according to the FAA's interpretation, a pilot working for an FAR Part 135 charter operator would be allowed to check tire pressures on a Learjet 60 in preparation for an FAR Part 91 ferry or maintenance flight. And yet, that same pilot would be prohibited from performing the check on the very same airplane for a charter flight carrying revenue passengers or cargo. Go figure.

Because of the nature of charter operations, it is not unusual for a flight crew to remain with an airplane away from home base for several days while flying both revenue and positioning flights. The Safety Board acknowledged that the different rules that apply to Part 135 flights generally represent a higher level of safety than those contained in Part 91. In this case, however, it noted that the FAA's interpretation could have an unintended negative effect on safety.

Probable Cause

The Safety Board determined that the probable cause of this accident was the operator's inadequate maintenance of the airplane's tires, which resulted in multiple tire failures during takeoff roll due to severe underinflation, and the captain's execution of a rejected takeoff after V1, which was inconsistent with her training and standard operating procedures.

Contributing to the accident were (1) deficiencies in Learjet's design of and the Federal Aviation Administration's (FAA) certification of the Learjet Model 60's thrust reverser system, which permitted the failure of critical systems in the wheel well area to result in uncommanded forward thrust that increased the severity of the accident; (2) the inadequacy of Learjet's safety analysis and the FAA's review of it, which failed to detect and correct the thrust reverser and wheel well design deficiencies after a 2001 uncommanded forward thrust accident; (3) inadequate industry training standards for flight crews in tire failure scenarios; and (4) the flight crew's poor crew resource management.

SAFO

On Jan. 6, 2011, the FAA issued a Safety Alert for Operators (SAFO), The Importance of Properly Inflated Aircraft Tires, to help ensure that tires are properly inflated and detailing the potential consequences that improper pressure can have during taxi, takeoff and landing.

The SAFO, which discusses the 2008 Learjet 60 accident in Columbia, South Carolina, also describes the 1991 crash of a McDonnell Douglas DC-8 shortly after takeoff from Jeddah, Saudi Arabia. The probable cause of the crash was underinflated tires, which in turn caused an overheated tire to explode during taxi, which then caused other tires to catch fire during the takeoff roll. The fire continued as the wheels were retracted into the wheel wells, eventually causing a loss of hydraulic control and finally an inflight breakup that destroyed the aircraft. All 261 crewmembers and passengers on board were killed as a result.

The SAFO goes on to suggest that any individual associated with aircraft maintenance make certain their procedures ensure tires remain inflated to within their appropriate maintenance-manual-specified inflation range. **BCA**

and dynamic loads that may be imposed during normal operating conditions and after the loss of one tire. This is especially the case if the tires are operated at their load rating, and the requirements may not adequately account for tires that are operated at less-than-optimal conditions.

The Safety Board report goes on to say that an aircraft tire in use can generate high temperatures within its structure in part because of the amount that the materials can flex in response to inflation pressure and loading. Aircraft tires perform properly only when they have the correct inflation pressure and are not overloaded. Proper inflation and loading result in an acceptable amount of sidewall deflection.

It explained that sidewall overdeflection occurs when a tire is operated while underinflated or overloaded. When a tire's sidewalls overdeflect at the bottom of each rotation, the excessive flexing of the rubber can result in fatigue of the reinforcing fibers and the generation of higher internal temperatures at a faster rate than would be generated in a properly inflated, properly loaded tire. High temperatures can degrade the physical properties of the tire's rubber compounds and melt the nylon threads in the plies. Such damage can lead to tire failure.

Moreover, testing by Goodyear showed that as little as 5% underinflation greatly reduces the fatigue life of transport-category aircraft tires. Since underinflation and overloading can result in sidewall overdeflection, tire testing data for both scenarios were reviewed.

According to estimated static load-deflection charts created during the Safety Board's investigation, "the amount of underinflation needed for a loaded tire to produce the type of overdeflection damage observed on the accident airplane's tires (specifically, the damage location on the sidewall) would be about 36% underinflation."

Alternatively, testing data showed that the amount of overload needed for a properly inflated tire to produce the amount of overdeflection consistent with the sidewall damage observed on each of the accident airplane's tires would be about 12,200 lb.

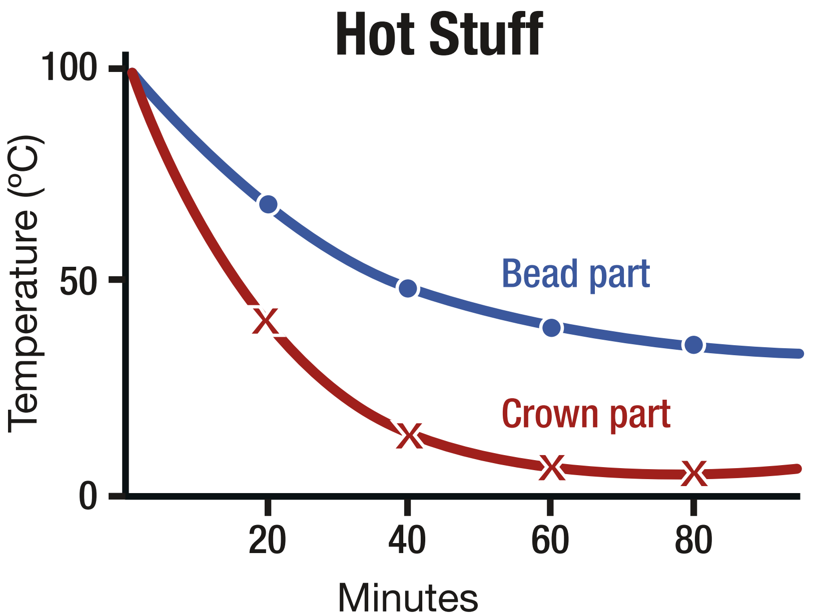
The Learjet's tires showed no evidence of impact, puncture or adhesive-separation damage. Examination of the wheels and brakes showed no evidence of overheating or brake lock-up, and none of the wheels' eutectic fuse plugs, which are designed to melt if the wheel temperature reaches about 390F, leaked when tested.

The NTSB reviewed tire pressure information collected from various sources for the purpose of gaining insight into industry practices related to tire pressures and maintenance for in-service transport-category airplanes. The information included historical data from 2005 to 2009 and tire pressure and maintenance practice information collected from FBOs and eight commercial operators.

The data collection was not intended (or sufficient) for performing statistical analyses. However, the data showed that most of the tires sampled were inflated to within 10% of their rated pressure, which was typically within maintenance limits. However, some tires were operated at inflation values well below the limits that the respective Aircraft Maintenance Manuals (AMMs) specified for tire replacement.

During the data collection, nearly all maintenance providers interviewed mentioned that use of the AMM was required by each operator's FAA-approved operations specifications. One FBO operator indicated that some AMMs do not call for mandatory tire pressure checks as part of scheduled maintenance and that he believed that weekly tire pressure checks were generally good practice.

A review of AMMs for the Cessna CE-650 and the Dassault Falcon 50 — airplane types operated by Global Exec Aviation, the accident aircraft's operator — found that they were organized similarly to the Learjet 60 AMM; the reference to daily tire pressure checks was found in Chapter 12 of each. The Falcon's airplane flight manual (AFM) for pilots also contained a reference to Chapter 12 of the AMM for tire pressure check information.



Source: Bridgestone Tire

Research has shown that transport-category airplanes can lose as much as 5% of tire pressure per day under typical operations. At that loss rate, it would only take a few days before the tires require servicing. Tires not serviced within an acceptable range may require complete replacement due to underinflation limitations specified in the maintenance manual.

Additionally, servicing of underinflated tires without proper protection such as a tire screen or other such devices can cause damage to the aircraft or injury to the individual servicing an underinflated tire.

Put simply, proper tire pressure needs to be maintained and checked regularly, or bad things can happen to the aircraft and those within it. **BCA**

Aircraft tires perform properly only when they have the correct inflation pressure and are not overloaded.

U.S. NAVY

Insuring Drones

British companies look to **push the UAS industry** to the next level

BY **ANGUS BATEY** angus@angusbatey.co.uk

AKLYOKO/ISTOCKPHOTO

Aviation insurance tends to be regarded as something that helps aircraft owners, operators and users deal with accidents or loss. But a London-based start-up argues that its innovative approach to insuring drone flights is encouraging pilots to think more carefully about minimizing risk and thereby helping to create a safer airspace environment.

The approach might even be applicable to manned aviation and help general and business aviation users reduce their costs while increasing the safety of their flight operations as well.

Founded in 2015, Flock, the insurer, has been selling policies since January 2018. Flock Cover, its flagship product, is a pay-as-you-fly insurance solution for drone operators. The policies are bought via a smartphone app, last for an hour, and cover flights in a 500-meter-radius circle from the takeoff point. The flight insurance can be bought up to two weeks in advance, at any time prior to takeoff. Policy documents are generated instantly and sent electronically.

Flock's least expensive policies cost £4.95 ($6.50), and the company claims that over 25% of the U.K.'s commercial drone pilots — those holding Permission for Commercial Operation (PFCO) certifications from the Civil Aviation Authority (CAA) — are using the app.

Rather than just gathering information about pilot and platform before offering coverage, the app takes a host of different variables into account. These include the time and date of the proposed flight; the proximity to facilities such as hospitals, schools or busy roads; and real-time information about weather in the precise area of the planned flight. The risks are then weighed and assessed by the company's algorithms, and matched against insurance data from Allianz, the German insurance giant, which is Flock's underwriting partner.

In seconds, the app presents the pilot with a score between one and 100, where a higher number represents a higher risk, and an insurance quote for the proposed flight. The higher the risk measure, the higher the price for the policy. The pilot can then make changes to the proposed flight plan and instantly see how these would affect risk number and price.

Flock CEO Ed Leon Klinger argues this is helping pilots better understand risks and provides a financial incentive to proactively mitigate them. He believes Flock's insurance is having a demonstrable effect on pilot behavior, and therefore on airspace safety.

"From our analysis we can see that our users are deliberately interacting with the app to reduce their risk," Klinger says, during an interview in Flock's small open-plan office in a shared building close to London's financial district. "We see, on average, 15 interactions per sale. People will move around the map and change the time of takeoff 15 times, on average, per flight. The risk metric will fall by 4.5 out of 100, and that results in a 15% decrease between initial quotation price and final quotation price. From that we can deduce, with a degree of statistical significance, that pilots are using the app to reduce the price of their flight by reducing the risk of their flying."

Flock was founded by Antton Peña, an engineer with a master's degree from Imperial College London's Data Science Institute, and was built on his and Klinger's academic research projects.

"We intended to build a risk-analysis platform for the drone industry," says Klinger, a graduate of Cambridge's Judge Business School. "We then very quickly realized that the most instant application, and certainly the quickest revenue-generation possibility for the company, was through insurance. We partnered with Allianz, and what we then built out with them was the ability to convert our instant, on-demand risk metric into an on-demand insurance product."

It took around six months, and 14 different versions of the cover note, before Flock Cover gained approval from the CAA. "Up until that point there had never existed a micro-duration or an on-demand insurance policy for aviation — certainly not in Europe, and not in the U.K.," Klinger says.

"What Ed and Antton came up with was essentially a step away from the traditional annual insurance policy product that's historically been in place," says Tony Avery, senior underwriter for Allianz's general aviation and aerospace business in the U.K. "Insurance is moving fast, and big insurance companies like Allianz don't tend to move fast; and we realized there is a necessity for this type of insurance."

The response from commercial drone pilots has validated Avery's assessment. Alistair Batey — the author's brother — is a freelance TV cameraman who flies a Mavic Pro drone to capture aerial footage. Insurance is mandatory for commercial drone pilots in the U.K., and prior to Flock's product becoming available, Alistair had been paying an annual premium to a traditional insurer of around £1,000 ($1,300). The flat-rate price took no account of the amount of flying taking place — which, in Alistair's case, is typically a small number of commercial flights per month, and some additional flying for personal photography or to maintain currency and familiarity.

Flock advertises sparingly, and its marketing has concentrated on partnerships with Nationally Qualified Entities (NQEs), the CAA-approved schoolhouses where pilots qualify for their Permission for Commercial Operations (PfCO). It was via an email from his NQE that Alistair first heard about Flock. After looking into the product

Flock's team works in a small open-plan office in a shared building close to London's financial district.

Flock founders, Ed Leon Klinger and Antton Peña

when his annual policy was due for renewal, he initially thought he must have misunderstood the offering.

"I got back to the NQE, and said, 'This is too good to be true, isn't it?'" he recalls. "And they said, 'That's what we thought, too. But, no, it's real.'"

As well as enjoying a hefty saving over the cost of the annual policy, Alistair is also able to make per-flight savings using the app's risk-reduction functionality. As an example, he cites a job in Nottingham, where he was hired to shoot aerial footage of local landmarks that was to be inserted into a preview of a cycle race.

"I wanted a shot over the river Trent, and the first place I planned to take off from meant that part of the 500-meter-radius circle was over a nature reserve, which was a higher-risk area," he says. "I didn't need to fly over the reserve, so by moving the takeoff point so it was no longer within the flight radius, I was able to halve the cost of insuring the flight."

Alistair has been impressed by Flock's approach in other ways, too. When he first began using the product, each policy document was a hefty 27-page PDF, with the specific per-flight details included among all the other necessary legal boilerplate. He asked whether a simplified, one-page summary could also be generated, which he could print and file separately, to save time when billing flight costs back to a client. During one job, where he had to fly in two different places a short distance apart, he found he was unable to insure the second flight until the hour's coverage he'd bought for the first flight had elapsed. He asked Flock to give pilots the ability to end a policy if the flight was completed before the hour was up. In both cases, the requested tweaks were implemented before the next time he flew.

"If you click the 'chat' icon in the app, you can talk directly to our tech team," Klinger says. "Loads of our customers will do that and ask for new features. It allows us to define a product roadmap based on what we know our customers actually want — which is changing all the time, because the industry's moving so quickly."

Flock's approach is not predicated on upending every tried-and-tested insurance concept. Toward the end of 2018 the company began to market a new product, Flock Unlimited, which aims to offer the advantages of Flock Cover but with the predictability and regularity of a single monthly payment — effectively a bridge back into the traditional insurance marketplace.

"We realized, by speaking to the broader drone market, that there are vast swaths of customers who are really interested in the flexible nature of the insurance that we sell, but they don't want to have to interact with the application every single time they fly," Klinger says. "We spent a lot of time agonizing over this as a company, but we decided to listen to their demands. They don't want to be doing this. Let's not force them to do it."

The company still intends to incentivize users to interact with the app, and future iterations of Unlimited will see users whose supplied data show them routinely modifying flight plans to reduce risk and lowering their premiums. There is also an option to "turn off" the policy. For example, if some customers don't intend to fly during the winter months they can pause coverage until their flying season resumes. Another potential benefit of the Unlimited coverage is that it insures the aircraft against theft, loss and damage when on the ground; the pay-as-you-fly coverage only lasts for the duration of the flight.

Unlimited is still aimed at the single-drone operators. A third Flock product, Enterprise, has been created to serve the fleet-operator market. The company was approached by a potential client — "probably one of the biggest operators of drones globally, which has millions of pounds' worth of drones and ancillary equipment," says Klinger, who is prevented from identifying the company by a non-disclosure agreement. He says his team "worked around the clock" and was able to launch the product for this customer before this past Christmas. A second, also as-yet-unidentified, customer signed on in late January.

The policy requires the client to upload its flight logs to Flock's server, and at the end of each month a bill is generated based on the flights that took place. Pricing still takes account of risk — it is generated by the same algorithm that powers the pay-as-you-fly policy — so the Enterprise users will pay less if their pilots reduce risks for each flight.

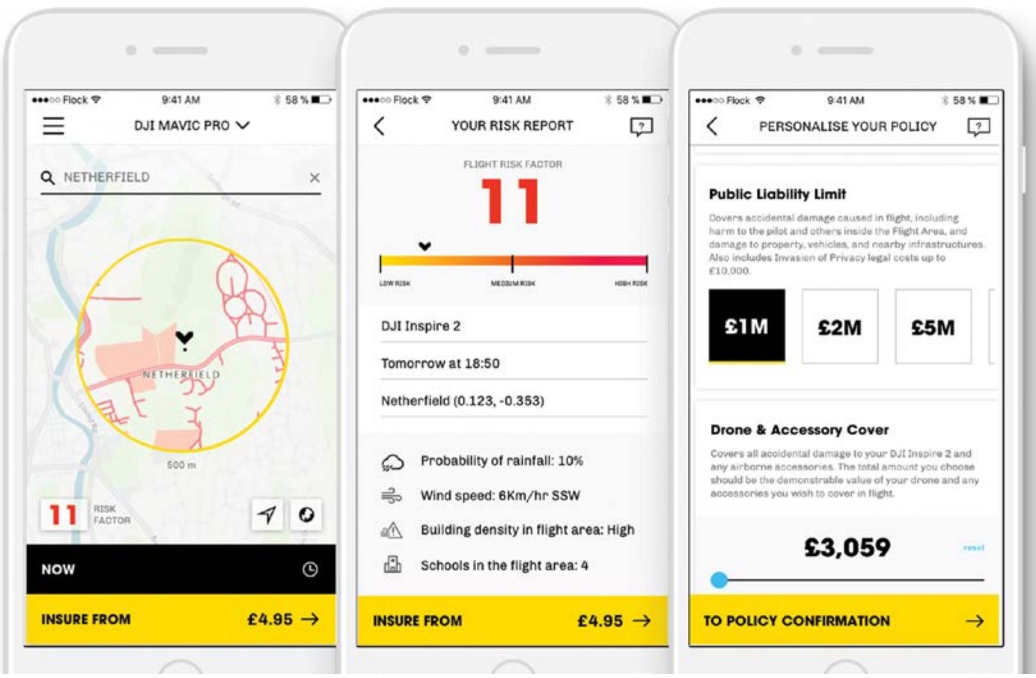
"What the Enterprise solution allows an insured to do is to fly multiple times, with multiple drones, within a monthly period, and they pay a premium based on utilization," says Avery. "With a lot of the traditional annual policies, if you've got, say, a fleet of 10 drones and you've got 10 pilots, it's likely they're not flying all those drones at the same time — yet you would be charged for those 10 drones, even though only two or three may be flying. What the Enterprise solution allows them to do is pay the premium for the two or three of those drones that are going to be flying."

Despite the growing number of options, Flock's products may not appeal across the board. Klinger recognizes that their risk-based model means that the most risk-averse pilots or companies will benefit, while those with higher tolerance for risk will probably be able to find cheaper cover elsewhere.

"Our product will always align risk and premium," he says. "We treat risk like it's a utility that is purchased, so we will always be competitive for those entities that manage risk sensibly. The benefit to the larger fleet operators, all the way down to the one-man bands, will be that we deliberately combine our risk-as-a-utility product with a risk-management solution. So we provide you with the ability to reduce your own risk, and we give you that for free so that you can reduce your own risk and therefore become one of the risk-mitigating, risk-minimizing players in the market, where suddenly our product is competitive."

Competitors are already emerging. A Silicon Valley startup, Skywatch, launched in 2016, offering a similar risk-based on-demand drone insurance app, while FlyCovered, a British firm, began offering on-demand policies to general aviation pilots in the U.K. last year. To build on its solid start and maintain a lead, Flock needs to keep innovating.

The next product in line may well be insurance for beyond visual line-of-sight (BVLOS) drone flights. Flock is developing a BVLOS version of its app and is testing it with potential customers, though as yet the company does not insure such flights. It works similarly to the standard Flock Cover product, but instead of assessing the risks in an area 500 meters from the takeoff point, it looks at the risks along a planned route. An allied development will allow users to ask the Flock system to interrogate its data sets, analyze risk metrics for a forthcoming period, and work out the optimal takeoff time (and routing, in the BVLOS instance) for the lowest-risk flight.



Screenshots from the Flock product. "Our product will always align risk and preminum," says CEO Ed Klinger.

A key metric in the insurance industry is a product's claims ratio — the number of successful claims expressed as a proportion of the number of policies sold. Klinger is reluctant to divulge the figure, arguing that to do so would be "slightly intellectually dishonest." For a company that's only been selling insurance for a year, and which is operating in a sector that is relatively new, such a figure lacks sufficient context to be useful, he argues.

Avery notes that the number of claims has been very small — "probably less than a dozen" — and that all have been hull claims. "Drone versus tree, or drone versus seagull," he says. "You may laugh, but that's true. But there's been nothing of any real substance, nothing to cause any concern."

As such, Flock's policies are not just providing benefits to pilots and operators, they are also generating solid profits for the underwriters. And it has not escaped the notice of Allianz, or its competitors, that the software back-end Flock has built — what Klinger refers to as "a comprehensive stack of insuretech technologies" — could, relatively easily, be applied to other sectors, including manned aviation.

"We've been approached by a number of large underwriters from around the world in the aviation space, who've said, 'Guys, can you basically repackage this product for manned aviation?'" Klinger says. "The scalable nature of this instant risk-assessed insurance product means that we could serve anywhere from a single small aircraft to a very large fleet of much larger aircraft, with one technology-driven platform — which is exactly the same platform that we've built for drones."

"The manned aspect is a very interesting topic for us, and is something we've talked about at length internally," says Avery, who confirms that Allianz's relationship with Flock is at present only for drone insurance. "We'd be naive not to think that this would be scalable to manned aircraft.

"There's such huge scope," he continues. "Let's be honest: We're not going to generate millions and millions with drone insurance, because the values are so small. Expanding into manned aircraft is a bit of a no-brainer for us. We've got a large book of business in the U.K. that would be perfect for the pay-as-you-go option.

"Imagine a glider client, for instance. Those guys are paying for an annual policy, but they're probably only flying for six months of the year. If they could just buy a policy when they needed it, they'd snatch your hand off."

Obviously, some of the capabilities the Flock app gives drone pilots will be of limited appeal or use to commercial manned aviation. An operator of a scheduled service will not easily be able to plan a flight for the lowest-risk time of day; a business jet pilot is unlikely to choose a low-risk routing that pushes back arrival time significantly. But Klinger believes Flock's safety-first approach will find an enthusiastic market.

"We've spoken to lots of individual pilots who fly recreationally or for small business purposes, who have absolutely said that if they had a tool available to help them to mitigate risk by making small behavioral changes, they would embrace that," he says. "Even if it didn't result in a saving, they want to be conscientious in the way that they behave. The fact that it results in an insurance saving is just a massive value-add for them, because it means that they're being rewarded for making good decisions that they want to make anyway." **BCA**

Maintaining Proficiency

Practice autorotations are a vital part of helicopter training . . . but also a leading cause of helicopter accidents. **How do we prepare pilots for this vital maneuver without causing so many accidents?**

BY **PATRICK VEILLETTE** jumprsaway@aol.com

As long as there are helicopters, there will always remain the necessity for the pilot to be proficient in autorotations. Helicopters have a distinct advantage over any airplane in that when the engine stops providing enough power to keep the craft airborne, it can descend and settle safely at a place selected by the pilot in almost any condition.

However, the workload of an autorotation is formidable and unrecoverable consequences can quickly occur if the pilot's inputs are incorrect, insufficient, excessive or poorly timed. The number and nature of the skills the helicopter pilot must master to properly perform an autorotation are intimidating and pilots must receive extensive initial and then frequent recurrent training in this critical maneuver to maintain proficiency.

Unfortunately, the practice of autorotations has been and continues to be a leading cause of rotary-wing accidents. The U.S. Joint Helicopter Safety Analysis Team (JHSAT) *Compendium Report* (2000, 2001 and 2006) shows that failures in autorotation training were noted in 68 of the 523 accidents, or 13% of all helicopter mishaps.

The fatal accident of an emergency medical service (EMS) helicopter near Mosby, Missouri, on Aug. 26, 2011, revealed considerable gaps in autorotation training. On that day at about 6:41 pm CDT, a Eurocopter AS350 B2 helicopter operated by Air Methods crashed following a loss of engine power as a result of fuel exhaustion a mile from an airport. The pilot, flight nurse, flight paramedic and patient were all killed, and the helicopter was substantially damaged.

Even though the helicopter had only about 30 min. of fuel remaining and the closest fueling station along the route of flight was at an airport about 30 min. away, the pilot elected to depart the hospital and fly to that facility with the two crewmembers and the patient. The helicopter ran out of fuel within sight of the airport and then crashed after the pilot failed to make a successful autorotation.

Pictures of the accident site revealed a wide-open field that should have been an ideal emergency landing site. The aircraft's rotor blades exhibited minimal rotational energy at impact, which occurred within 10 sec. of the engine flame-out. Pictures from the NTSB hearing showed that the helicopter struck the ground approximately at 40 deg. nose low.

How could a highly trained former U.S. Army AH-64 Apache pilot have failed to make the necessary control inputs for a safe autorotation?

During simulator re-creations of the accident sequence, the pilots involved reacted to the flameout with simultaneous aft cyclic, down collective and left pedal input (the main rotor rotates clockwise in the European-built AS350, just the opposite of most American-built helicopters.) The actual flame-out in the accident flight occurred at approximately 300 ft. AGL and at a cruise airspeed of 115 kt. By using the described control inputs, the simulator pilots successfully transitioned the helicopter into autorotation, bleeding off the kinetic energy during the cyclic flare, and setting down without mishap in 27 sec.

In contrast, when the simulator scenario attempted an initial pilot reaction with just the collective and no cyclic under the same entry conditions, the machine crashed in less than 5 sec.!

The simulator flight tests conducted after this accident showed that when a loss of engine power occurs in the Eurocopter AS350 B2 at cruise

airspeeds, the pilot must simultaneously apply aft cyclic and down collective in order to maintain rotor rpm and execute a safe autorotation. And these reactions must occur within about 2 sec. to maintain rotor rpm. The NTSB investigation determined that the autorotation training the pilot received was not representative of an actual engine failure at cruise speed, which likely contributed to his failure to successfully execute the maneuver.

The investigation also found that without specific guidance regarding the appropriate control inputs for entering an autorotation at cruise airspeeds, pilots of helicopters with low-inertia rotor systems may be unaware that aft cyclic must be applied when collective is lowered within seconds of losing engine power. Failing that, they may be unable to maintain control and perform a successful

in Autorotations

autorotation. The FAA and industry partners have since revised training materials to convey this information.

There is no debate within the industry on the importance of autorotation training. However, according to the FAA's Planning Autorotations, "The autorotation maneuver continues to cause problems for helicopter training providers throughout the country. The problem stems from the high number of accidents associated with the practice autorotation with a power recovery."

Despite a well-intentioned initiative within the helicopter industry to drive accidents to record low levels, a 2011 analysis of three years of helicopter accident data by the FAA and the International Helicopter Safety Team (IHST) recognized an unacceptable increase in the helicopter accident rate. Autorotations — both actual emergencies and during training — were involved in a third of all rotary-wing accidents for that period.

There are many recommendations from industry sources on planning for autorotation training. The IHST's *How to Train to Survive a Real Autorotation* stresses the importance for autorotation training flights to be properly briefed on the ground before takeoff. This is to include a discussion of what is going to take place during the training session and what the instructor's expectations will be for the student. Instructor experience, proficiency, currency, instructor and student recency in conducting autorotations, rotorcraft characteristics and environmental conditions must be assessed and then adjustments made as necessary for each training flight.

MAYO5/ISTOCKPHOTO

Given the risk of a helicopter entering into an unrecoverable condition if the student makes incorrect and/or untimely inputs, it is vital during in-flight training that the maneuver not be induced without warning. The U.S. Helicopter Safety Team's (USHST) *Airmanship Bulletin: Full Touchdown Autorotation Training* cautions, "A hurried, improper entry can create a very high pilot workload during the remainder of the autorotation. The CFI-H should clearly indicate how the practice autorotation will be initiated." Additionally, the IHST recommends using a verbal warning of "Practice Engine Failure Go." And if the instructor also wishes to reduce the throttle to simulate the engine loss, the student should be reminded that it does not move when the engine fails for real to avoid primacy misconception.

Rotor rpm is the most critical element in an autorotation. It provides the lift required to stabilize an acceptable rate of descent and the energy necessary to cushion the landing. The briefing should include the autorotation techniques to be used.

▶FAA Advisory Circular 61-140A, *Autorotation Training* (dated Aug. 31, 2016), stipulates that the collective should be moved to the full down position to maintain rotor rpm immediately following a loss of power. It also reminds pilots that rapid or abrupt lowering of the collective could lead to inadvertent unusual attitudes, which, depending on altitude, may not be recoverable. The IHST recommends the lowering of the collective to decrease the angle of attack (AOA) to a tolerable level to preserve rotor rpm. The subtle difference between the wording of the FAA's AC and the IHST is likely negligible when performing practice autorotations at low density altitudes. However, at high density altitudes the rotor rpm with a fully lowered collective may be high enough to exceed the power-off limitations. (See "High Density Altitude Autorotations" sidebar.)

In the aftermath of the Eurocopter accident in Mosby, many industry publications have been revised to include the importance of the synchronous application of pedal to maintain a trim condition and of aft cyclic to set a proper attitude of the rotor tip path plane for the autorotative descent. When the collective is lowered during the entry, the rotorcraft's nose will pitch down due to dissymmetry of lift. This will increase the rotor rpm decay rate, and if not corrected soon enough, the nose-low attitude will also increase the descent rate.

During autorotation entry, a large pedal input is required (right pedal in a rotor system that spins counterclockwise) and is perhaps the largest pedal input of any maneuver. Thus, it is not uncommon for the student to apply too light or too much pedal. Failure to do so results in additional parasitic drag on the rotorcraft, causing a higher descent rate, and can result in erroneous airspeed readings.

A full discussion about autorotations with inexperienced pilots would emphasize that altitudes, positioning and pre-maneuver parameters are all essential

High Density Altitude Autorotations Are Different

As part of the preparation for this article, *BCA* visited nine flight schools in Florida (1), California (1), Hawaii (2), Montana (1) and Utah (4) to sample autorotation training in helicopters. This author flew with 13 different CFI-Hs in the Robinson R22 and R44, Schweizer 300 and Enstrom 280FX. The goal of these visits was to sample autorotation training at civilian flight schools utilizing a range of training rotorcraft. (Note to readers: These visits were "self-funded" to avoid any conflict of interest or favoritism.)

The industry's recommendations regarding instructional preflight briefings were well followed by the 13 instructors. All conducted a full discussion of what would take place during the training session and what the instructor's expectations would be for me. Each confirmed my currency and previous autorotation training, and, prior to conducting training in the Robinson models, it was necessary to assure compliance with SFAR 73, which consists of ground awareness training in energy management, mast bumping, low rotor rpm, low G hazards and rotor rpm decay. Depending on a pilot's helicopter experience, it can also require an endorsement and flight training in enhanced autorotations, rpm control without the governor, low rpm and recovery, and effects of low G and recovery.

Each of the six flight schools visited using R22s or R44s for autorotation training were "less than enthusiastic" about accepting the SFAR 73 endorsement from other flight schools and insisted on completion of their own training. That was accomplished without protest. The material covered by those six flight schools followed the standard industry recommendations. (Sidenote: Each of the CFIs who gave the ground training for the SFAR 73 endorsement provided unsolicited positive impressions about their training on Robinson-specific issues by attending the safety course conducted at the Robinson Helicopter Co. factory in Torrance, California.)

Prior to beginning autorotation practice it was necessary to get acquainted with the handling characteristics of each make and model. Since my initial helicopter training had been on a "conventional" cyclic and collective design, it took me a while to adjust to the teeter bar in the Robinsons as well as the handling characteristics of low-inertia rotor systems. There were times when the negative habit transfer from past experience made me question if indeed this "old dog" could learn "new tricks."

Some of the autorotation training sessions were done on warm summer days at density altitudes (DA) nearing the performance margin limit to safely conduct a power recovery in ground effect. Preflight preparation necessitated using a sharp pencil to closely look at the performance charts on those days.

One of the notable differences in rotorcraft handling and performance during autorotation practice was caused by DA. The rotor rpm in autorotation changes depending on a great number of variables. At higher DAs, with less dense air, there is less drag on the rotor blades. With the collective

Information Sources

Collaborative working groups within the helicopter industry have published a wealth of informative recommendations to help flight schools and instructors. These include:

- ▶ European Helicopter Safety Team: *Risk Management in Training.*
- ▶ FAA Advisory Circular 61-140A, *Autorotation Training* (dated Aug. 31, 2016).
- ▶ FAA: *Helicopter Flying Handbook,* FAA-H-8083-21A (2012).
- ▶ FAA: *Planning Autorotations,* FAA-P-8740-71.
- ▶ FAA Special Airworthiness Bulletin SW-12-12, *Conducting Engine-Failure Simulation in Helicopters With Reciprocating Engines.*
- ▶ International Helicopter Safety Team: *How to Train to Survive a Real Autorotation.*
- ▶ International Helicopter Safety Team: *Training Fact Sheet — Energy in Autorotation.*
- ▶ NTSB Safety Alert: *Safety Through Helicopter Simulators.*
- ▶ Robinson Helicopter Co. Safety Notice SN-38 (dated July 2003 and revised in October 2004), *Practice Autorotations Cause Many Training Accidents.*
- ▶ U.S. Joint Helicopter Safety Analysis Team (JHSAT) *Compendium Report* (2000, 2001 and 2006).

components to learning this maneuver correctly and safely. Factors affecting the choice of practice area include wind velocity, wind direction and altitude.

The preflight briefing needs to evaluate the expected performance of the rotorcraft for the existing weather conditions. Critical factors will include density altitude and rotorcraft gross weight. Additionally, wind direction and velocity should be re-checked several times a day, especially during hot summer afternoons. Evaluate whether the rotorcraft has sufficient performance margin to safely conduct a power recovery in the event that a full-touchdown autorotation is inadvisable.

The FAA's Planning Autorotations urges instructors to avoid an out-of-the-way place to practice autorotations since airports have more available resources and people to come to your aid in the event the planned autorotation does not go well. It advises that when training at

The CFI-H at this Montana flight school (wisely) chose smooth grass and taxiways as the practice site for our power-recovery autorotation practice. Minimal traffic and proximity of suitable terrain allowed for the practice of multiple autorotations per lesson.

fully lowered, the rotor rpm will be faster at high DAs than at low ones. The rotor rpm with a fully lowered collective may be high enough to exceed the power-off limitations. A slight amount of collective pitch may be needed to maintain the rotor rpm within limits.

According to Shawn Coyle, a helicopter flight test expert, this adjustment is especially true on rotor systems with more than two rotor blades. "It may not ever be possible to fully lower the collective," he said.

Other effects on an autorotation performed at high DA include a higher rate of descent, reduced rotor rpm build in autorotation, low initial rotor rpm response, the requirement for a higher flare height and reduced engine performance for the go-around. The difference in the characteristics of the autorotation were significant compared to sea level, leaving me to ponder how many pilots get exposed to autorotation training under this challenging environmental condition.

Another interesting difference between autorotation practice in a mountainous location versus the flat terrain was the ability to accurately perceive the rotorcraft's pitch and rotor-tip path plane with respect to the horizon. For instance, when getting reacquainted with the autorotation characteristics of the Schweizer 300 at a flight school in Florida, the instructor demonstrated the relationship of the rotor-tip path plane with respect to the horizon. Maintaining this sight picture resulted in a stable (and lower workload) autorotation descent. It was nearly a textbook demonstration straight out of the FAA's *Helicopter Flying Handbook.*

In contrast, performing autorotations in mountainous terrain prevented the ability to see a flat discernible horizon. "False horizon" is a common visual illusion when operating in mountainous terrain, and this heightened the workload when trying to scan outside for the rotorcraft's and rotor-tip path plane's relationship with respect to the horizon. Without an accurate horizon it required more frequent scans of the cockpit instruments.

All but one of the flight schools was located at a busy airport, which required flying to another location to practice autorotations. Given the time spent en route to a practice area, the number of autorotations per lesson was typically limited to five or six for 1.4 hr. of block time. At an average cost of $350/hr. for the helicopter and instructor, this equates to roughly $80 per autorotation.

As discussed in the "Simulators" sidebar (page 48), there needs to be a more effective option to afford students a large number of practice autorotations to master this important maneuver. **BCA**

an airport, use a runway or smooth surface next to a runway when conducting practice autorotations in case the intended recovery results in a full touchdown. The Advisory Circular also suggests using designated hard-surface off-airport helicopter landing areas, large hard-surface parking lots, large grass fields and grass runways in good condition. If any doubt exists as to the condition of the surface, a ground or low reconnaissance should be conducted prior to conducting training.

Some flight instructors have introduced simulated engine failures by "throttle chops," *i.e.,* cutting the engine to idle. This has caused the practice autorotations to become actual autorotations. On Sept. 22, 2001, near Ramona, California, the flight instructor in a Hughes 269C initiated the autorotation demonstration maneuver between 600 and 700 ft. AGL by rolling off the throttle and splitting the needles. About 300 ft., he initiated the recovery; however, he then noticed that the engine rpm was near zero and that the engine would not respond to throttle input. At about 100 ft., the airspeed was about 40 kt., and the rotor rpm was on the low side of the green arc. The helicopter subsequently landed hard, slid forward, rolled over, and came to rest on its right side.

The company chief pilot stated that, shortly after the instructor was hired, he showed the instructor the proper technique for teaching autorotations, which did not include rolling the throttle off in flight, a procedure that could result in engine stoppage. The NTSB determined the probable cause of the accident to be the flight instructor's failure to follow the proper procedures while demonstrating a practice autorotation, resulting in a total loss of engine power and subsequent hard landing.

About four months after the accident, the FAA issued Special Airworthiness Bulletin SW-12-12, Conducting Engine-Failure Simulation in Helicopters With Reciprocating Engines. The bulletin cautions owners and operators of Schweizer 269C and 269C-1 helicopters to avoid throttle chops to full idle in order to minimize the possibility of engine stoppage.

The Robinson Helicopter Co. Safety Notice SN-38 (dated July 2003 and revised in October 2004), Practice Autorotations Cause Many Training Accidents, provides similar recommendations. It states, "do not roll throttle to full idle. Reduce throttle smoothly for a small visible needle split, then hold throttle firmly to override governor. Recover immediately if engine is rough or engine rpm continues to drop."

The FAA Advisory Circular recommends that initial training for a 180-deg. autorotation be introduced over a number of flight lessons and should start with a much higher altitude as the entry point and as training progresses, reduce the altitude and thereby gradually increase the level of difficulty. The

Simulators

Managers whose fleets include helicopters are faced with multiple choices in keeping their pilots proficient in autorotations. Should a company helicopter be used for this training? Insurance companies have clauses in contracts nullifying coverage if damage occurs during autorotation training. Then there are the practical considerations should something go wrong during practice. Any damage could put your rotorcraft in the repair shop for a long and expensive time.

The author settling into the seat of an EC-135 sim to experience first-hand the fidelity of the Level D full-motion simulator in a variety of emergency maneuvers.

Another training option is to use flight simulators, which afford the ultimate benefit of damaging only one's ego without bending metal or breaking bones when mistakes occur. Moreover, advances in simulation technology have produced remarkably accurate handling and performance characteristics mimicking the actual make/model of helicopter. Simulator training offers learning opportunities from student and instructor errors that could not be safely attempted in the actual rotorcraft.

The NTSB's *Safety Alert Safety Through Helicopter Simulators* points out that improper performance of emergency procedures has led to numerous helicopter accidents. Moreover, deteriorating weather, helicopter limitations and autorotation performance characteristics restrict what scenarios can be performed in an actual helicopter. During flight training, it is difficult to re-create the element of surprise and the realistic, complex scenarios that pilots may experience during an emergency.

"Consistent, standardized simulator training will help prepare pilots for the unexpected and will decrease the risk of an accident," it states. "Simulators can be a helpful tool for operators to provide pilot training on autorotations during any phase of flight, which reinforces the immediate responses required during actual emergencies."

At Heli-Expo 2015, industry-government workshop attendees discussed autorotation training options. Those at the invitation-only meeting included NTSB members, investigators and staff; FAA investigators and simulator inspectors; insurance industry representatives; training vendors; members of the U.S. Helicopter Safety Team and the National EMS Pilots Association; and this author.

One of the questions fielded in the meeting was whether the fidelity of simulators is sufficient to create a positive transfer of skill. FAA simulator inspectors assured the audience that as long as the maneuver stays within the sim's certification limits it would accurately replicate an autorotating helicopter's behavior.

In May 2015, we were invited to Metro Aviation's Training Center in Shreveport, Louisiana, and given the opportunity to experience first-hand the capabilities of the EC-135 Level D full-motion simulator as well as observe its usage by pilots attending recurrent training.

One of the maneuvers that ably demonstrated a simulator's capabilities was a fixed-pitch tail rotor control failure in forward flight. After reducing the collective to obtain a minimum sideslip angle and maintaining 70 KIAS or higher, the sim instructor gave the trainee an advantageous crosswind from the left. The pilot initiated a shallow approach with the nose pointing left. As the airspeed lowered below 40 kt., the procedure called for further reducing the airspeed close to

instructor should first demonstrate a 180-deg. autorotation with an entry from above 1,500 ft. AGL and conclude by performing a power recovery and go-around no lower than 500 ft. AGL. Once the student is proficient in performing this maneuver to the go-around point at 500 ft., the instructor should then demonstrate the 180-deg. autorotation from a lower entry point, such as at 1,000 ft. The student should then be given the opportunity to practice this maneuver with an entry at that altitude, terminating in a flare and power recovery at a safe hover altitude above the ground, until proficient from the lower altitude.

The FAA Advisory Circular also recommends the adoption of a decision check at 300 ft. AGL at which point the pilot, instructor, examiner or inspector chooses to either continue the autorotation or abort the maneuver and return to powered flight. It is important to impress upon the pilot the need to have the helicopter in a steady state at approximately 300 ft. in order to help ensure that a safe landing or power recovery can be accomplished.

The 300-ft. decision check requires the rotorcraft's airspeed to be within +/-5 kt., rotor rpm in the green, a normal rate of descent, all turns completed and the rotorcraft in proper alignment. If any of these parameters are not met, the USHST's *Touchdown Autorotations* specifies the instructor must announce "my flight controls" and take the controls, reintroduce power and commence recovery. A go-around at this stage takes advantage of the translational lift and is far preferable to the potential consequences of trying to salvage an autorotation close to the ground. Higher density altitudes would necessitate moving this decision point to a higher altitude.

Robinson Helicopter's Safety Notice SN-38 states:

Many practice autorotation accidents occur when the helicopter descends below 100 ft. AGL without all the proper conditions having been met. As the aircraft descends through 100 ft. AGL, make an the ground until the nose was aligned with the flight direction. At this point the instructor tugged on his seat belt, braced himself with a firm hold, looked over with a grin and said, "What's going to happen next is impressive. Hold on!" The trainee's initial attempts at touchdown with this simulated malfunction resulted in a wild series of gyrations.

The advantages of a simulator were clearly evident during the practice of numerous abnormal procedures. The simulators allowed a demonstration of an ideal maneuver as well as how not to do the maneuver, presenting common errors and ways to avoid them. Demonstrations were offered for variations in rotorcraft weight, density altitude, wind speed and direction, showing how each factor will individually or in combination affect performance of an autorotation.

Several dozen abnormal procedures were performed during the 2-hr. session, which was many more than could have been done in an actual rotorcraft in the same time frame. In a simulator, any part of the maneuver can be practiced in isolation. For example, the complex and synchronous movement of the collective, cyclic and pedal at the initiation of the autorotation can be practiced over and over again with the instructor critiquing each attempt until the student shows adequate performance.

And unlike a real helicopter, a simulator can be "frozen" so the instructor can show the student the nature of the situation. Time manipulation can allow error recovery, stepping back to a previous system state. Oftentimes — especially in the high workload of an autorotation — some of the control inputs made by the student do not result in an easily observed change. In the simulator, supplementary cues may be added to aid the student's perception of subtle changes in the visual field.

As one trainee I observed became more proficient, the simulator instructor programmed a variety of more challenging problems. Simulators provide the ability for "surprise" engine failures and allow students to make mistakes without jeopardizing safety. Timely use of the "freeze" button allowed the instructor to show the student the nature of the situation that had developed without any further change.

During autorotation practice in an actual helicopter, a great deal of time is spent climbing back into the traffic pattern to a position to repeat the maneuver. This limits the number of autorotations that can be practiced in a session. In a simulator, with the press of a button the helicopter is right back at the spot to start another autorotation.

The value of a simulator for training of critical procedures is unquestioned. The downside is that sending an organization's pilots to simulator training requires significant financial commitment and removes them from the work schedule.

An autorotation is a complex "perceptual motor skill," meaning that muscular movement is required as well as sensory control. An autorotation is more difficult to learn than simple motor skills and would potentially benefit from hundreds (or even thousands) of repetitions. Inexperienced pilots who are most in need of a safe training environment in which to make the many repetitions necessary could especially benefit from access to flight training devices.

Several companies have developed low-cost helicopter simulation platforms that allow trainees to practice difficult maneuvers to include autorotations, hovering, vertical reference and slung loads. These platforms are reconfigurable, allowing the device to add a variety of instrument panels, modules and rotorcraft-specific flight controls.

The industry could benefit from the utilization of flight training devices that effectively provide extensive practice of perceptual-motor skills, part-task training and augmented cueing in a realistic cockpit environment. Unfortunately, none of the flight schools we visited had these training platforms at the time. This *BCA* author intends to follow up on this promising technology. **BCA**

immediate power recovery unless all of the following conditions exist:

(1) *Rotor rpm in the middle of the green arc.*

(2) *Airspeed stabilized between 60 and 70 KIAS.*

(3) *A normal rate of descent, usually less than 1,500 ft./min.*

(4) *Turns (if any) completed.*

The Robinson notice also states that a high percentage of training accidents occur after many consecutive autorotations. To maintain instructor focus and minimize student fatigue, it recommends limiting practice to no more than three or four consecutive autorotations.

Meanwhile, the FAA AC indicates that the predominant probable cause of autorotation training accidents is failure to maintain main-rotor rpm and airspeed within the rotorcraft flight manual's (RFM) specified range, resulting in an excessive and unrecoverable rate of descent. Each helicopter has a recommended airspeed and rotor rpm for autorotations, specified in the RFM. Throughout the autorotation, pilots should continually cross-check rotorcraft attitude, rotor rpm and airspeed and that the helicopter is in trim (centered trim ball.)

CFI-Hs must rapidly recognize and intervene if the safety of the crew and rotorcraft is jeopardized during a practice autorotation. The FAA's Planning Autorotations preflight briefing includes at what point the instructor will take control of the rotorcraft if the previously determined conditions are not met. The Advisory Circular recommends that instructors should not talk the student through corrective action or try to manipulate the controls and attempt to correct the autorotation. If proper conditions are not met at the 300-ft. decision point, then power should be immediately restored and a go-around performed.

The Mosby crash brings forth other questions regarding autorotation training. Plenty of civilian helicopter pilots have previous military rotary-wing training. The intense training to become mission-qualified in the military would thoroughly ingrain the reactions for helicopters with high-inertia rotor systems. But as the Mosby investigation revealed, the former military aviator involved had not received adequate training to re-program his reactions to a low-inertia rotor system. Logic would also extend that concern for a pilot who transitions to a rotor system that rotates opposite from one's previous experience.

How much practice is necessary to re-program a pilot's deeply trained reflexes, especially for a rotorcraft emergency in which correct control inputs must occur within seconds of sudden engine failure? To answer this question I sought out the resources from national organizations that train Olympic athletes in skiing and hockey, sports that require lightning-fast reactions to rapidly changing conditions. These organizations include physiologists, biophysicists, psychologists and neuroscientists who focus on changing seemingly small reflexes to create a competitive edge. I had the assistance of an Olympic-medalist skier and Olympic team hockey coach who put into practical terms this in-depth science. The bottom-line answer is that making fine adjustments to reflexes of highly trained athletes can take thousands of repetitions. After walking out of the U.S. Ski & Snowboard Center of Excellence training academy, I couldn't help but wonder if we in aviation are fooling ourselves by thinking a modest number of repetitions is sufficient to deeply ingrain the complex and rapid reflexes needed to respond to a sudden autorotation. Not only does that concern extend to autorotation training but also to upset recovery training in fixed-wing aircraft.

The NTSB's Mosby investigation emphasizes the importance of realistic autorotation training in all environmental conditions. However, inflight training of autorotations requires tightly controlling as much risk as possible. This includes no "surprise" simulated engine failures or practicing the maneuver in less-than-good conditions. The problem is that in the real world, an autorotation can occur at any moment without warning and in adverse environmental conditions.

Autorotation training is risky, time-consuming and expensive — and yet absolutely necessary. How best to conduct that training is a critical matter likely to reviewed and refined well into the future. **BCA**

Common Autorotation Training Errors

The FAA and numerous industry documents have compiled lists of typical student errors during autorotation training. Correct control application immediately after engine failure is necessary to establish the rotorcraft in a proper autorotative descent and to preserve the all-important rotor rpm.

If the nose is permitted to lower during the initial moments in the autorotation, it delays the recovery of rotor rpm and allows the airspeed to build rapidly beyond the optimal glide speed. A rapid correction of the cyclic aft can result in a rotor overspeed.

A student needs to learn the proper balance between having the eye scan outside of the rotorcraft versus checking the instruments without affecting the all-important task of flying the rotorcraft. There is the temptation for students to focus too much on the airspeed rather than focusing on the attitude of the rotorcraft. FAA Advisory Circular 61-140A, Autorotation Training, advises, "Do not allow the nose to pitch up or down excessively during the maneuver, as it may cause undesirable rotor rpm excursions. Pitot-static airspeed indications may be unreliable or lag during an autorotative turn. Pilots should also exercise caution to avoid using excessive rotorcraft pitch attitudes to chase airspeed indications in an autorotative turn."

While it is advantageous to land into the wind during an autorotation, continuing to turn into wind regardless of height can place the rotorcraft perilously close to the ground during the critical maneuvering portions.

Since the kinetic energy (airspeed) will be converted into rotor rpm during the flare, it is vital for students to learn the importance of maintaining a sufficient airspeed for an effective flare and power recovery.

Every autorotational flare will differ, depending on wind conditions, airspeed, density altitude, the specific make and model of helicopter, and its gross weight. The FAA Helicopter Flying Handbook FAA-H-8083-21A (2012) states in part, "Care must be taken in the execution of the flare so that the cyclic control is neither moved rearward so abruptly that it causes the helicopter to climb nor moved so slowly that it does not arrest the descent, which may allow the helicopter to settle so rapidly that the tail rotor strikes the ground . . . extreme caution should be used to avoid an excessive nose-high and tail-low attitude below 10 ft. The helicopter must be close to the landing attitude to keep the tail rotor from contacting the surface."

Other errors during the flare include flaring too little or too much as well as misjudging a proper height above the surface to begin the flare.

Failure to adjust flight path when clearly overshooting or undershooting and failure to use differing attitudes/airspeeds to adjust autorotative glide to make the landing spot are also cited as common student errors. It was interesting to bring up this question during preflight briefings.

Flight instructors who want to expand their knowledge of autorotation also have a wide selection of books from which to choose. Shawn Coyle, a helicopter test pilot instructor with more than 6,000 hr. of experience in 40+ rotorcraft, published Little *Book of Autorotations*, which is dedicated solely to the topic of landing a helicopter without engine power. This author referred to that book often after the flight lessons with the young CFIs, contemplating how they could more effectively explain and teach autorotations. **BCA**

Trends From 2016-2017 Autorotation Training Accidents

A total of 61 helicopter accident investigation reports involving an autorotation are contained in the NTSB's accident database during 2016 and 2017. Thirteen of the 61 accidents occurred during autorotation training in this two-year period. One accident resulted in a fatality. All of the other accidents involved non-fatal injuries. Two of the 13 involved turbine-powered helicopters. The rest occurred in recip-powered helicopters. Improper flare occurred in six of the 13. Lack of timely intervention by the CFI was cited in five. A loss of power during autorotation training occurred in three. Improper throttle usage, adverse winds and loss of rotor rpm were factors in one accident each.

That's the raw data. It is worth noting that the number of autorotation accidents in this two-year period was "only" 13. This is worth contemplation especially if one considers the amount of helicopter flight training that occurred during the time frame. Making sweeping pronouncements from a small number of data points is not good science. With that said, is this lower number of autorotation accidents in the period indicative of a positive reaction to the government-industry initiatives? Perhaps. The debate on whether this is a direct cause-and-effect or mere happenstance would carry good arguments on both sides.

Second, notice many important topics that are absent in these accidents. For instance, the one accident with loss of rotor rpm occurred in the final moments of a landing flare, resulting in airframe damage but no major injuries. Given the (essentially) unrecoverable condition if the rotor rpm falls below critical values, it seems apparent that flight instructors are appropriately monitoring rotor rpm during a student's practice.

Third, it is worth mentioning that none of the accidents involved flagrant deviations from the industry's recommendations. Instructors weren't practicing autorotations over a poor choice of terrain, and in all but one accident they were adhering to the recommendations for "no throttle chops." Of course, the argument can be made that these don't represent other events in the real world in which instructors were not abiding by the industry's recommendations but avoided mishaps anyway. Without FOQA data we can't definitively determine the margins of safety of a helicopter's flight condition during autorotation practice. **BCA**

Touchdown Autorotation Pros and Cons

The majority of inflight training autorotations end with a power recovery to a hover. However, there are vocal advocates who believe that learning an autorotation procedure all the way to the ground — "a touchdown autorotation" — is better since it provides the student pilot the maneuver's actual look and feel and thus heightened preparation should it happen for real. Touchdown autorotations have been a point of lively debate within the helicopter industry for quite some time and will likely continue, as it should.

The FAA Practical Test Standards do not require applicants for the private, commercial or ATP certificate to demonstrate proficiency in full touchdown autorotations. Neither does 14 CFR 135 during initial and recurrent training. However, the Flight Instructor Practical Test Standards do require a CFI applicant to demonstrate proficiency in full touchdown autorotations.

The U.S. Helicopter Safety Team's (USHST) *Airmanship Bulletin: Full Touchdown Autorotation Training* highlights the pros and cons of full touchdown training. Advocates believe it increases pilot confidence and thus reduces the chance of a catastrophic outcome to a real engine failure. They also believe that the power recovery aspect of the autorotation training does not resemble the real situation and may even build a false sense of security on the part of the pilot.

In comparison, advocates for power-recovery claim that the increased risk of damaging the rotorcraft in a full touchdown maneuver is not worth the benefit gained over a power recovery to the hover. They also believe that with the increased reliability of today's modern engines, the industry would damage more rotorcraft practicing for an event that rarely occurs. The USHST's Airmanship Bulletin does not take either side in this debate.

The U.S. Joint Helicopter Safety Analysis Team (JHSAT) identified intervention recommendations associated with full touchdown autorotations for training. These include a quality training program and a CFI with judgment and decision making focused on following the student more closely during the maneuver and an emphasis on training for maintaining awareness of cues critical to safe flight. Also, it maintains that exceptional risk management and adherence procedures are highly important.

Helicopter organizations must assess the risk of performing their training autorotations to the ground. There are associated costs involved in doing this including cumulative wear and tear on the rotorcraft.

Organizations whose insurance won't permit full touchdown autorotation training in their helicopters but who still want their pilots to experience it can attend training at well-known vendors that provide expert instructors who teach full touchdown autorotations for a living and have a rather respectable safety record teaching this potentially high-risk maneuver **BCA**

GPS Vulnerabilities

It's become **a utility,** so can GPS afford to be **susceptible to malicious** interference?"

BY **DAVID ESLER** david.esler@comcast.net

NOAA

The current Global Positioning System constellation consists of 24 Block II satellites, 21 active and three spares, rotating the planet at 12,550 sm in medium-earth orbit. New upgraded, more powerful Block III satellites now being launched will form a replacement constellation of 31 units claimed to be more resistant to jamming.

Back in the 1980s, as the U.S. Air Force was testing the first NavStar satellites in research trials that led to today's Global Positioning System (GPS), Charlie Trimble, founder of a small navigation equipment company in Silicon Valley, wrote a pamphlet in which he predicted that GPS would eventually become a "utility," or essential public service.

I recognized that the proposed system with its "constellation" of satellites circling in mid-earth orbit might become a useful navaid for aircraft, missiles and marine vessels but probably not for much else. Furthermore, who among the general public would need a precision navigation device or be able to afford to buy one?

Well, of course, Trimble was prescient — and right — and his little eponymous venture that started by manufacturing Loran-C navigation sets became a pioneer in developing GPS equipment, and today Trimble Inc. employs more than 8,000 people. Meanwhile, GPS has become the basis for a multitude of activities and conveniences, everything from surveying, agriculture, construction, vehicle tracking and autonomous drone operation to digitized map reading and guidance in our cars — and smartphones. It is even making the much-vaunted autonomous (driverless) car possible. In other words, GPS has become that utility Trimble predicted three decades ago and now we're carrying affordable, handheld computers equipped with GPS engines and using GPS guidance and time data routinely.

For aviation, space-based position and navigation enabled 3-D position determination for all phases of flight — even for maneuvering on the ground. GPS provided a repeatable level of accuracy hitherto unavailable. It opened up a raft of new precision approaches independent of ground-based navaids, meaning that airports without conventional (and expensive) guidance infrastructure could now have these procedures. The same was true for en route navigation, especially in remote areas devoid of radio aids including oceanic airspace, since guidance signals were emanating from space and available almost everywhere on the globe (or at least between 80 deg. north and 80 deg. south latitudes).

The Global Navigation Satellite System (GNSS) also made Automatic Dependent Surveillance (ADS) possible, since positioning was so accurate that aircraft could now broadcast their own locations in areas where there was little or no radar coverage. Air traffic controllers could then track them with a "virtual radar" presented on a computer-generated display, based on the GPS-verified ADS transmission. It's not surprising, then, that FAA planners and contractors designed the NextGen ATC system around GPS and its progeny, ADS.

When the full GPS constellation of 21 active satellites and three spares became fully active in 1995, the system's consistent accuracy and reliability even prompted planners in the FAA and Department of Defense (DOD) to consider ultimately decommissioning the huge and expensive network of radio navigation aids — the VORs with their DME adjuncts, NDBs and various instrument approaches — since it was assumed their functions could be provided by GPS with greater accuracy (easily supporting Required Navigation Performance [RNP]) and for less money.

For a while, the FAA and the Pentagon considered retaining the low-frequency Loran-C navigation network as a compatible backup to GPS, both being ground-referenced (i.e., calculating position in latitude and longitude), but it was eventually decided that the U.S and Canadian Loran transmitter chains would be turned off in 2010. Other chains in Europe and Russia followed in 2015. There has been talk among governments of resurrecting a new digitally based Loran system ("enhanced," or eLoran, studied by the U.K. until 2015 when work was halted on the project), but so far no agreements have been finalized.

Thus, at the present, there would be no backup for GPS except inertial reference navigation (with its cumulative error limitation) and existing radio navaids, if for some reason, the system were to go down. For aviation alone, becoming more dependent on GPS every day, such an event would be merely disruptive to devastating.

According to a 2011 FAA assessment, the potential economic impact to aviation from a nationwide GPS interference event would be an estimated $70 billion. "Aviation relies on GPS significantly, and we not only need it but [must] make sure it is protected," Andrew Roy, director of engineering services at Aviation Spectrum Resources, told *BCA*.

But It's Vulnerable . . .

But the truth about GPS is that it is vulnerable to interference, both accidental and malicious.

"Aviation has been aware of GPS vulnerabilities since Day One," confirmed Guy Buesnel at U.K.-based Spirant (pronounced "SPY-rent"), which makes, among other things, GPS simulators for testing of receivers. "The low signal strength, as low as a 40-watt light bulb, transmitted from space, is vulnerable to spoofing and jamming." (The signal comes in below thermal noise, and that had to be accommodated when the system was designed.)

The designed GPS receiver sensitivity level is below 10-14 watts, given the 13,000 sm (20,000 km) distance the signal needs to travel from the satellite to the ground. "So, from a jamming perspective," Roy added, "it isn't that hard to get a higher-power signal onto the L1 operating frequency, which is 1575.42 MHz. If you can get some power into that band, whether deliberate or accidental, it doesn't take that much power to stop the receiver from being able to 'see' the GPS signal. So, it's easy for the signal to be lost — DOD intentional jamming has proven that." [More on those DOD exercises further on.]

Massive areas can be affected in the worst-case scenarios. Not only that, but even local interference over a city block or larger area can be accomplished with a handheld jammer.

For an interesting walk on the wild side, Google "GPS jammers" and see what comes up — and mind you, this is not on the so-called "darknet" but the public platform anyone can access. Easily available, the jammers you will see advertised are "sold as 'personal privacy systems,' and their use is quite widespread," Buesnel observed. The devices — made in China, of course, and in many cases, sold on line from there — can be purchased for less than $125. The smallest can be plugged into the cigarette lighter or USB port of a vehicle. High-powered handheld jammers, some of which are claimed to corrupt all GPS bands, L1 through L5, while covering both tracking and navigation plus cellphone signals, are battery powered and retail for between $200 and $500.

In addition to malefactors blocking GPS signals for malicious purposes or just to create mischief, personal jammers have become especially popular with long-haul truckers or package delivery drivers tracked via GPS by their employers to ensure they're adhering to their schedules. The jammers disable tracking devices installed by the shipping companies on their trucks that calculate GPS location.

The larger problem is that the jammers can disrupt any GPS signal within their range — up to miles away, depending on the unit. Moreover, "It is quite hard to identify the source of jamming," Roy pointed out, "especially if it's coming from a moving vehicle like a truck." Truckers are also using jammers to avoid paying tolls, since the automated toll-takers on highways and bridges operate on GPS tracking, and the big rigs can simply blast through the toll lanes with impunity.

Jammers work by broadcasting noise on the same frequencies generated by the satellites, blocking receivers from picking them up. Think of the jamming signal as a bubble around the jammer that GPS signals can't penetrate. And these jamming bubbles have inadvertently caused a lot of trouble where highways pass in the vicinity of airports or when vehicles containing jammers drive or park near airports or under approach and departure paths.

This scenario occurred at Northeast Philadelphia Airport (KPNE), where in 2015 pilots were reporting loss of GPS on approaches, and at Newark Liberty International Airport (KEWR) in 2012, where a jamming device in a parked pickup truck disrupted the airport's GPS Ground Based Augmentation System (GBAS). The driver of the pickup, who claimed he was using the jammer to keep his employer from tracking him, was himself tracked down by Federal Communications Commission investigators and ultimately fined $32,000 for interfering with a critical aviation guidance system. And at business aviation's Teterboro Airport (KTEB), there have been reports of GPS jamming believed to be emanating from truckers plying U.S. Route 46, which passes just north of the airport and Runways 19 and 24.

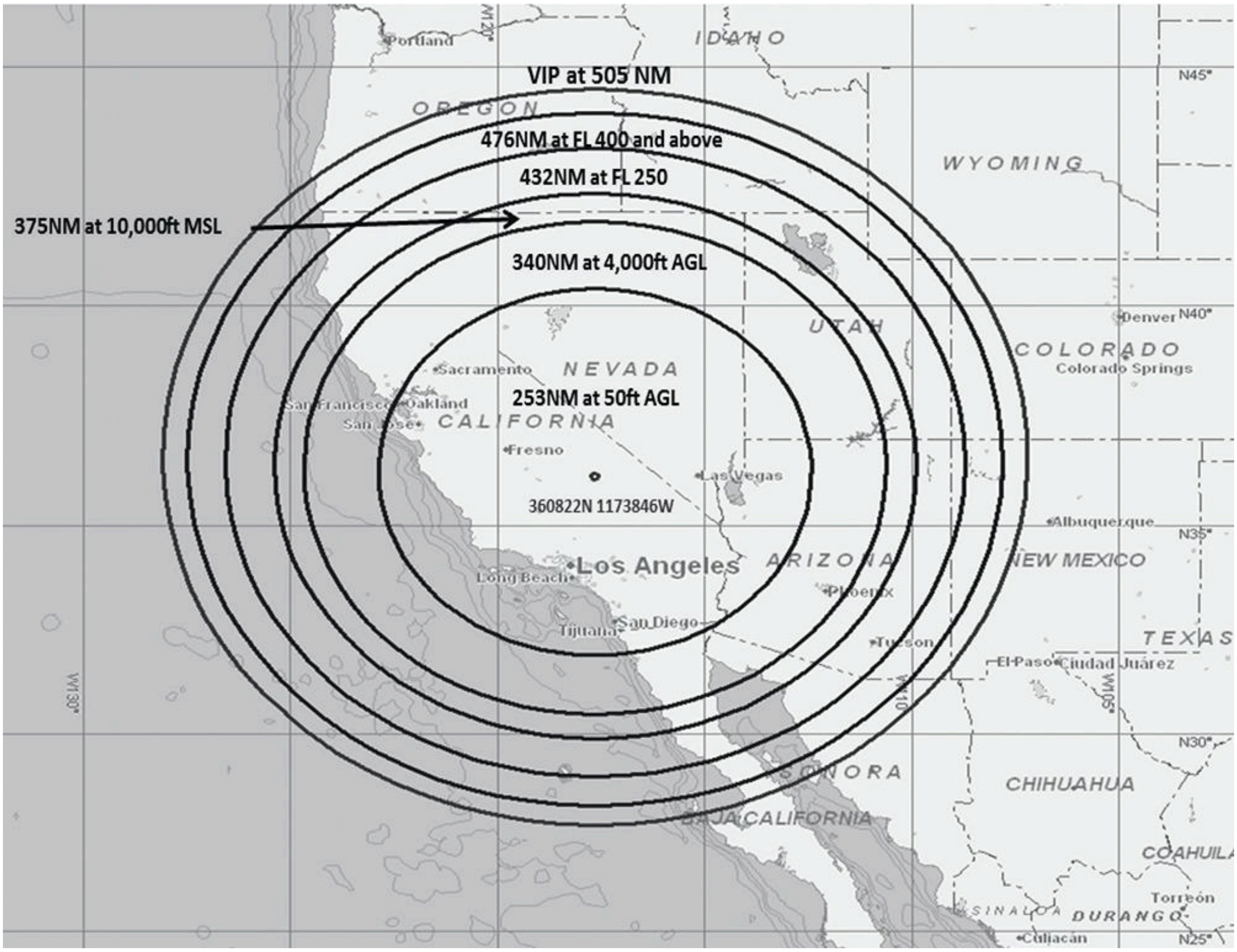
Buesnel related that, "Last year, I took a London black cab and saw a GPS jammer in the cigarette lighter. I asked the driver why he was using the device, and he said it was to interfere with Uber, 'because the Uber drivers rely on GPS to meet their customers' at airports and other venues, and this was taking business away from him." Of course, the jammers also mess with the GPS signals that aircraft rely on at the airports.

In August 2017, at Nantes Atlantique Airport (LFRS) in France, a traveler left his vehicle in the car park with a GPS jammer activated in the cigarette lighter port. Meanwhile, he departed on an airline flight for a vacation. The jammer "disrupted the tracking systems of planes arriving and taking off from the airport, leading to delays on several flights before it was located and disabled." The perpetrator was eventually fined €2,000 by French authorities, but there is no report as to the condition of his car when he got it back from the impound lot.

Jammed Up by Jamming

It is illegal in the U.S. to use, sell or manufacture GPS jammers, and according to Kashmir Hill, writing for Gizmodo Media in 2017, every time you turn one on, you're liable for a $16,000 fine from the FCC (see https://gizmodo.com/jamming-gps-signals-is-illegal-dangerous-cheap-and-easy-1796778955). Additionally, infractions can be punished by jail time. ASRI's Roy added that "Jamming GPS signals is a fundamental assault on the public spectrum. . . . There is lots of publicity to try and stop it and a crackdown from the FCC on sellers of the equipment."

FAA



For six days in 2016, the Department of Defense conducted this GPS "denial-of-service" jamming exercise centered on China Lake, California, and extending outward with a radius of 500 nm and upward from 50 ft. at origin to more than 40,000 ft. at periphery. Note that the outer circle encompassed Class A airspace at San Francisco, Los Angeles, and Las Vegas. Such exercises, which are becoming more common, are announced via notam.

In 2016, the FCC fined a Chinese supplier $34 million for selling 10 GPS jammers to undercover FCC agents. Further, the FCC extended its GPS jamming prohibition to state and local governments and law enforcement agencies when it learned that some undercover cops were using jammers to avoid being tracked in their cars. Some websites marketing jammers have been blocked or taken down, as well, but thousands of the devices remain in the field and in daily use and are often traded on websites like eBay.

Hill relates how small drone users — many of them teenagers — have circumvented manufacturers' "no drone zone" software, which is dependent on GPS signals to know a drone's location in order keep it away from sensitive areas like airports, government installations, even the White House. They do this by employing jammers to confuse the GPS signals, essentially telling the drones they are outside the prohibited areas.

Even practitioners of the highly popular video game Pokemon Go are spoofing GPS signals with jammers. Players download an app to their phones that superimposes creatures, or monsters, over real-world locations named "arenas" and go to them to either "collect" the virtual creatures or defend the arenas from other players. Buesnel said a second app allows gamers to "collect the monsters from a single location and spoof their GPS system so it looks to other players like they're wandering around the map. You can buy these apps that will give a false location of your phone."

Pokemon Go designers have changed the game to neutralize this, but the hackers still have their apps and can simulate a GPS constellation for less than $300. Hill claims that some players are buying multiple jammers and stationing them at the arenas to block competitors from registering their locations in the virtual space, thus preserving their dominance of it. Some of these locations have been near — and even on — airports, thus affecting GPS and aircraft operations.

Unintentional jamming of GPS signals also occurs, as at Hannover International Airport (EDDV) in Germany in 2010 when a GPS repeater was set up in a hangar less than 3,000 ft. from the threshold of an active runway to test GPS receivers on business jets. Airline crews began to experience Ground Proximity Warning System (GPWS) alarms and displaced runway threshold alerts while taxiing for takeoff. In one case, the repeater acted like a GPS spoofer. Subsequent investigations determined that the repeater power level was unnecessarily high for the testing being accomplished and that the hangar door was occasionally left open during testing, increasing the jamming effect.

Since 2013 and to November 2018, more than 250 incidents of GPS disruption have been reported to the Aviation Safety Reporting System (ASRS) by pilots. In Europe and adjoining areas, 815 incidents were reported to Eurocontrol, again, through November 2018. A sampling of incidents from the last three years reveals the ubiquity of suspected jamming incidents experienced by aircraft in flight:

▶ Manila Ninoy Aquino International Airport (RPLL), Philippines, 2016. There were more than 50 reports of GPS interference on approach to Runway 24 during the second quarter. Lapses included total loss of onboard GNSS with GPS-L and -R "invalid" messages appearing on displays; decrease in navigation performance leading to RNP alerts due to increasing lateral error (i.e., actual nav performance deterioration below RNP) leading to missed approaches and GPWS alerts. In some aircraft, nav reverted to IRU or DME/DME, loss of autoland and ADS-B capabilities. According to an International Civil Aviation Organization Information Paper, there exists some suspicion that a cellphone tower on the approach course at 14 nm DME might be the cause of the GPS signal degradation, although this was not verified, and suspicion exists that the GPS signal degradation may have been caused by jamming attacks.

▶ Undisclosed U.S. location, 2017. Pilot reported temporarily losing the GPS signal, saying "GPS loss seemed an illusion." This was supported by ATC radioing that no other aircraft in the area had reported a GPS outage, causing the pilot to assume that he'd encountered a trucker with a GPS jammer on a highway beneath the aircraft. "So I continued into the rain, clouds and turbulence . . . then all hell broke loose: GPS signal failure, ADS-B failure, multiple cascading messages on the GTN."

▶ Fresno Yosemite International Airport (KFAT), California, 2017. Aircraft appeared to crew to turn toward assigned waypoint; however, ATC asked crew to confirm heading. "At that point it appeared the GPS had lost position, and we declared a lost signal to ATC and asked for vectors. We were not able to regain accuracy with the GPS and navigated on vectors and VOR tracking for the remainder of the trip."

▶ Undisclosed U.S. Location, 2017. "I experienced a failure of the WAAS [Wide Area Augmentation System] GPS antenna in flight. The antenna failed in such a manner as to create spurious emissions that caused all other GPS antennas on my aircraft to lose signal."

▶ Cherry Capital Airport (KTVC), Traverse City, Michigan, 2018. Pilot reported that while instructing in vicinity of LADIN intersection he experienced a "GPS anomaly," the receiver displaying scrambled characters that were indiscernible. The event lasted approximately 10 sec., then cleared up.

The Government Jams, Too

Just to make flight crews' lives more interesting and increase cockpit workload and stress, the U.S. DOD, which manages the Global Positioning System through the U.S. Air Force out of Schriever AFB, Colorado, is mandated by presidential directive to train and test U.S. military forces in operationally realistic conditions that include "denial of GPS" through jamming. These events, staged at varying locations throughout the country, have been increasing in frequency in recent years and covering ever larger areas. The DOD conducts intentional GPS interference during these events in coordination with military exercises to ensure weapons systems can operate in a GPS-degraded environment and for research purposes and testing of the GNSS.

The DOD coordinates with the FAA when it schedules these exercises, and the latter publishes flight advisories announcing dates, times and areas covered by them — another reason to plow through the reams of NOTAMs and notes on your computerized flight plan before you fly. As an example of the growing scope of these events, consider the six-day one staged in June 2016 centered on China Lake, California, and extending outward in a 500-nm circle from 50 ft. AGL at the source up to more than 40,000 ft. at the periphery and encompassing the cities — and Class A airspace — of San Francisco, Los Angeles and Las Vegas.

The Radio Technical Commission for Aeronautics (RTCA) in a March 2018 report titled "Operational Impacts of Intentional GPS Interference" concluded that the effect of GPS jamming in the DOD exercises varies on aircraft flying through or near the test zones from total loss of GPS reception to "degraded integrity." Of course, it also causes lapses in ADS-B. In a 2012 event, two airliners flying near one another in an interference zone drifted off course when their GPS receivers lost signal and had to be sorted out by a vigilant air traffic controller, averting a possible midair collision.

On April 14, 2016, the FAA released a priority message indicating that an Embraer Phenom 300 had experienced a yaw damper failure following loss of GPS signal while cruising through a DOD interference zone. The GPS loss precipitated a cascade event causing subsequent failure of AHRS, autopilot, ventral rudder and yaw damper, instituting a Dutch roll and triggering a stall warning protection system fault — all at high airspeeds.

The FAA priority message stated that "Further analysis revealed that GPS constellation signal instability in the flight area leading to loss of both GPS information data and causing the event. . . . The AHRS continuously calculates and applies altitude and heading measurement updates to correct gyro-integrated altitude and heading during flight maneuvers and, in normal operation, the AHRS relies upon GPS, air data system, and magnetic field measurements supplied by the magnetometer to maintain primary AHRS operation mode."

The FAA subsequently urged pilots of Phenom 300s to avoid DOD GPS jamming areas and closely monitor flight control systems due to potential loss of GPS signals. Embraer responded with a statement that the government's GPS testing shouldn't affect the normal operation of the Phenom and that the aircraft flight manual specified how to fly the aircraft under the conditions described in the FAA's priority message.

How could a GPS signal failure possibly cause an aircraft's flight controls to become erratic? It has to do with how GPS attributes are harvested from the satellites' signals for purposes other than navigation. Roy at ASRI explains that "There are three core attributes to GPS: position, velocity and timing. Each attribute relies on receiving an appropriate quality of GPS signal, with even small variations in signal quality — from signal reflections, signal propagation, satellite movement or orientation, your hand blocking some of the signal, and so forth — affecting the accuracy of each attribute." (Just as a footnote, this explains the reason why you see a blue circle constantly varying in size when using GPS mapping on your smartphone, as the GPS receiver constantly adjusts to the changing signal quality to give you the best accuracy it can.)

"The reason why jamming is an issue for aviation is because the GPS receiver receives the three parameters," Roy continued, "and therefore it is a key reference point for an airframe because it can be allowed to operate for both navigation and functionally for other aircraft systems, depending on how the OEM designs the aircraft. This can be troublesome if the timing signal is used for something critical for flight."

Jamming as a Weapon

We are engaged in a war right now in which the weapons are not guns, bombs, poisonous gas or biological agents but cybernetic attacks on infrastructure. Compared to conventional warfare, the cyber equivalent can be waged for magnitudes less in funding and by considerably fewer players than those serving the major powers. In addition to probing of telecommunications networks, malicious manipulation of social media and theft of intellectual property through the internet, other forms of infrastructure can be targeted, as well, including GPS and its aviation users.

At last year's Air Transport IT Summit in Budapest, Societe Internationale de Telecommunications Aeronautiques, better known as SITA, estimated that more than 60% of cyberattacks on aviation targeted "critical assets," the most common being IT systems, airport and airline websites, and air traffic control and navigation systems — the last constituting GPS and representing 12% of attacks. Given the role that GPS plays today in terms of en route and terminal guidance and as a key component of ADS-B, it is easy to accept that targeted attacks on the GNSS signals could be disruptive to aviation — and the general economy of any nation that relies on it.

It has been documented that GPS jamming and spoofing have occurred near the airspace of Western powers adversaries Russia, North Korea, Iran and other Middle Eastern countries. Here are three examples of GPS interruption that were suspected to have been caused by jamming from sources within these nation states or regions:

▶ Middle East near Israel, 2017. Departing Ben Gurion International Airport (LLBG), Tel Aviv, this airline crew saw "ADS-B Out R" on their aircraft's EICAS. Performing the checklist, the pilots received an "ADS-B Out L" message, followed 5 min. later at FL 300 with "Unable RNP," "Runway Sys," "Terr Pos" and "GPS" additional messages. RNP showed 2.75 nm right of course. The crew contacted Nicosia Center to verify position and used VOR for navigation. Operations returned to normal when passing into Greek airspace where all nav systems returned to normal. "Everyone involved seemed to believe we were being jammed by possible military aircraft."

▶ Norwegian and Finnish airspace, September 2017 and November 2018. In the 2017 period, Widderoe and SAS airline flights experienced GPS disruption. During the 2018 period, GPS signal again deteriorated but this time during NATO exercise "Trident Juncture." The pilots reported loss of GPS while flying into airports in northern regions of Finnmark and Lapland. Norwegian aviation authority Avinor issued a NOTAM of irregular navigation signals over eastern Finnmark between Oct. 30 and Nov. 7. "Altogether GPS signals were jammed five times in 17 months," Buesnel said. It was subsequently reported that Finland summoned the Russian ambassador to answer allegations that Moscow was behind jamming of GPS signals in Lapland during NATO exercises.

▶ Near North Korean airspace, 2018. A Boeing 777 crew received EICAS message "ADS-B L Out," confirmed a few minutes later by the ADS-B itself. "I wrote both of them up," the captain reported, "and we then started discussing if this was a GPS jamming event, since we were just north of North Korea. The FO and I referenced the B777 GPS jamming update, and our situation was the first example listed."

Could the anomaly have been jamming generated by the North Koreans? Kashmir Hill had this to say in her Gizmodo article: "North Korea periodically interferes with GPS using jammers mounted on trucks that it drives close to the South Korean border, causing navigational problems for airplanes, ships and drones in the area — not to mention any GPS guided missiles headed in its direction." Would it be too much to assume they'd do the same along or near their northern border, especially knowing that international airlines fly there?

Another threat to GPS, and thus to aviation, is "spoofing," which is defined by the RTCA as "the surreptitious replacement of a true satellite signal with a manipulated satellite signal that can cause a GPS receiver to output an erroneous position and time." Spoofing "is a newer source of interference with advancing technology," Roy said. Much of that advancement has been spurred by open-source software, where users constantly make improvements to the code — all for free.

"Unfortunately, you don't even know you are being spoofed," Roy continued, "as a malicious user could send signals to slowly trick your GPS into moving you off target. The receiver does not know that the malicious signal is false, so it's insidious, like someone shouting at you at a higher volume than the one you want to hear. It can change or delay signals. Especially vulnerable is the older GPS equipment; the newer equipment — 'multi-constellation receivers' — is more robust and can receive signals from other satellite networks like GLONASS and Galileo."

Nation states are engaged in spoofing, Buesnel claimed, "trying to fool you, broadcasting replica GPS signals to deceive the receivers and steer you off position or spoof the time/date function backward or forward. And smugglers have been trying to spoof border-surveillance drones. Commercial aviation is well aware of this, and it would be difficult to spoof a commercial-level aircraft equipped with backup systems and operated by well-trained pilots." Spoofing is not as big a threat as jamming, he believes, but since the advent of Pokemon Go, it has become more prevalent in the larger community.

No Silver Bullet . . . But There Are Strategies

Can it be stopped, and if not, can we protect aviation from jamming and spoofing? First some background on GPS and how it works. A GPS receiver needs to receive signals from a minimum of four GPS satellites to report a position (three for position, and a fourth for timing information). The more satellites the receiver can see — and this could be up to 14 when cruising at high altitudes — and the more spread out they are across the sky relative to the aircraft, the better the information the GPS receiver has to specify an accurate position. Modern receivers — and this is important when considering local jamming and especially spoofing — can also receive similar signals from other countries' nav satellite systems to provide even more accuracy, *e.g.,* Russia's

GLONASS, Europe's Galileo and, maybe, China's BeiDou.

The system has to take into account relativity considerations from the satellites moving at 8,700 mph (14,000 km/hr.) in medium earth orbit (MEO) at 12,550 sm (20,200 km) altitude, each circling the earth twice a day, or end up hundreds of miles off the intended course or target. Thus, even the slightest variance can mean a significant error in a GPS device's performance.

"Fortunately," Roy said, "modern receivers can account for the multitude of effects that can cause errors, including use of additional geostationary satellites that provide correctional data [in other words, the GPS WAAS in the U.S.]. The best performing receivers are used by surveyors and agriculture to gain accuracy to within 1 cm horizontally and 2 cm vertically."

> "There is no silver bullet to solve this in one hit . . . But conducting risk assessment of equipment is **the most important part of a jamming protection strategy."**

Receivers have had significant development to ensure that aviation-certified units used for RNAV operate within known parameters that provide a consistent level of performance. Aircraft receivers can still experience interference, given the low power signal they are trying to see, but will also warn the pilot when they cannot achieve necessary performance. This is also reflected in the ADS-B system, which combines the aircraft position data with metrics for both GPS integrity and accuracy (known as NIC and NAC), so that en route traffic controllers know if position data is valid. "While INS can compensate for loss of GPS signals for short periods," Roy said, "aircraft will not be able to comply with many RNP requirements without GPS."

Buesnel insists that, "There is no silver bullet to solve this in one hit. Before you think about enforcement, first you have to monitor the signal near airports. We [Spirent] have a detector that detects and sounds an alert when it sees interference. It allows a 'picture' to be made of the areas where jamming is occurring so troubleshooting can take place within them and an intelligence picture built to determine the nature of the problem and when and where jamming is happening. NOTAMs to pilots can then be generated."

That "intelligence picture" will contain what type of jamming or wave form is happening, as these events leave a unique footprint, the timestamp of jamming events to know when they show up, even the type of jammer used, and whether the event is intentional or a leakage accident like the one at Hannover.

"With this information, you can test your equipment and take action," Buesnel said. "But you need the intelligence — the quantifiable data — first. With the data, you can then influence the standards board to make the equipment on aircraft more robust. Enforcement is great but it is difficult due to the resources needed. You have to do the risk assessments to gain the intelligence picture."

But conducting risk assessment of equipment is the most important part of a jamming protection strategy. "We don't do enough of it," Buesnel said. "GPS is a utility we all depend on. The U.S.'s NextGen and ADS are good examples. So risk assessment is essential. It has to be repeated every few years, as things change."

The third generation of GPS satellites — the so-called "Block IIIs" — are promised to offer some resistance to signal jamming. First, there will be more of them, as the full constellation was to constitute 32 satellites. Secondly, their signals will be more powerful than those of their Block II predecessors, and there will be more frequencies generated, including the new L5 band (1176.45 MHz) designed specifically for aviation use (although other disciplines will be able to access it). Furthermore, the U.S. Air Force claims the Block III satellites will be equipped with defenses against jamming but has not indicated what they are.

These improvements should make the system more robust, Buesnel believes, "but it will not be totally free from interference or spoofing, and we still will need to protect it." The first Block III satellite was launched from Cape Canaveral by Space X in December. As of last September, nine more satellites were in production by Lockheed-Martin, whose contract for the first 10 units is valued at $10 billion.

Backups Always Necessary

So the new system will be better, more defensive, but as advanced as it is, the practitioners of jamming and spoofing will continue to advance their malicious technology, and the Block IIIs will still be vulnerable to cyber-tampering. And while the industry has developed standards to support robustness in GPS receivers, high levels of integrity in the GNSS as a whole, and augmentation for it on the ground, there is an understanding that backups will continue to be necessary.

As Buesnel points out, pilots tend to be very conservative, and this is reflected by the fact that airline and business aviation aircraft continue to carry backup nav equipment, and the aviation-support infrastructure retains legacy facilities like radio navaids, including VOR/DME, ILS, etc. The additional GNSS constellations (GLONASS, Galileo and BeiDou) could also serve as backups for each other during cyberattacks on one of them. "All this is good for us," Buesnel insists. "The International Committee on GNSS out of the U.N. has been doing a lot of work on interoperability and has developed the common standard, or L1."

"We can never underestimate the randomness of GPS interference," Roy warned. "Even a bad comm radio can cause an outage in rare cases, emitting radiation on the GPS band. Always report an outage to ensure we can monitor and maintain the integrity of GPS everywhere."

But whatever the threat, aviation will be living with and relying on GPS and its counterparts elsewhere in the world for a long time. "GPS is the only system I've ever worked on that has surpassed expectations," Buesnel admitted. "We talk about its vulnerabilities, but it is in such wide use that we need to be more aware of the risks. Get quantifiable data, and do your risk assessments, and you will be fine." **BCA**

Grounded!

Getting your **medical reinstated**

BY **FRED GEORGE** fred.george@informa.com

Andrew McCallan, a fictitious name we've chosen to protect the anonymity of a young Embraer EMB-145 captain at a U.S. regional airline, dreamed of becoming a pilot when he was three years old. As a teen, he became impressively proficient at desk flying using Microsoft Flight Simulator. Fifteen years ago, the dream started to become reality when, oddly enough, he went to work as a busser at a popular drive-in restaurant in central New Jersey. Over time he advanced to higher levels of responsibility in the food service business, and caught the attention of one of the restaurant's owners, who also managed a flight department for a Fortune 100 company. McCallan told the fellow of his passion for flying and his dream of becoming a professional pilot.

Impressed, the owner invited the young man to go flying with him in his Piper Super Cub. Shortly after takeoff, the pilot turned to his passenger and said, "Your airplane," both surprising and delighting McCallan. That first attempt at flying an actual airplane went well and was followed by others. The young man's obvious embrace of and facility for flying eventually led the restaurant's owners' to provide him a $75,000 scholarship to get his private, instrument and commercial pilot ratings at the FlightSafety Academy in Vero Beach, Florida.

After completing his training, and with the assistance of his sponsors, he soon found employment flying air freight in Cessna Caravans and Pilatus PC-12 single-engine turboprops. Once he logged 1,500 hr., he applied for a pilot position at several regional air carriers. He quickly landed a job and rose to captain.

HUMONIA/ISTOCK

▶ ASK FRED

Send your questions about this article to: fred.george@informa.com

But in October 2018, his dream of flying for a major carrier was almost crushed when, as he went to renew his FAA first-class medical certificate, the Aviation Medical Examiner (AME) refused to sign it, saying he needed much more data to confirm the pilot's fitness to fly. It seems an entry on McCallan's Form 8500-8 MedXPress medical certificate application had raised a red flag.

The problem? As required by law, the pilot had noted visiting a health care professional after experiencing chronic headaches beginning in early October 2018, and that these were sometimes accompanied by "shaky vision." So, he went to see his regular doctor for diagnosis. When that doctor could find nothing medically wrong, he elected to go to a local hospital for a more thorough examination. In the process, he was admitted for a 12-hr. overnight stay during which vital signs were taken and a blood test was performed. As with his regular physician, the doctors at the hospital could find nothing wrong with McCallan, either.

The symptoms eventually subsided. So, the pilot assumed he only would have to discuss the matter with his AME and his explanation on his medical certificate application would suffice.

But the episode derailed the process. McCallan immediately contacted his Air Line Pilots Association representative, who directed him to seek assistance from Dr. Quay Snyder's Aviation Medicine Advisory Service (AMAS), which serves as a liaison between pilots, AMEs and the FAA's Office of Aerospace Medicine. It, along with its predecessor organizations, has a half century of experience in helping pilots navigate FAA aeromedical branch intricacies and avoid subtle traps that delay or prevent medical certificates from being issued.

AMAS staff physician Dr. Kurt D. McCartney, MPH, board certified in aerospace medicine, knew he would need a plethora of data to provide clear and convincing evidence to the FAA that McCallan was fit to fly. Required tests and documented results were required from a neurologist, ophthalmologist and ear/nose/throat specialist. McCallan underwent balance tests with his ears flooded with warm water, an MRI scan, more blood tests and a complete head-to-toe physical. Total costs soared upward of $10,000, but McCallan's medical insurance covered 65% of the bill.

It was worth it. McCartney submitted the complete package to the FAA aeromedical branch in January 2019. Ten days later, the FAA informed McCallan's AME that he could reissue his first-class medical certificate. And on Friday, Feb. 1, 2019, Capt. McCallan belted into the left seat of an Embraer ERJ-145 and flew his first revenue trip in three months.

Know Your AME's Strengths and Limitations

The FAA designates medical professionals to be AMEs, in a process similar to its practice of designating Pilot Examiners. Then, based on a pilot applicant's medical history and the results of an examination, the AME (1) issues the medical certificate, (2) denies the application or (3) defers action to an FAA regional flight surgeon (RFS) or the agency's Aerospace Medical Certification Division (AMCD) in Oklahoma City.

There are only 14 disqualifying conditions in accordance with FAR Part 67 Medical Standards and Certification, but AMEs have leeway to defer medical certificate applications to the FAA for further review and action, based on unresolved questions in the applicant's medical history, exam findings, interpretation of standards or FAA AMCD policies.

There also are 18 conditions that allow AMEs to issue medical certificates, if the FAA's detailed medical work-up forms are completed properly. Some conditions require x-rays, ultrasound imaging, CT or MRI scans. AMEs may need to consult with specialists to interpret results in order to determine if they can issue or defer medical certificate applications. From personal experience, we can inform readers that such outside medical expertise isn't instantly available. It can be days or weeks before the required outside tests can be performed. It then takes more time for the results to be interpreted by the specialists and forwarded to the AME for action.

There are dozens of other conditions or exam findings that aren't published in the FAA's Guide for Aviation Medical Examiners that are left up to the discretion of the AME to issue, defer or deny a medical certificate application.

Notably, the Guide holds AMEs to a high standard. "The consequences of a negligent or wrongful certification, which would permit an unqualified person to take the controls of an aircraft, can be serious for the public, for the government and for the Examiner. If the examination is cursory and the Examiner fails to find a disqualifying defect that should have been discovered in the course of a thorough and careful examination, a safety hazard may be created and the Examiner may bear the responsibility for the results of such action."

That provision biases AMEs to err on the side of caution. Moreover, most AMEs do not have close professional relationships with their RFS or AMCD, so they don't want to chance losing their standing by issuing medical certificates, if there's the slightest question about the applicant's fitness to fly. Again, based on our personal observations, many AMEs find it expeditious to "just say 'no'" and defer decisions pertaining to issuing medical certificates to the applicable RFS or AMCD. When that happens, the result can be several months of delay as the RFS or AMCD makes repeated requests for more and more detailed medical data in order to determine whether to issue the certificate.

A well-known aviation entrepreneur, for instance, who flies his own aircraft for business, started to lose weight unexpectedly two years ago and also became increasingly fatigued. His solution was to increase the frequency and intensity of his athletic workouts and fine-tune his diet, with emphasis on cardiovascular conditioning and improving his body mass index.

The regimen didn't have much effect, so he further increased his exercise routines and became extremely strict about his eating habits. Then, one day, he almost collapsed. He immediately called his personal physician, Dr. Jan Stepanek, at Mayo Clinic in Scottsdale, Arizona, who focuses on, and is board certified in, internal medicine. After preliminary tests, Stepanek determined that the pilot had developed Type 2 adult-onset diabetes mellitus. Acute hypoglycemia (low blood sugar) is what caused the pilot to nearly pass out.

As the condition most often affects people who are obese or sedentary, Stepanek told the pilot that his rigorous exercise program and strict diet probably saved his life. Among other interventions, the doctor initially prescribed insulin to treat the condition, but gradually made the transition to metformin, an FDA-approved medication that decreases the body's glucose production and absorption.

Stepanek also is the pilot's AME, board certified in aerospace medicine, medical director of Arizona Mayo's aerospace medicine program and holds senior AME status with the FAA. He has a close relationship with AMCD and has compiled dozens of detailed medical data packages that he has processed through the FAA for pilots seeking special issuance (SI) medical certificates. He knew precisely what detailed medical data he needed to process the medical certificate application through the FAA with minimal delays.

"The more data, the better," says the owner/pilot who developed diabetes. The applicant has to prove blood sugar control and stability, along with lack of side effects or complications from the blood sugar control medication. The data package also should include a complete blood panel performed in the last 30 days, plus test results for cardiovascular, neurological, kidney and/or eye disease. Missing one essential test detail in the SI application package could result in weeks, if not months, of delays in processing it. Stepanek's team knows how to run the gauntlet of FAA aviation medicine procedures.

It helps if you're seeking only a third-class special issuance medical certificate, since that doesn't qualify you to fly people for hire. If the pilot requires insulin, or any other drug, to treat low blood sugar, AMCD generally restricts SI approvals to third-class medical certificate applicants. First- and second-class SI medical certificate applications are "evaluated on a case-by-case basis by the Federal Air Surgeon's Office," according to the FAA's Guide for Medical Examiners.

Yet, one medical advisor says that providing too many details, information not pertaining directly to the deferral or denial issue, just invites the RFS or AMCD to initiate more probing, more delays, more avenues for opening new challenges to approving medical certificate issuance. Supply the FAA with all pertinent medical data — and no more.

Medical Certificate Renewal Challenges? Get Professional Help Early

Snyder says that AMAS receives more than 200 inquiries per day from pilots seeking assistance in obtaining their medical certificates and the service assists about 10,000 pilots per year. About 2,400 of those cases require liaison with the FAA, backed up by comprehensive documentation. As pilots age, they encounter more medical conditions and undergo more medical procedures that require special attention during the medical certificate renewal process.

All 10 AMAS physicians are board certified in aerospace medicine. It has represented more than 100,000 professional and private pilots, and air traffic controllers, achieving an enviable success rate in getting medical certificates issued for pilots with problematic medical conditions or histories. AMAS doctors regularly meet with the Federal Air Surgeon to work on requirements for special issuance medical certificates.

The process typically includes a thorough records review by an AMAS physician to identity and clarify medical questions that could prevent or delay medical certificate issuance. The physician creates a summary of findings, submits the package to the FAA for expedited review and conducts person-to-person advocacy with AMCD as required to keep the FAA's medical certificate decision-making process moving forward. Pilots affiliated with ALPA or working for corporate clients get these services for free as part of AMAS's umbrella contracts with such organizations. Private individuals are charged $75 for initial phone consultations and $1,200 for full review and processing. Special cases may result in higher fees.

"Our three main goals are to keep people healthy, assure safety of flight and preserve people's incomes and careers. We have a long history of working with the FAA," says Snyder. "We're familiar with the required documentation and protocols." To assure the probability that each pilot's case will be processed by AMCD without hiccups, AMAS provides individualized worksheets to pilots tailored for their medical conditions or medical histories.

In the case of a suspected coronary disease, such as a fast, abnormal or irregular heartbeat that can portend of a future myocardial infarction (heart attack), AMAS's worksheet specifies the need for resting and treadmill stress EKGs, a temporary EKG recording device worn by the pilot for up to two weeks, a complete blood panel and a comprehensive evaluation by a cardiologist.

The process may take 30 days, or more, depending upon the availability of the cardiologist, treadmill equipment, downloading of the recording EKG results by an outside contractor and review of the results.

It becomes even more complicated if the pilot has had the misfortune of having a routine EKG test for another medical issue in the recent past during which the readings were misinterpreted due to an equipment malfunction. If, for instance, the pilot was misdiagnosed as having periodic ventricular tachycardia because of a loose electrical lead to the EKG box, then the AME, erring on the side of caution, might defer issuance of the medical certificate until the pilot can provide clear and convincing medical evidence to AMCD that the EKG result was "artifact" or not clinically relevant.

AMAS recommends that if pilots know they have medical issues that could or would cause problems or delays in getting their medical certificates, they should start working at least 60 days in advance with their

AMEs and AMAS to compile medical documents and test results needed by AMCD to approve special issuance medical certificates. Once reviewed and cleared by the FAA, many subsequent medical certificates can be issued by AMEs using defined criteria. The FAA authorizes its designated physicians to issue subsequent, so-called AME assisted special issuance (AASI) medical certificates based upon satisfactory completion of the initial special issuance by AMCD headquarters.

But what about unknown snags, such as McCallan's periodic headaches or the pilot who had the misdiagnosed EKG readings? Then, plan on at least three months lead time, coordinating with an AME and experienced aerospace medical consultants, such as those at Mayo or AMAS. It's also essential to be observant of FAR Part 61.53, which requires pilots to ground themselves if they know of any medical condition that would render them unable to qualify for an FAA medical certificate or if they are taking any medication that would prevent them meeting the requirements for a medical certificate.

The FAA's mental standards for medical certificates can present one of the highest hurdles for earning a medical certificate, especially in the aftermath of the Germanwings Flight 9525 crash caused by a suicidal copilot. The FAA permanently disqualifies pilots with a medical history or clinical diagnosis of psychotic conditions including delusions, hallucinations, "grossly bizarre" or disorganized behavior, bipolar disorder or substance dependence.

Substance dependence includes amphetamines, marijuana, cocaine, tranquilizers and several other medications. For pilots, the most commonly abused substance is alcohol and the most common alcohol-related incident is a driving under the influence or driving while intoxicated (DUI/DWI) finding. If the pilot submits to a blood alcohol concentration (BAC) test and if the BAC is less than 0.15%, then the FAA requires the AME to submit an Alcohol Event Status Report to AMCD for special issuance processing for each medical certificate during a five-year period. After five years with no subsequent alcohol-related incidents, the AME can issue a medical certificate, only having to add remarks to the application pertaining to the original incident.

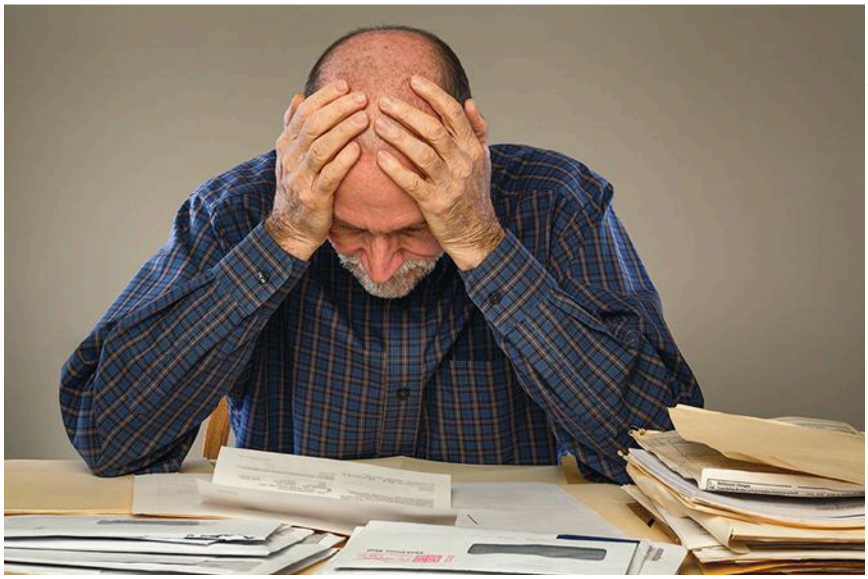
But if a pilot has an alcohol-related incident and refuses a BAC test or if the BAC is 0.15% or more, then AMCD usually requires the individual to undergo a regimen of special treatment before it will consider approving special issuance of a medical certificate. The second such offense during one's lifetime can be a career ender.

Airline pilots who have alcohol- or substance-related incidents are eligible for the FAA's Human Intervention Motivation Study (HIMS) rehabilitation program, headed up by Snyder. HIMS works with airline management, pilots, healthcare professionals and the FAA to achieve the most favorable outcomes for people with chemical dependencies. It has an 85% success rate in rehabilitating commercial pilots so that they can return to work, according to Snyder. Following rehabilitation, pilots may return to work in accordance with FAR Part 67.401, Special Issuance of Medical Certificates.

Non-airline pilots, particularly those seeking second- and third-class medical certificates after alcohol- and/or substance-related incidents, also may qualify for special issuance medical certificates in accordance with Part 67.401.

Bottom line? Call a taxi or a ride-sharing service if you want to party hardy on the ground. And if your BAC exceeds 0.04%, about half the legal maximum BAC level in most states, you're illegal to fly. As with a DUI/DWI offense, flying with a BAC in excess of the legal limit can land you in jail.

Aviation medicine specialists recommend that pilots contact experienced consultants as soon as they suspect they have a medical condition that might interfere with issuance or reissuance of a medical certificate. Most require pilots to sign medical information release forms that allow them to share pertinent information with the FAA's AMCD or RFS. The goal is to provide the FAA with all medical information needed to determine a pilot's fitness to fly in as little time as possible.



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But what about unknown snags, such as McCallan's periodic headaches or the pilot who had the misdiagnosed EKG readings?

As McCallan with his headaches and the pilot with the erroneous EKG can attest, what appears to be a minor medical hiccup can keep you grounded for months or more. And if you're diagnosed with diabetes, a heart condition or a vision problem, you can be out of the cockpit for a considerably longer period.

AMEs have limited authority to issue medical certificates, essentially restricting them to signing off on past elective surgeries and minor medical procedures that don't potentially affect a pilot's performance in the cockpit. But much is left to the discretion of the AME in determining if a pilot is fit to fly. As good preparation for your next medical certificate examination, it's advisable to download and peruse the FAA's Guide for Aviation Medical Examiners. Inside, there's a wealth of information that can help you decide whether you need an experienced medical consultant, such as the doctors working at Mayo or AMAS, to intervene on your behalf, to provide essential liaison between you, your AME and the FAA's AMCD to streamline approval of your application for your next medical certificate. **BCA**

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Hangar Rights and the Restrictions on Usage

IF YOU ARE PAYING YOUR MONTHLY HANGAR RENT, CAN YOU USE the hangar as you please? Quite simply, no. In the highly regulated world of airports, FAA rules come down from the sky, across the ramp and into your hangar.

The agency's authority over airports comes primarily from the Airport Improvement Program (AIP). The FAA doles out billions of dollars in AIP grants, and polices compliance with the many grant assurances that airports must abide by in order to receive the funds. The FAA wants to ensure that the federal funds that were intended for aeronautical use don't subsidize non-aeronautical users. If you happen to have a privately owned hangar, on a privately owned airport, congratulations! No hangar restrictions apply. But most of us pay for hangars on public airports that have received AIP grants.

Can I store my car in my hangar? The FAA has issued a variety of warnings about "non-aeronautical" storage, but these warnings must be read carefully. So long as the hangar is still serving its primary purpose (storing an aircraft) then tucking a car in next to it may be permitted. Putting your car in the hangar while you're out flying the aircraft should also be permitted, but hangar restrictions are often construed very strictly by airport managers who don't want to risk future federal funding.

EXTREME PHOTOGRAPHER/ISTOCK

Can I work on my aircraft in my hangar? Generally, yes, but this is an area where an airport manager may have made the lease a little too restrictive. Changing the oil in your aircraft in your hangar should be permitted. Recent FAA guidance offers protections to amateur aircraft builders to let airport managers know that FAA policy supports amateur aircraft building as an aeronautical activity. However, most builders would laugh at this statement of FAA policy: An airport manager "leasing a vacant hangar for amateur-built aircraft construction may incorporate progress benchmarks in the lease to ensure the construction project proceeds to completion in a reasonable time." Any builder will tell you that if an aircraft project is 90% done, it still has 90% to go.

But even if the FAA supports amateur aircraft builders, it doesn't suggest that every aspect of the build process has to be allowed by the airport manager. FAA guidance to managers suggests that painting or repainting an aircraft in a standard hangar should not be permitted. This is a common restriction today, but years ago, managers at small airports didn't think about such things when writing their hangar leases. Paint spray often goes where it is not wanted (on someone else's aircraft, for example), and it is a hazardous material in its most dangerous form.

And many hangar leases today forbid storing hazardous materials within, despite the obvious fact that the aircraft is one big hazmat container of fuel, oil and battery acid. Leases vary widely on how much, if any, hazmat outside the aircraft is allowed in the hangar.

Airports set "minimum standards" as a way to make competition fair: If you want to start a flight school or open an FBO at a public airport, you can find out what minimum standards you will be required to meet before you start spending money on the business. These minimum standards sometimes bleed over into overly restrictive lease language. For example, standards designed to set a high level of service for FBOs on the field may result in leases preventing individual tenants from conducting any FBO-type services for their own aircraft.

While individual aircraft owners or operators should be able to repair, refuel, clean and otherwise service their own aircraft, the FAA, and FBOs, are very wary of competition in the form of co-ops. If a group of aircraft owners combines to form their own fueling cooperative, the FAA typically rules that they must meet the minimum standards for an FBO on the airport in question. If an aircraft owner wants to self-fuel, then the owner must do so with his own employees and equipment, and in accordance with airport minimum standards and/or other rules adopted by the airport.

There is an old saying among airport executives: If you know one airport, then you know one airport. There are always exceptions, and sometimes exceptions appear to be the rule. The FAA will generally allow airports to lease airport space to non-aeronautical users when there are no aeronautical users waiting for the space and the airport needs to generate revenue. So, despite thousands of pages of FAA guidance designed to make airport regulation uniform, there is still a strong element of local rule.

Finally, if you want to have a peaceful time in your hangar, drop by the airport manager's office once in a while to say hello. And bring cookies. **BCA**

Fred George
Senior Editor
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Hawker Beechcraft Premier 1A

Midsize cabin on a **light jet airframe**

IN THE MID-1990S, RAYTHEON AIRCRAFT'S ROY NORRIS WAS FOND of saying the $5 million composite fuselage RA 390 Premier light jet would have a cabin cross section "embarrassingly close" to that of an $8 million midsize aircraft. Indeed, headroom is only 3-in. less that of Citation Excel and the cabin is nearly as wide.

The development program suffered repeated delays. Initial entry into service was delayed until 2001. And then, the aircraft fell short of customer expectations in several areas, including runway performance, erratic lift dump functioning, poor brake feel and response, cabin sound levels, avionics capabilities and cockpit layout.

Premier 1A succeeded Premier I in 2006, offering several improvements. It cruises as fast as 451 KTAS when cruising at FL 310 and it redlines at 320 KIAS/Mach 0.80. At midweight, it will cruise at 424 KTAS while burning only 817 pph. During 5 years of production, 163 aircraft were built. They originally sold for as much as $7 million. Now many are priced in the $2 million range.

Enhancements include more responsive and consistent brakes, three-screen Pro Line 21 avionics, avionics file servers that support XM radio weather and enhanced map graphics, plus digital radios and audio systems. These aircraft also have upgraded cabin furnishings, better acoustical insulation, more usable cabin headroom and long-life LED interior lighting, along with more cabin IFE options.

Collins offers a $200,000 package of improvements, including ADS-B OUT, synthetic vision, upgraded FMS with WAAS GPS and a more power file server computer. Elliott Aviation offers a Garmin ADS-B solution for about $80,000.

Premier IA aircraft have pleasing handling qualities with the solid feel of a midsize jet, but with the crisper control response of a light jet. It has some midsize aircraft systems, such as a 3,000 psi hydraulic system that powers the spoilerons, landing gear actuators and wheel brakes. But, it only has one engine fire extinguisher bottle, a semi-automatic pressurization controller, straight-leg landing gear and an annunciator light panel rather than a full EICAS.

Aircraft typically are fitted with a four-seat center club section, plus two chairs in the aft cabin. The main seating area is 11.2-ft. long, about the same as a CJ2. There is forward, right side refreshment center and a fully enclosed, full-width 2.3 ft.- long aft lavatory.

Weight gain has been the bane of Premier 1A. The 212-sq.-ft. wing and 2,300-lb. thrust engines are undersized for a 12,500 lb. aircraft. Typically BOWs are close to 8,400-lb. BOWs. Thus, tanks full payload is 570 lb., just shy of three passengers.

Premier 1A aircraft need 3,792 ft. of runway to depart from a sea-level, standard day airport and they can fly four passengers 1,105 nm. With a single pilot and two passengers, the aircraft can fly 1,365 nm while cruising at Mach 0.73 to 0.76. Operators say they're comfortable flying 1,000 nm legs, 1,200 nm if the destination weather is VFR and there are suitable divert airports in the vicinity.

Operators love the aircraft's speed, but most say they need as much as one more hour of range. The 400+ nm boost would enable them to fly between the U.S. coasts virtually every day of the year with one fuel stop. It also would enable them to fly non-stop from New England to Florida in the winter.

Loaded to MTOW, the aircraft will climb directly its 41,000 ft. service ceiling even at ISA+10C. But such warm day conditions will knock 20 kt. off of max cruise speed as well as reducing range performance.

Airport performance also suffers on hot days. Depart from Carlsbad McClellan-Palomar Airport on a 29C day and you'll need virtually all 4,897 ft. of runway. Leaving Phoenix Deer Valley at 40C, you'll need 6,900 ft. of runway.

Pilots say they plan on burning 1,200 to 1,300 lb. the first hour, 820 lb. the second hour and 900 lb. during the final hour of most high-speed cruise missions, assuming standard day conditions. Slowing down to long-range cruise adds up to 11% in travel time, but increases range by less than 100 nm. Budget fuel consumption at 154 gal. per hours, says Brad Stancil, Holstein Aviation's executive vice president.

Maintenance tasks are relatively easy. There are comprehensive line service and lube inspections at 200-hr. intervals, A checks at 600 hr. and B checks at 1,200 hr. There also are some calendar required inspections. Budget $300 per hour, says Stancil.

Williams' TAP Blue runs close to $300 for both engines and it provides extended maintenance intervals of 2,500 hr. for hot section inspections and 5,000-hr. TBOs. Operators say Textron Aviation has stepped its product support for Premier IA, even though it's been out of production for 8 yr.

Citation CJ2 and Nextant 400XT/XTi are Premier 1A's main competitors. CJ2 has considerably better airport performance and it can fly four passengers more than 1,500 nm. But, it's 30 to 40 kt. slower, it has a smaller cabin cross section and it's up to $1 million more expensive. Nextant 400XT also has a tighter cabin, albeit it with a flat floor. It'll fly 1,800 nm and it has considerably sportier runway performance. Asking prices for some aircraft also are around $2 million, but they're generally high-time jets formerly operated by Flight Options. **BCA**

Edited by Jessica A. Salerno *jessica_salerno@informa.com*

News of promotions, appointments and honors involving professionals within the business aviation community

▶**Airbus,** Marignane, France, appointed **Alain Flourens,** currently head of Engineering for Airbus Helicopters, head of Industry for Airbus Helicopters, following **Christian Cornille's** departure from the company. Flourens will be replaced by **Stefan Thome**, who is currently head of New Business Model and Services at Airbus Defense and Space.

▶**Aerion,** Reno, Nevada, promoted **Steve Berroth** to chief operating officer and program manager of the AS2 Supersonics Business Jet. Berroth brings leadership and 35 years of experience in large aerospace organizations and aircraft development programs.

▶**CAS,** Ontario, California, announced the appointment of **Jay Scott** as director of operations for the Recovery, Repair and Modifications division. Scott will help develop and implement new strategies to deliver premier AOG service and support.

▶**Wing Aviation,** Houston, Texas, announced that **Jill Case** is the national sales director. Prior to joining Wing Aviation, Jill worked at Connecticut-based Gama Aviation as vice president of Business Development.

▶**Cutter Aviation,** Phoenix, Arizona, is pleased to announce the promotion of **David Clifton** to the position of director of Technical & Flight Support Services. In this new role, Clifton is responsible for supervising all aspects of Cutter's Part 145 Repair Stations in Phoenix, Arizona (PHX); Addison (ADS) and San Antonio (SAT), Texas and Denver, Colorado (APA) as well as overseeing Part 135 Charter operations and the Client Relationship team.

▶**TAG Aviation Ltd.,** Farnborough, United Kingdom, announced the appointment of **Stuart Stevenson** as head of Compliance and Safety to be based in Farnborough. Stevenson will head up a team comprising Compliance, Safety and Flight data specialists and hold overall responsibility for overseeing TAG (UK) Ltd.'s regulatory compliance, as well as ensuring the promotion and effective management of the Safety Management System, the safety policy and safety culture within TAG (UK) Ltd.

▶**Universal Avionics,** Tucson, Arizona, announced that **Tal Golan** has been appointed to the newly created position of Rotorcraft Business Development manager.


ALAIN FLOURENS


STEFAN THOME


JAY SCOTT


DAVID CLIFTON


STUART STEVENSON


TAL GOLAN


KATHERINE HILST


MARIO SAMBOLTTE


DAVID DYCHE


MICHELLE DODSON


JIM WHEELER


ED KOHARIK

▶**Aeroshield USA,** Chicago, Illinois, announced that **Craig Lawrence** joined the firm as a senior director.

▶**Presidential Aviation,** Fort Lauderdale, Florida, appointed **Leon Knight** as director of maintenance and **Sean Anthony** as the company's new chief inspector.

▶**Allianz Global Corporate and Speciality,** New York, New York, announced that **Hugo Reyes** has been named senior underwriter, General Aviation, for North America.

▶**IBAC,** Montreal, Canada, announced that **Katherine Hilst** has joined the organization as the new operations manager for the IS-BAO Program.

▶**Western Aircraft,** Boise, Idaho, announced that it has hired **Mario Sambolte** as its new interior sales manager. He will be based in Southern California.

▶**Duncan Aviation,** Lincoln, Nebraska, hired new manager of Avionics Install/Line Service department **Mark Kahle** to its full-service facility in Battle Creek, Michigan.

▶**London Biggin Hill,** London, United Kingdom, announced that **David Winstanley** will be the new CEO, Biggin Hill's first. **Will Curtis,** managing director, has announced that he will step down at the end of March after overseeing six years of unprecedented growth in the business.

▶**FlightSafety, International,** LaGuardia Airport, New York, announced that **David D. Dyche** has been promoted to assistant manager of the company's Learning Center in Tucson, Arizona. **Michelle Dodson** has been promoted to assistant manager of the Wichita East Learning Center. She joins **Chad Raney** who also serves as assistant manager of the center. **Jim Wheeler** has been promoted to general manager, Visual Systems. He assumes this responsibility from **Ed Koharik,** who will now jointly lead a company-wide transformation team as vice president. **Dann Runik** has been promoted to senior vice president, operations. He assumes responsibility for operations at FSI's worldwide network of Learning Centers from **Daniel MacLellan** who will jointly lead a company-wide transformation team as senior vice president.

▶**Castle & Cooke Aviation,** Van Nuys, California, has hired **Dean Williams** as general manager at its Everett, Washington,


DANN RUNIK


D. MACLELLAN


DEBORAH WELLS


GEORG FANTA


DIETMAR FOCKE

location responsible for directing all FBO activities including the company's core corporate and general aviation customers, along with the soon-to-be initiated scheduled airline service at Paine Field Airport.

▶ **Dallas Airmotive,** Dallas, Texas, announced that **Deborah Wells** has joined its leadership team as vice president of Strategy and Business Improvement. She will lead the integration of GES Score operations, consisting of engineering, quality and continuous improvement, with the global strategic planning process.

▶ **GAMA (General Aviation Manufacturers Association),** Washington, D.C., announced the addition of **Raphael Fabian** as its director of European Affairs. Fabian was born and raised in Brussels, Belgium, lived in Italy and Germany, and is fluent in five languages. Fabian comes to GAMA from the Rolls-Royce European Affairs team in Brussels.

▶ **Jet Aviation,** Basel, Switzerland, announced the appointment of **Norbert Ehrich,** former vice president Sales for Jet Aviation Flight Service South East U.S. and South America, as its new vice president Flight Services EMEA and Asia. Ehrich succeeds **Jurg Reuthinger,** who retired at the end of 2018 after more than 35 years of service with Jet Aviation.

▶ **Lufthansa Technik,** Hamburg, Germany, announced that the former head of Strategic Purchasing, **Dr. Georg Fanta,** has taken over the role of the new spokesman for the management of the Product Division Component Services. **Dietmar Focke,** former managing director of Lufthansa Technik Budapest, has assumed the role of spokesman in the management of the PD Engines.

▶ **National Air Transportation Association (NATC),** Washington, D.C., announced the election of three new members to it Board of Directors: **Marc Drobny,** president, Business Aviation for StandarAero; **Geoffrey Heck,** senior vice president of Operations, Signature Flight Support in Minneapolis, Minnesota; and **Mike Magni,** president, Monaco Air in Duluth. **Jonathon Freye** has been named as the Association's vice president of Government and Public Affairs

▶ **National Air Transportation Association Compliance Services (NATACS),** Reno, Nevada, announced that **Joe Dalton** is its new director of Security. Dalton will oversee the security and regulatory efforts for NATA Compliance Services with the technology and operations teams to expand and deploy security initiatives that serve the corporate aviation community. He joins the association after service as director, Aviation Security for NetJets Inc.

▶ **Vertis Aviation,** Boston, Massachusetts, named **Robert Coleman,** general manager of its new Boston office. He will be responsible for promoting the boutique Vertis charter services across the Americas. **BCA**

If you would like to submit news of hires, promotions, appointments or awards for possible publication in On Duty, send email to jessica_salerno@informa.com or call (520) 638-8721.

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Products & Services Previews

By Jessica A. Salerno jessica.salerno@informa.com

1. Yingling Adds Paint Services

Yingling Aviation has expanded its current facilities at Wichita's Dwight D. Eisenhower National Airport. Construction on a new 23,000 sq. ft. facility for avionics and maintenance has begun and has added another 50,000 sq. ft. of newly leased space consisting of a paint hangar, prop hangar, service, aircraft interiors and office space. Yingling is planning a mid-January 2019 start date for paint services to begin.

Yingling Aviation Dwight D Eisenhower National Airport
Wichita, Kansas
www.yinglingaviation.com

2. Jet Aviation Signs with Excellent Air

Jet Aviation has signed a preferred FBO service agreement with Excellent Air, which operates Europe's largest fleet of Cessna CJ2 aircraft based in Memmingen, Germany. Under the agreement, Jet Aviation becomes the preferred handling service provider at its FBO locations in EMEA. Oliver Bergsch, Jet Aviation's vice president of Sales Management for EMEA and APAC said, "We are delighted to partner with Excellent Air and look forward to welcoming their customers at our facilities in Berlin, Dubai, Dusseldorf, Geneva, Moscow, Munich, Vienna and Zurich."

Jet Aviation
www.jetaviation.com

Excellent Air
www.excellentair.de

3. Naples Unveils Name Change

The sole full-service FBO at Naples Airport has announced a name change from Naples Airport Authority to Naples Aviation. Still under operation by the Naples Airport Authority, the FBO has the same dedicated team provide services customers know them for along with a new fueling option. We have launched a new website for easier customer use and are offering competitive rates on jet fuel with Avfuel Contract Fuel, said Mike Hushek, manager, Naples Aviation. With the addition of contract fuel, operators will benefit from better-than-retail rates, as well as no-fee purchases, access to purchasing in a network of 3,000-plus global locations, online account management and tax-savings benefits.

Naples Aviation
www.naplesfbo.com

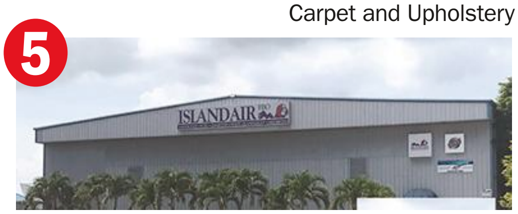
4. Flying Colours Completes Medevac Challenger 650

Flying Colours Corp., has completed the industry's first trio of Bombardier Challenger 650 medevac interiors. Number three, under contract from Bombardier Specialized Aircraft, was completed in December and has already arrived at Swiss Air-Rescue Rega's base in Switzerland alongside the first two aircraft which were completed earlier in 2018. Working in conjunction with Aerolite, the medical equipment specialists, and the Bombardier Specialized Aircraft team, Flying Colours designed, manufactured

and installed the majority of the non-medical monuments, furnishings and interior components. When in full operation the cabin functions as a fully operative Intensive Care Unit for up to two patients with attending medical experts or can be easily configured to support transport of up to four patients. The spacious cabin can also accommodate specialized medical equipment as needed.

Flying Colours Corp.
www.flygincolourscorp.com

5. Ross Acquires Island Air FBOs



Ross Aviation has acquired the Island Air FBOs located at the Owens Roberts International Airport (MWCR) on Grand Cayman and at the Charles Kirkconnell International Airport on Cayman Brac (MWCB), both in the British West Indies. Island Air will remain branded as such, and Marcus Cumber, will continue as managing director and partner, will oversee daily operations. Ross Aviation currently owns and operates 11 FBOs located on nine airports.

Island Air
www.islandair.ky

Ross Aviation
www.rossaviation.com

6. Sharp Acquires T Brennan

Sharp Details, LLC, a PrimeFlight Aviation Services company, has acquired T Brennan Aircraft Cleaning LLC and Performance Carpet and Upholstery Cleaning LLC. "I am excited to expand our operations to California, adding the experience and professionalism of Terry Brennan and his team," President of Sharp Details, Jim Garland said. Brennan will stay on as regional vice president, overseeing West Coast operations for Sharp Details.

Sharp Details, LLC
www.sharpdetails.com

7. Satcom Direct to Provide Engine Data to Rolls-Royce

SD has entered a formal arrangement with Rolls-Royce to deliver business aviation engine utilization data directly to the OEM via the SD Pro Operating System, using the SD FlightLogs post-flight data recording module. SD FlightLogs automatically captures flight data and cycle events in real time from the aircraft via its datalink service, and once it is verified by the customer, it will be automatically sent to Rolls-Royce. The result is the recording of extremely accurate and valuable information that Rolls-Royce can use to further understand the utilization of its engines.

"This reporting adds another level of understanding for Rolls Royce by providing automated, current information via our SD FlightLogs and SD Pro tools. Until very recently this sort of information was often hand-written so could be easily misunderstood, misrecorded or lost. We are aiming to work with Rolls Royce to modernize the process which will eventually enhance the value of our customers assets through better maintenance management. Our digital platform can be a rich source of data, and we hope to develop the agreement further in the near future," said Chris Moore, chief operating officer, SD.

"SD's platforms auto-captures inflight data such as engine cycles and flight hours, automatically providing extremely accurate and immediate reporting to our dedicated 24/7 Business Aviation Availability Centre. In combination with all the data we have about each of our engines this allows our services team to pro actively support our customers based on the latest available information, guaranteeing highest levels of availability and enhancing our market-leading CorporateCare service," said Axel Voege, head of Digital Operations Germany, Rolls-Royce.

Satcom Direct
www.satcomdirect.com

8. World Fuel to Supply London Oxford

World Fuel Services won two contracts with London Oxford Airport and London Heliport to supply Jet A-1, Avgas and training packages. This fice-year contract solidifies World Fuel as the primary supplier to the general aviation market in the south of the United kingdom, but also solidifies a long-term partnership in the region. London Oxford is the largest user of Avgas in the UK and is the third largest dedicated GA airport in the London area. World Fuel will also offer refueling equipment, maintenance support, marketing support and potential design and build of a new fuel farm at Oxford.

World Fuel Services
www.wfscorp.com

9. CPaT New Courseware for Q400

CPaT Global, announced the release of their new Q400 Aircraft Systems Courseware. This online and off-line course can be accessed on iPad, Android, PC and iOS devices and allows pilots the ability to train anywhere, anytime. CPaT has developed a training course for pilot of this aircraft which has many advanced systems and our new course is a great way to students to learn the Q400.

CPaT Global
www.cpat.com

10. Skyservice Gets First STC for Learjet 45 Upgrade

The Transport Canada Civil Aviation authority has awarded Skyservice Business Aviation an STC for installation of the Satcom Direct Data Link Unit (DLU) upgrade on the Learjet 45. SD supported Skyservice through the TCCA STC process. Of the three Skyservice Learjet 45's one is already benefitting from the system installation. The next two are schedule for the upgrade in early 2019. The installations will support CPDLC (FANS1/A and ATN-N) compliance to augments operational safety.

Skyservice Business Aviation
www.skyservice.com

March 1969 News

FAA's budget for FY 1970 is a record-setter at $996.5 million, up $64 million from FY 1969. About $154 million should come from (proposed) general aviation user fees, **said President Johnson.** – *BCA Staff*

Edited by Jessica A. Salerno *jessica.salerno@informa.com*

1968's summer of discontent dramatically projected long-stored gripes of taken-for-granted air traffic controllers onto headlines and video screens across the nation. ATC was goaded into aggression by a militant and articulate core.

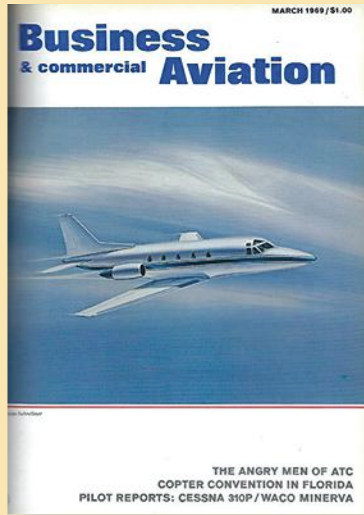
Pair of Pawnees labored all winter to deice runways of Chicago's O'Hare and Midway and Milwaukee's Mitchell Field. Ag planes were contracted to local groups by Chicagoland Airport, Inc., which, with United Air Lines, developed "dew deicing," dispersion of non-corrosive urea over runways.

Cessna/Franklin/McCauley/Edo are combined in seafaring mutation of 172/Skyhawk with 215-hp Franklin and McAuley constant-speed prop, STC'd on Edo floats.

Slight Simulator, Flightmatic 150C is fully automatic and may be flown solo. Panel layout is the preferred "T" arrangement. Price is $9,8600 pus $500 for the enclosure and instructor's plotting board.

HAA: Helicopters appeared everywhere and anywhere their whirling rotors could clear the tall palms at Hollywood, Florida's Diplomat Hotel. (It was the year of HAA's "red-letters" Donnybrook. And within a 24-hr. period, there was actually no HAA to represent the delegates; executive director John Ryan offered and withdrew his resignation; the Board of Directors had offered its collective resignation (leaving no one to accept it); manufacturers fell all over themselves trying to convince the press they had nothing to do with HAA's internal problems) and ops seminars became so acrimonious that reporters and insurance reps were asked to leave. [If anyone remembers that show, drop us an email at jessica.salerno@informa.com] **BCA**

THE ARCHIVE



A look into the future of the Sabreliner is provided by an artist's rendering of the popular bizjet fitted with Garrett ATF-3 tubofan powerplants. Business jet operators' desire for increased range is the stimulus for the turbofan re-engne program, and the 4,000-lb. thrust ATF-3, available in 1971, will provide the stretched Series 60 Sabreliner with transcontinental capabilities.

High society. Talk about snob appeal. This is it. With the "250" you will be able to out climb, out fly and outdistance anything of comparable size.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