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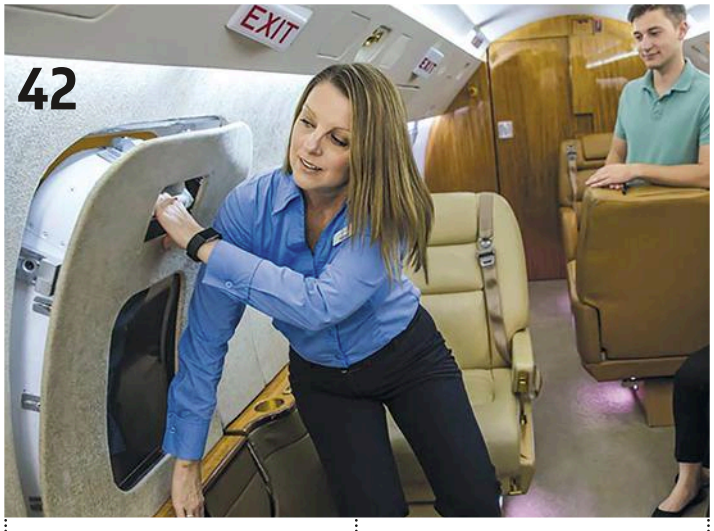

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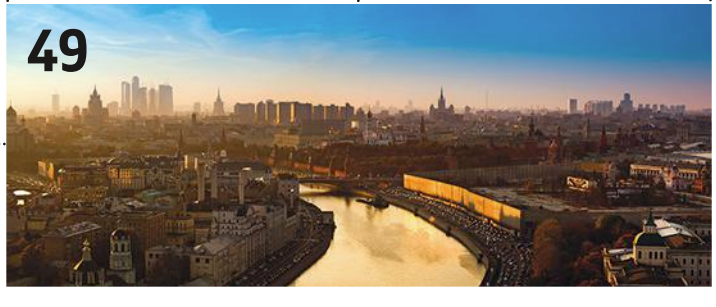

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COVER
Photo of the Pilatus PC-12 courtesy of Pilatus

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An Informa business

BCA - Business & Commercial Aviation (ISSN 0191-4642) is published monthly by Informa Media Inc., 9800 Metcalf Ave., Overland Park, KS 66212-2216. Also the publisher of *Aviation Daily*, *Aviation Week & Space Technology*, *The Weekly of Business Aviation* and *World Aerospace Database*. Single copy: Current and back issues, $10.00 Domestic/Canada/Mexico. $15.00 International. Subscriptions (1 year, 12 issues): United States and Canada, $59.00; all other countries, $79.00. For single copies/back copies call Customer Service at (800) 525-5003 in the United States and (847) 763-9147 for all other countries. Periodicals postage paid at Kansas City, MO and additional mailing offices. Registered for GST as GST #R126431964. Canada Post Publication Mail Agreement Number 40026880. Editorial contributions should be addressed to BCA, 520 Folly Rd., Ste. 238, Charleston, S.C. 29412, editorial address and must be accompanied by return postage. Publisher assumes no responsibility for safety of artwork, photographs or manuscripts. USPS 503-450.

Printed in the U.S.A.

Postmaster: Send address corrections to BCA - Business & Commercial Aviation, P.O. Box 1174 Skokie, IL 60076-8174. (Present subscribers include label)

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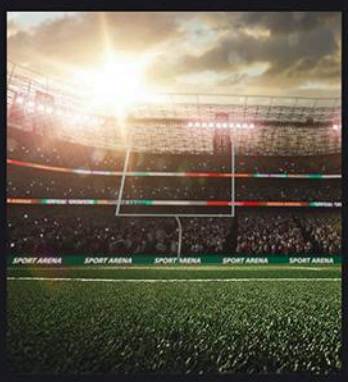

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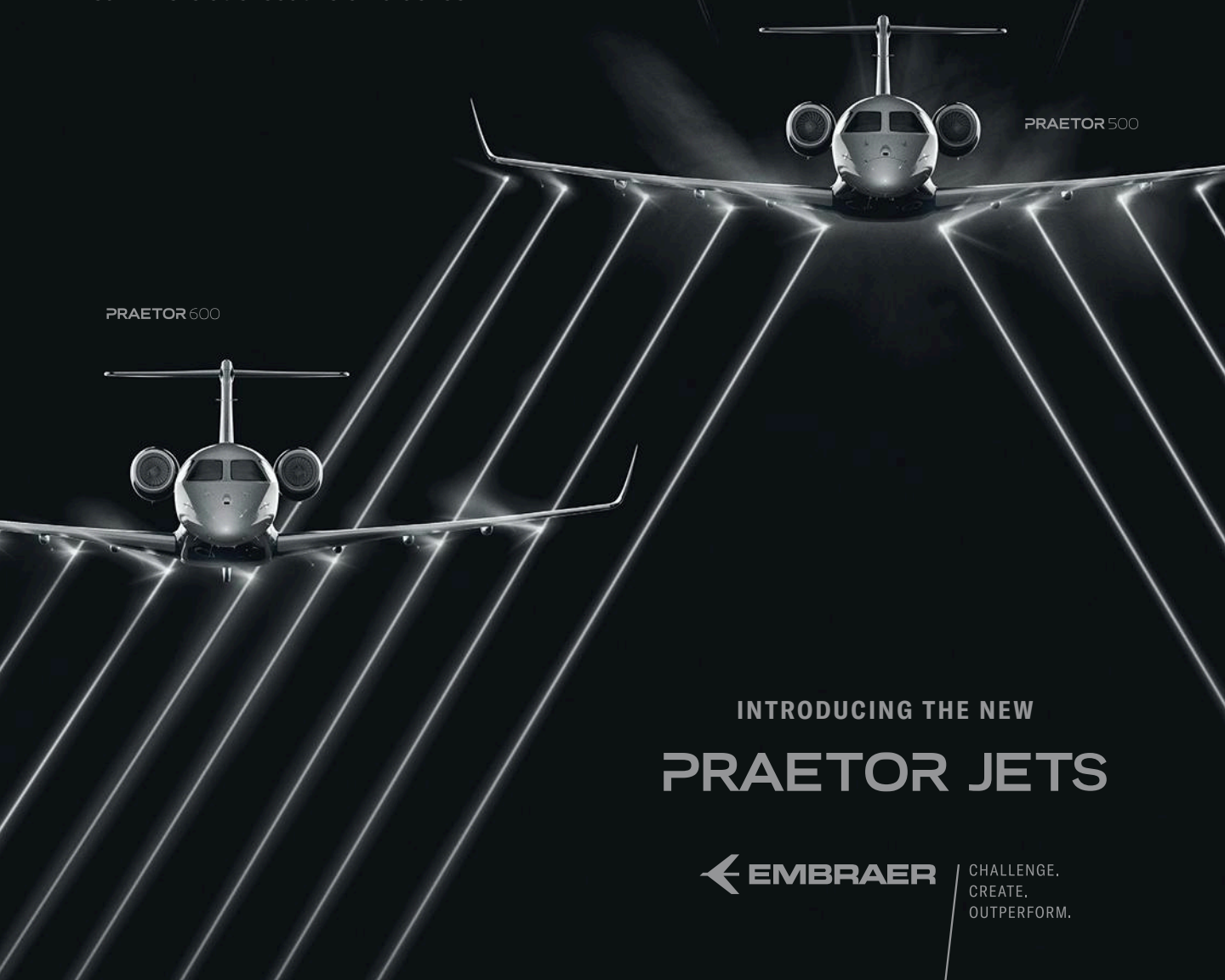

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The Envelope, Please

Business Aviation **Laureates 2019**

WE EDITORS OF THE AVIATION WEEK NETWORK, OF WHICH THIS publication is a member, conduct an annual awards program honoring individuals and teams from various segments of the aerospace community. I've participated over the years and always come away impressed by the people selected for Laureates.

Often, they're industry superstars — astronauts, generals, CEOs — but just as often they're otherwise unheralded team members whose dedication, professionalism and determination were crucial to their respective programs' success. And so it was on March 14 when the 62nd Annual Laureates gala convened at the magnificent National Building Museum in Washington, D.C.

Business and general aviation comprise a key segment of the aerospace world and this year's honorees helped mightily to protect and advance it. Together, they represent the best of the sector with innovations, products and services that make flying safer, more efficient and more comfortable than ever. While we provided a brief on the program in the April issue's Intelligence section, I thought it appropriate to detail the reasons behind those awards here:

CHRIS ZIMMER

Left to right: William Garvey; Brad Mottier, v/p & gm, Business and General Aviation & Integrated Systems, GE; Mark Baker, president/CEO, AOPA; Jim Alpiser, director, Aftermarket Sales, Garmin; Michel Ouellette, senior vp, Bombardier Global 7500/8000; Tom Landers, principal engineer, Gulfstream; Maria Della Posta, senior vp, Pratt & Whitney Canada; Derek Zimmerman, president, Gulfstream Customer Support; Molly McMillin, editor-in-chief, The Weekly of Business Aviation.

Announced a decade ago, the FAA is holding firm to its Jan. 1, 2020, deadline for aircraft equipage with automatic dependent surveillance — broadcast. Thanks in large measure to Garmin International — which offers a wide range of ADS-B solutions for all types of aircraft and budgets — it looks like a majority of the general aviation fleet will meet that deadline and continue operating in controlled airspace. For that significant accomplishment the Olathe, Kansas, company was named this year's Electronics and Avionics Laureate.

Confronted with a serious decline in private pilot numbers and ever-increasing operational costs, President Mark Baker has championed a host of initiatives at the Aircraft Owners and Pilots Association to check both those trends. These include providing an aviation curriculum for high school students, lobbying for medical certification reform, instituting seminars for "rusty" pilots so they can go aloft again with confidence, fighting overcharges and restrictions at airports, and even encouraging the remanufacturing of light planes to lower their cost. For all of those initiatives, he was given the Leadership Laureate.

Gulfstream Aerospace continues as a business jet industry leader in providing customer support for its aircraft, from turnkey maintenance to simplify ownership, to dedicated airborne teams of technicians for aircraft needing on-site service, to web-based support and mobile apps, along with a component repair center, dedicated paint shop and company-owned service bases in the U.S. and Europe. Accordingly, and deservedly, Gulfstream was the segment's MRO Laureate.

Sharing its core with the Pratt & Whitney PW1000G geared turbofan engine, the PW800 entered service in 2018 on Gulfstream's new G500. In the 13,000- to 20,000-lb.-thrust range, with low emissions, noise and vibration, the PW800 also has been picked to power Gulfstream's G600, which is expected to enter service this year, as well as the Falcon 6X, currently in development by France's Dassault Aviation. Quite a hat trick and we editors thought most deserving of Propulsion Laureate honors.

General Electric Aviation's all-new, electronically controlled Catalyst turboprop engine entered testing at the end of 2017 and is to fly this year in Cessna's new Denali. It makes the most use of additive manufacturing of any aircraft engine. Remarkably, that technology enabled the manufacturer to replace 855 conventionally made parts with just a dozen — that's right, 12 — produced through 3-D-printing. In the doing, the company reduced the engine's weight by 5%, improved its efficiency and maintainability, increased its durability and earned the Supplier Innovation Laureate.

Gulfstream took Honeywell's well-proven Runway Awareness and Advisory System to a new level by using dynamic, real-time data, such as current runway condition and predicted touchdown point, to gauge if there would be enough runway to touch down and come to a safe stop. If the calculation proves insufficient, the enhanced Runway Overrun Awareness and Alerting system tells the pilots in no uncertain terms to abort the landing and come up with a better plan. A system and message that won the Safety Laureate.

Lastly, certified in 2018, Bombardier's Global 7500 sets a new standard for business jets, becoming the first purpose-design model with a four-section cabin, full-size kitchen and dedicated crew suite. It features an advanced, fly-by-wire flight deck, all-new General Electric Passport turbofan engines and a 7,700-nm transoceanic range — enough to fly nonstop from New York to Hong Kong or from Singapore to San Francisco. We editors were so impressed with the remarkable Global 7500 that we named it not only this year's Platform Laureate but also the Grand Laureate for the segment.

We salute these winners and all the people who helped them excel. Our industry is stronger, more effective and safer. You have our thanks, and hearty congratulations. **BCA**

Readers' Feedback

Good Work

I read David Esler's article **"GPS Vulnerabilities" (March 2019**) with much interest. This is a topic that I, as an aircraft consultant, have wanted to learn more about since the massive expansion of the use of the GPS system. His article answered all of my questions.

It has been my experience that Mr. Esler always researches his topics very thoroughly and expertly and presents the information in a very well written manner. Kudos and thanks to David!

John D. Yates
The Yates Group, LLC
Peel, Arkansas

Well Balanced

I enjoyed reading **"Hawker Beechcraft Premier 1A" (20/Twenty, March 2019).**

I had the pleasure of flying the airplane for six years. It was the first factory new airplane I had been around.

While a joy to fly, we frequently dealt with range/payload and runway issues. It was common for us to fly with a full or nearly full cabin. We did some long trips, so fuel stops were the order of the day. So was planning for alternate ideas for passengers when we couldn't use the exact airport they requested.

One memorable trip, with only two passengers, we went from San Diego back home to Charleston, West Virginia in 4.5 hr. Twenty some minutes of that was spent quick turning at Garden City, Kansas. The airplane was in its element.

Your article was balanced. You did well in mentioning positive aspects and areas of concern. Nice work.

Eric Stewart
Wilmington, North Carolina

First Read

"Deviations From SOPs" **(Cause & Circumstance, March 2019)** was a great article.

I was struck with the thought that had there been no 170-kt. restriction, this accident could very well have been fatal like the Phenom 100 crash in Gaithersburg, Maryland. I didn't see in the article what the minimum Vref for icing conditions was as compared to their computed VREF of 96 KIAS.

The *Cause & Circumstance* article is what I turn to first every month. Keep up the great work!!

John C. Scherer
ATP/CFII SMEL
East Troy, Wisconsin

Author's note: Following this climb, HZ-IBN then flew a curving base leg, descending at up to 3,000 ft. per minute towards the threshold of Runway 25. The aircraft's TCAS annunciated "clear of conflict" when HZ-IBN was 1.1 nm from the runway threshold, at 1,200 ft. above aerodrome level (AAL), and at a speed of 146 KIAS, with the landing gear down and flap 3 selected.

The aircraft continued its approach at approximately 150 KIAS. Between 1,200 and 500 ft. AAL the rate of descent averaged approximately 3,000 fpm, and at 500 ft. AAL the descent rate was 2,500 fpm. The aircraft's TAWS generated six "pull up" warnings on final approach. The aircraft crossed the Runway 25 threshold at approximately 50 ft. AAL at 151 KIAS. The aircraft manufacturer calculated that the appropriate target threshold speed for the aircraft's mass and configuration was 108 KIAS.

From the Web

Comments regarding Cabin Ozone: A Potentially Serious 'Poison' At High Altitude by Patrick R. Veillette, April *BCA*


Operations

Cabin Ozone

Are you exposing your passengers and yourself to danger?

Since the North Atlantic tracks change every day how much consideration is given to avoiding high areas of ozone by the individuals that designate the location of the tracks and how accurate are the ozone concentrations designated as such on the high altitude meteorology charts?

buckschott1@cs.com

Gulfstream has been using ozone converters since the advent of the GIV. Although we had no way to measure concentrations in the cabin, long flights should have sensory indications I would think. The ozone converters were a time change item. Proper and timely maintenance is the key. Same with cabin air recirculation filters. It's pretty obvious on some flights that these items are going way too long before replacement.

jetdoc2@me.com

1) The new research shows extreme variability of ozone at high altitude. The current FAR/JAR is clearly inadequate in terms of using route planning as a means of compliance with ozone regulations. Any commercial aircraft will need to use ozone converters to reduce the level of ozone to protect the health of the crew and passengers.

2) The current FAR/JAR regulations of maximum 100 ppb of ozone concentration for flight segment above 27,000 ft. that exceeds 4 hr. are not always met. And there is no penalty once the aircraft is in service for not meeting the federal regulations. Ozone converters degrade with time and need regular cleaning and maintenance to keep their noble metal catalysts efficient. Their efficiency depends strongly on the bleed temperatures and airborne contaminants.

3) The federal 100 ppb needs to be lowered. Consideration should be given to the fact that the current national ambient air quality standard is 75 ppb measured over 8 hr. and a lower standard (down to 60 ppb as the peak hourly average) has been recommended (*Federal Register,* Vol. 75, No. 11, 2938, 19 Jan 2010).

4) Ozone sensors are becoming more accurate and need to be used for monitoring ozone levels. The industry needs to start thinking in terms of protecting the health of the crew and passengers. I think it is a question of a culture shift and may help airlines and OEMs differentiate themselves in the marketplace, which can also help their bottom line.

kfellague1@gmail.com

If you would like to submit a comment on an article in BCA, or voice your opinion on an aviation related topic, send an email to jessica.salerno@informa.com or william.garvey@informa.com

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NEWS / ANALYSIS / TRENDS / ISSUES

THE FINANCIAL PRESSURES IMPACTING HELICOPTER OPERATORS supporting the oil and gas industry have claimed another victim, with U.S.-based Petroleum Helicopters Inc. (PHI) filing for Chapter 11 bankruptcy protection. The Lafayette, Louisiana-based operator, with a fleet of 240 helicopters, announced its filing on March 14. In the doing, it joined a growing list of helicopter operators that have turned to Chapter 11 to restructure their businesses, including CHC, Erickson and Waypoint Leasing. Oil and gas helicopter support operators continue to face a challenging market caused by lower energy prices. Reduced demand for their services has resulted in aircraft sitting idle. At the same time, they are also facing increasing pressure from clients to reduce costs. Fellow operator Bristow was also recently forced to abandon a takeover of Columbia Helicopters, as the company faces a dramatic drop in revenue due to its attempts to diversify away from oil field operations. Although best known for its Gulf of Mexico drill rig crew-change flights, PHI also has operations in Australia, Canada, Israel, New Zealand and West Africa. And it flies emergency medical service operations in the U.S. and Saudi Arabia. The company's international operations are not impacted by the Chapter 11 filing. "This filing does not in any way reflect the relative health of our businesses. It is simply a reflection of the need to reorganize our financial structure," the company said in a letter to customers. "We are confident that this is the best option for a timely and efficient resolution to protect PHI's future." PHI said it received $70 million in funding through a loan from Blue Torch Capital on March 13 and that it is continuing to generate revenues from existing operations. The company also said it is in discussions about addressing $500 million of debt obligations and is in negotiations with lessors about its helicopter fleets. It has not said whether it will try to shed some aircraft to reduce its leasing burdens as with other operators. "We are working to emerge from bankruptcy in the summer of 2019 with a significantly reduced and more sustainable debt structure that will position PHI for long-term success," company officials said.

L3 COMMERCIAL AVIATION HAS PLACED AN ORDER FOR UP TO 240 new Piper aircraft to expand and modernize the training fleet at its airline academies. Piper said the contract represents the largest civilian fleet order in the company's 82-year history. Announced at the Sun 'n Fun International Fly-In and Expo in Lakeland, Florida, on April 2, the contract includes delivery of 26 aircraft this year, beginning immediately. The companies did not disclose financial terms of the agreement. The Vero Beach, Florida, planemaker is to deliver 19 single-piston Piper Archers and seven twin-piston Piper Seminoles to L3 this year. Archers and Seminoles are fitted with the Garmin G1000 NXi integrated avionics suite. New aircraft will be based at L3's airline academies in Sanford, Florida; Ponte de Sor, Portugal; and Great Britain. "This significant investment in expanding and modernizing our fleet with these brand-new aircraft will help us in our aspiration to provide the highest-quality training while meeting the increasing international demand for new pilots from our airline customers," said L3 Airline Academy Vice President Geoff van Klaveren. The agreement exceeds the seven-year, 152-aircraft order placed by Fanmei Aviation Technologies, Piper's exclusive dealer in China, in February 2018. Fanmei is a subsidiary of a leading aviation training provider in that country.

Jet-A and Avgas Per-Gallon Fuel Prices

April 2019

Jet-A

Region	High	Low	Average
Eastern	$8.79	$4.51	$6.30
New England	$7.75	$3.87	$5.21
Great Lakes	$8.33	$3.90	$5.58
Central	$7.71	$3.37	$5.00
Southern	$8.28	$4.20	$6.06
Southwest	$6.83	$3.35	$5.31
NW Mountain	$7.79	$3.40	$5.30
Western Pacific	$8.35	$3.80	$5.99
Nationwide	**$7.98**	**$3.80**	**$5.59**

Avgas

Region	High	Low	Average
Eastern	$9.05	$5.05	$6.63
New England	$7.45	$4.96	$5.89
Great Lakes	$8.59	$4.59	$6.06
Central	$7.59	$4.41	$5.44
Southern	$8.19	$3.70	$6.24
Southwest	$7.09	$4.00	$5.61
NW Mountain	$8.46	$4.70	$5.74
Western Pacific	$8.52	$4.90	$6.32
Nationwide	**$8.12**	**$4.54**	**$5.99**

The tables above show results of a fuel price survey of U.S. fuel suppliers performed in April 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.

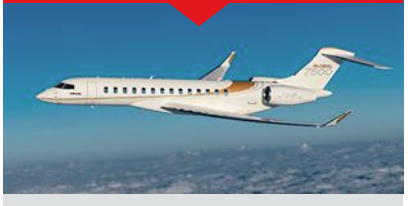
For additional information, contact Aviation Research/U.S. Inc. at (513) 852-5110 or on the internet at www.aviationresearch.com

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

FAA Certifies GE CT7-2F1 Engine

GE Aviation recently reported its CT7-2F1 engine received FAA certification following more than 1,000 flight hours and more than 1,350 hr. of turn time. The engine powers the Bell 525 Relentless medium-lift helicopter. The FAA joined the Bell 525 flight test team in November and is now involved in certification flight testing. The final flight test vehicle was scheduled to fly at the end of March. The 525 Relentless program was launched in 2012. The aircraft is designed to transport up to 19 passengers.

Bombardier Delivers First European Global 7500

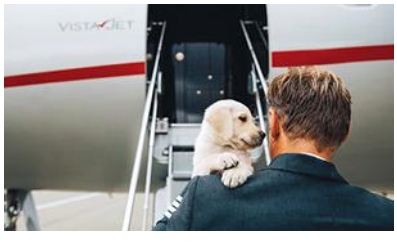


Bombardier recently delivered a Global 7500 to the model's first European customer — Formula One driver and world champion Niki Lauda, a handover that "thrilled" the maker's Business Aircraft President David Coleal. Lauda previously has owned and operated a Global 6000, Global 5000 and Challenger 300 as his private aircraft. The Montreal manufacturer says it expects this year to deliver 15 to 20 of the ultra-long-range aircraft, which Coleal described as "the crown jewel of the industry."

FLIGHTSAFETY INTERNATIONAL AND TRU SIMULATION + TRAINING have formed a new company called FlightSafety Textron Aviation Training to provide instruction services on Textron Aviation's broad product line of business and general aviation aircraft. According to FlightSafety co-CEO and President-Commercial David Davenport, the joint venture will "increase efficiency, promote innovation and ensure the extension of our high-quality training programs into new and upcoming Textron Aviation aircraft." Meanwhile, Gunnar Kleveland, president of TRU Simulation + Training, said, "By leveraging our teams' strengths and combination of world-class training capabilities, I am confident this will provide an enhanced training experience for our customers." **Brian Moore has been named CEO of the new entity.** He joined FlightSafety more than 20 years ago and has held positions of increasing responsibility since then, including manager of the FlightSafety Wichita East Learning Center, and most recently as executive director of Operations. The joint venture will offer training on 48 Cessna, Beechcraft and Hawker aircraft models at 16 locations, using a fleet of 89 simulators.

DASSAULT AVIATION SAYS IT PLANS TO ACQUIRE EXECUJET'S maintenance, repair and overhaul (MRO) business at Subang Airport in Malaysia as it strengthens its aftermarket support in Southeast Asia. ExecuJet Malaysia is part of ExecuJet's global MRO network, which Dassault agreed to purchase earlier this year. **The network includes operations in Africa, Europe, the Middle East and the Asia-Pacific region.** ExecuJet Malaysia's 64,000-sq.-ft. facility at Subang Airport is the largest business aviation MRO in the country. The operation is in the process of adding Falcon aircraft to the list of models it supports. "Malaysia is an important center for business aviation and our largest Southeast Asian market. It is expected to achieve further growth in the future," said Jean-Michel Jacob, Dassault Aviation Asia-Pacific president. "To anticipate this growth, Dassault Aviation decided it was important to have a factory-owned service center in the region." Despite the change in ownership, ExecuJet MRO Services will maintain its separate identity and leadership team and continue to serve aircraft of all types. "ExecuJet has been a pillar of business aviation for nearly 30 years and has a well-deserved reputation for providing high-quality MRO service," said Geoff Chick, Dassault Aviation senior vice president, worldwide service network. "Adding Falcon capabilities to ExecuJet's portfolio will help ensure that current and future Falcon customers — many of whom have mixed fleets — will continue to receive world-class after-sale service for many years to come."

VISTAJET, THE GLOBAL BUSINESS JET CHARTER OPERATOR based in Malta, recently launched "VistaPet," which it describes as "the most comprehensive program designed to ensure all passengers feel welcome — "even if they are four legged." **As rationale, the company says it has seen a 104% increase in animals flown in the last two years and that a quarter of all its passengers fly "with their loyal companions."** Beyond that, it asserts that most pet owners distrust the care of pets by the airlines transporting them. And thus VistaPet, a service "designed in collaboration with experienced veterinary practitioners, groomers, dieticians and coaches to respond to the need and challenges when traveling with animals." The new offering includes "care kits, sleep mats and balanced menus" and even "fear of flying courses" for pets and their owners.



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FL450: The fastest engine in its class, the HF120 enables effortless climb to FL450 and beyond. Its high fan and core pressure ratio provides increased aircraft speed and reduced climb time to higher cruising altitudes. With a low thrust lapse rate, the engine allows for initial climb in excess of 4,000 feet per minute and reduces time to climb by 40%.

ADVANCED: The engine represents decades of research and development. A wide-chord, swept titanium blisk fan with composite fan outer guide vanes and the use of innovative turbine blade and combustor materials are just some of the unique features the HF120 brings to the light jet market.

SILENT (Inside & Outside): Smart placement of the rotor dynamic resonant frequencies outside of the engine taxi and flight settings minimizes unwanted cabin noise. Tight tolerance controls and exceptional build quality deliver low fan and core vibration levels. Low levels of vibration transmission to the fuselage result in a quiet cabin and the smoothest flying ride in its class.

TOUGH: Setting new standards for durability and efficiency, superalloys used in the hot section permit a higher operating temperature with extended parts life. All HF120s are monitored closely via proven large aircraft engine proactive diagnostic systems to minimize downtime and enable longer uninterrupted service.

EFFICIENT: Using innovative aerodynamic designs, the HF120 delivers greater cycle efficiency while optimizing operability. Unique airblast fuel nozzles provide better fuel atomization yielding superior fuel-to-air combustion to minimize fuel burn. Laser drilled combustor liner holes ensure minimum pressure drop across the combustor, enabling optimum transfer of compressor energy to the turbine side. This unique design offers outstanding overall environmental benefits, including low NOx, CO, and HC emissions.

RELIABLE: All of these amazing features combine to create an engine that redefines dependability. Extensive testing in excess of 23,000 cycles and simulated 5,000 flight cycles run on a single engine reveal proven reliability and readiness for longer uninterrupted operation.

The HF120 enjoys enviable operational success. It's an incredible machine built to set a new standard for the light jet market—ready for applications beyond its current aircraft installation.

Icon Opens Sales and Demo Center Showroom

Icon Aircraft, maker of the amphibious Icon A5 light sport aircraft, has opened its first sales and demonstration center showroom at Santa Monica Municipal Airport (KSMO) outside Los Angeles. The plane-maker says Santa Monica is the "idea flying environment" for its aircraft and a cultural fit for customers who enjoy adventure and the outdoors.

Bombardier Completes Sale of Flight Training to CAE

Bombardier has concluded the sale of its flight training and technical activities to CAE in a transaction valued at $645 million. The companies announced the deal last November. CAE will add 12 Bombardier business jet full-flight simulators (FFS) to its

training network. The company operates more than 80 business aircraft simulators. Jean-Christophe Gallagher, Bombardier Business Aircraft vice president and general manager of customer experience, said, "Bombardier's talented employees and strong relationships with clients, combined with CAE's network and expertise, will elevate the customer experience.

HARBOUR AIR, NORTH AMERICA'S LARGEST SEAPLANE AIRLINE, has partnered with motor developer magniX to convert its fleet to electric propulsion. The companies plan to replace the radial piston engine in one of the airline's de Havilland Canada DHC-2 Beavers with the startup's 750-hp electric motor. The "re-motored" aircraft is expected to fly by the end of 2019 and will be used as the test aircraft for supplemental type certification of the conversion. Harbour Air plans to begin commercial service with the electric-powered Beaver in 2022, says Roei Ganzarski, magniX CEO, and wants to convert its entire fleet of almost 35 seaplanes, including the larger DHC-3 Otter and DHC-6 Twin Otter. The

Vancouver, British Columbia-based airline operates 12 routes to islands and other locations in the Pacific Northwest. A typical Beaver flight lasts 10-20 min. "We can do that with today's batteries, let alone with 2022 batteries, which will provide longer range," Ganzarski says. "Harbour Air understands what we can do today. For Seattle-Vancouver, they use a Cessna Caravan. We can't do that with today's batteries," he says. "We can't do 200 mi., but a Beaver flying 65-70 mi. between islands does make sense." Harbour Air operations also lend themselves to electric propulsion, with frequent stops during which batteries can be recharged. Ganzarski says, "A 20-min. flight, 20-min. charging, and Harbour Air's turnaround times are 30 min. to 1 hr. They can do this without changing the aircraft or their business model." **At 750 hp, the magni500 motor is significantly more powerful than the Pratt & Whitney R-985** radial engine powering the DHC-2. But Ganzarski says operators are already re-engining their Beavers with the more-powerful PT6A turboprop. "If they are looking for more power, we can make it clean. And an electric motor is not affected by altitude," he says, noting piston and turbine engines lose power with altitude. The cost of "re-motoring" an aircraft like the Beaver "should be equivalent to re-engining with a PT6," says Ganzarski. But the operating cost should be significantly less because of the lower maintenance required by electric motors. "The five-year life-cycle cost should be 20-80% cheaper than today." Under the partnership, Harbour Air will help with engineering of the modification and hold the STC to convert its own fleet and those of other operators. The plan is to begin with certification of the Beaver, then move on to the DHC-3 Otter, DHC-3T Turbo Otter and the DHC-6 Twin Otter. MagniX will be responsible for all aspects of the electrification, including the charging infrastructure, he says.— **Graham Warwick**

A PAIR OF BOMBARDIER GLOBAL 6000S HAVE BEEN DELIVERED to Turkey in readiness for a conversion process that will turn them into standoff jammer platforms. A total of four Global 6000s will be modified as part of the country's program to provide a platform for electronic support and electronic attack. The aircraft's mission will be to detect, identify and locate enemy communication systems and radars and put them out of action if necessary. This will allow combat aircraft to operate safely – a mission similar to that performed by the U.S. Air Force's Compass Call-equipped C-130 Hercules. Notably, the USAF is planning to replace those C-130s with a business jet-based platform. Models displayed at Turkish trade shows reveal that the Hava SOJ will be equipped with wingtip- and fuselage-mounted electronic support measures, and active electronically scanned array (AESA) jamming equipment for targeted electronic attack fitted into fairings underneath the fuselage. Inside are workstations for up to eight operators. Meanwhile, Australia is acquiring a second pair of Gulfstream G550s modified by L3 for vaguely described electronic warfare missions that evidently include relaying communications. That program appears to have been cut to four aircraft from the five originally considered. A defense equipment plan published in early 2016 said two G550-based electronic warfare aircraft and later up to three more would be acquired in the early 2020s.

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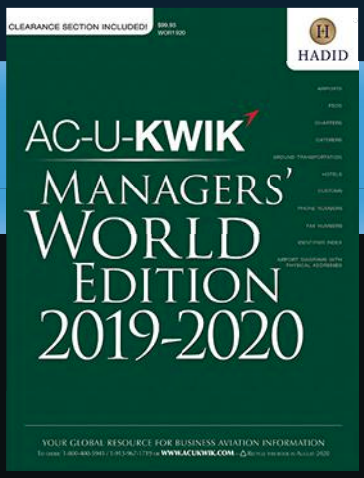

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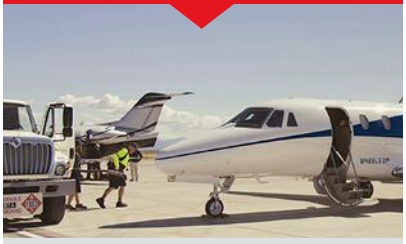
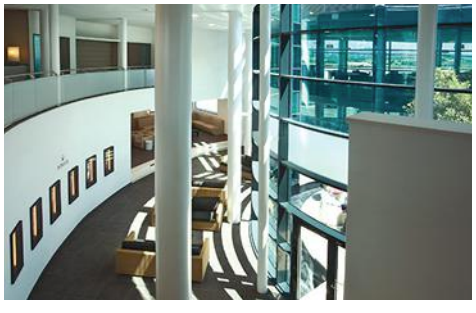


World Fuel Services is now supplying Gateway Aviation Services at Phoenix-Mesa Gateway Airport (KIWA). The FBO will now have new payment options and a new loyalty offer with the World Fuel Contract card, AVCARD by World Fuel and World Fuel Rewards. Gateway Aviation Services has recently remodeled its flight planning room and pilot lounge and expanded its airside entryway and ready room.

Jetex Adds Third Location in Japan

Jetex has opened its third location in Japan — at Kansai International Airport (RJBB). Kansai adds to the existing Jetex portfolio of 56 locations in 26 countries. The 300-sq.-meter Premium Gate is equipped with private parking, a lounge, meeting room, reception counter, and Customs, Immigration and Quarantine facilities 24 hr. a day. "We have been operating in Narita and Haneda airports since 2015 and believe Kansai to be a strategic addition based on the impressive 31.5% growth over the last 18 months." said Adel Mardini, founder and CEO of Jetex.

ECCELSA AVIATION IS AN FBO IN THE SMALL COASTAL town of Olbia, in the heart of the Costa Smeralda on northeast end of the island of Sardinia, and for most of the year, it's a relatively quiet place. But beginning each June, that changes and there are few busier FBOs anywhere. On an especially busy summer weekend, the FBO at Aeroporto Olbia Costa Smeralda may see as many as 350 aircraft movements, and there may be as many as 100 airplanes parked on the FBO ramp at any one time, from large-cabin private jets to head-of-state VIP Boeing 747s. And traffic increases from a winter average of two movements and three passengers a day to some 125 movements and 276 passengers on a day in August. The workforce at Eccelsa varies from 11 agents in December to 45 in August. While a majority of the seasonal workers are based in and around Sardinia, said General Manager Francesco Cossu, "Others come from Canada, France, the Middle East, Poland and the Russian Federation, to reflect the FBO client base." **The FBO spares no effort in meeting and exceeding the demands and expectations of those seasonal clients,** from private owners to celebrities to powerbrokers from every corner of the globe. The FBO's Runway Restaurant was created to take diners on a culinary tour of the finest Sardinian cuisine, including centuries-old dishes with a modern flair. There is also inflight catering from the town's Cortesa Restaurant to a meet wide variety of ethnic tastes and conform to various religious strictures, from Hebrew to Hindu to Muslim. To further ensure a seamless stopover, partnerships up and down the coast include a Ferrari dealership, a yacht leasing agent and private estate realtors. Eccelsa's Expedition Service agreement with Plaisant-Lloyds of London sub-agents will facilitate shipping of virtually anything to anyplace in the world, from an important business contract to a 300-ft. mega-yacht. **There is even a small office at the FBO representing the independent microstate of San Marino** where an aircraft owner may change its registration to take advantage of offshore aircraft residency. Luxury services also extend to crews. There are such necessities as weather and flight planning assistance, as well as a private crew lounge with Wi-Fi and satellite television. A separate snooze room offers peace and quiet, and a summer terrace with chaise-lounges is available for the sun-seekers. Getting into the airport is relatively straightforward. The French École National de l'Aviation Civil-licensed field has an 8,019-ft. runway and ILS/DME approach. **And unlike so many of the world's most popular destinations, the airport does not have slot restrictions.** Eccelsa is an aviation enthusiasts' dream. An evening at the Runway Restaurant, declared one diner, "Is a perfect meal, surrounded by a constant parade of the finest airplanes in all of aviation." **— Kirby Harrison**



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INTERVIEW BY **WILLIAM GARVEY**

William Korner
Chairman and CEO of Flight Research Inc., and The International Flight Test Institute, Mojave Air & Space Port (KMHV), Mojave, California

A highly decorated military aviator — first as a U.S. Army helicopter pilot and later as a U.S. Air Force fighter pilot — "Stryker" Korner flew 202 combat missions in Vietnam, where he was shot down several times but evaded capture, and then another 25 in Desert Storm. He retired as a lieutenant colonel from the Air National Guard. He has logged 11,000 hr. of flight time in a wide variety of aircraft and continues to add to that count as an instructor pilot at Flight Research. A business graduate from Penn State University, where he played football for the Nittany Lions, he has started and run several successful businesses during his 40+ year career. He is considered one of the foremost experts in the field of advanced aviation flight training, education and flight systems development, and readily confesses to a lifelong passion for aviation.

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

Questions for William Korner

1 **What exactly is Flight Research's business?**

Korner: We do many things, but our primary work is flight test education. We train NATO pilots and military pilots from Israel, South Korea and elsewhere, along with airframe manufacturer pilots. We put experienced pilots through a rigorous ground and flight program that ultimately qualifies them to be true test pilots. And a sister company, the National Test Pilot School, which is also based here at Mojave, is a certified academic institution and those completing its program can earn a master's degree in test flying. We have some 20 to 30 students going through that long course annually. Altogether, those training programs represent about 60% of our business.

2 **And the other 40%?**

Korner: We do flight testing for a wide range of manufacturers, both helicopter and fixed wing, along with structural, avionics, systems, modifications and weapons tests for them and component and missile makers, and we also conduct control system evaluations. To do all that, we have a group of highly experienced test pilots, engineers and A&Ps, along with a fleet of 42 aircraft ranging from a MiG 21 and Hughes 369 to an L-39 Albatros and Cessna 172.

3 **Anything else?**

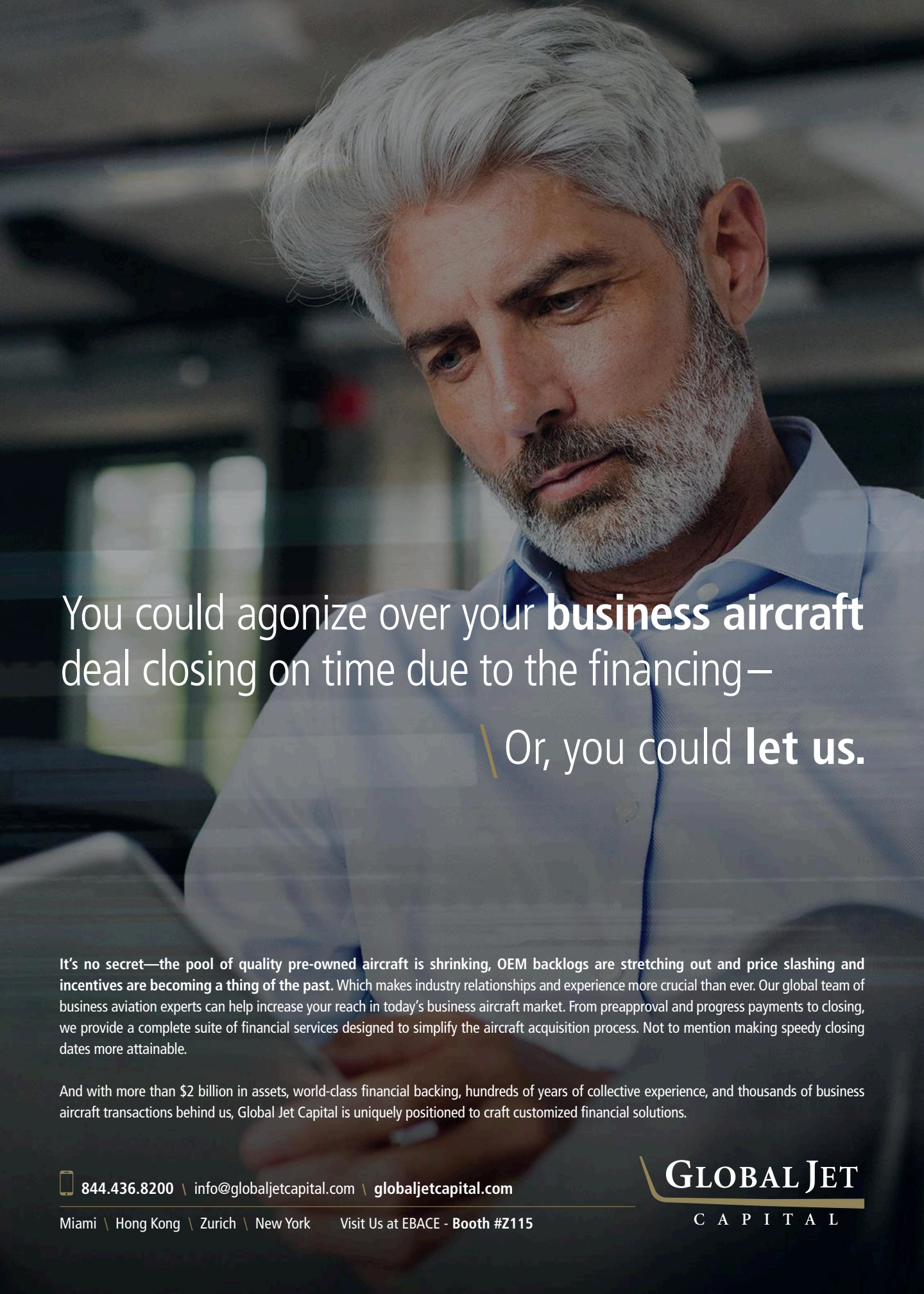
Korner: Yes. We have a fully staffed and equipped maintenance, repair and overhaul facility at Mojave capable of all manner of mechanical and avionics work. We do orientation training on zero-G parabola flights for individuals destined for space flight. And we conduct flight tests and training on unmanned air systems, both indoors and out.

4 **Inflight upsets are a real problem, as you know. What's Flight Research's response?**

Korner: When I bought the company in 2013, Sean Roberts, the previous owner, had been doing upset training for a single customer. I took the training myself and came away so impressed that I decided to expand the program because of the loss of control problem. We offer a four-day initial and a two-day refresher. And we do this for pilots operating business jets, turboprops, piston planes or helicopters, but probably the business jet program gets the most attention. In the initial, we do a ground school profile of Air France 447 and go flying first in T-67 Firefly, then in an Aermacchi 326 to get used to 2.5- to 3-G conditions and inverted flight, and finish in one of our Sabreliners, which, thanks to its F-86 parent, is fully aerobatic.

5 **How do they do?**

Korner: The biggest inhibitor to people taking the course is fear and, initially, most of them fail. But by the end of three flights and 25 upsets, they're ready. We think the Sabre is a great teaching device since it is most like the aircraft they fly every day rather than one designed specifically for aerobatics. And here's the thing: If you always operate in a 1-G environment and wake turbulence puts you inverted and the autopilot cuts off, you better understand what's happening and what to do. Anybody carrying passengers really ought to know how to do this stuff. We even offer upset training for flight attendants to help them remain calm in upsets and respond to passenger needs. This training can run $20,000 for an initial, but customers see its value, which is why 200 pilots took the program last year. **BCA**



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Richard N. Aarons
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bcasafety@gmail.com

Incapable of Flight

All safeguards **failed**

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

It seemed nothing would go right on March 8, 2017, for the crew of Ameristar Charters Flight 9363, an MD-83 flight from Willow Run Airport (KYIP) in Ypsilanti, Michigan, to Washington Dulles International Airport (KIAD) in Virginia — at least that was the case until the captain's quick decision-making averted tragedy by aborting the takeoff well after accelerating through V_1.

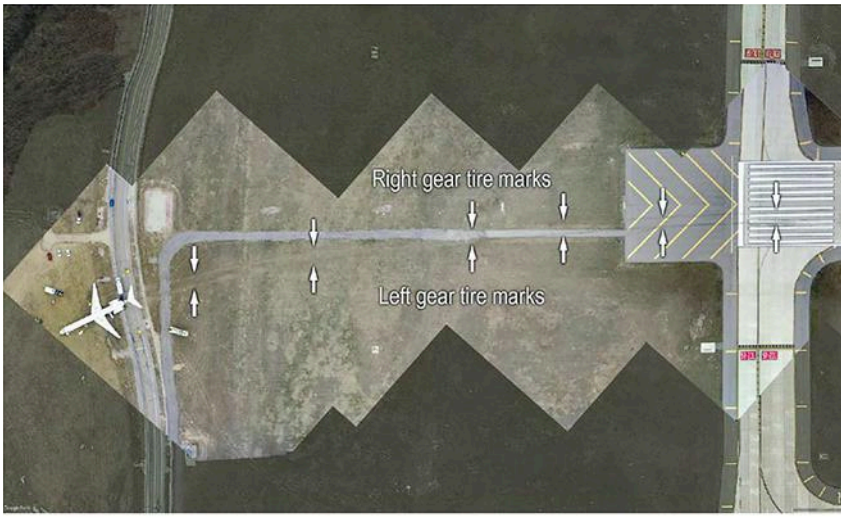
Still, the aircraft ran off the 7,543-ft.-long Runway 23L (including a 200-ft. blast pad) and traveled about 950 ft. across the grassy part of the runway safety area (RSA) before striking the airport perimeter fence and a raised, paved road and finally coming to a stop on the fuselage belly about 1,150 ft. west of the runway end.

The thing that went right is that all 110 passengers and six crewmembers evacuated with only one minor injury suffered by a passenger. Another thing that went right is that the NTSB congratulated the crew on a job well done despite challenges faced by the pilots earlier that morning.

Ypsilanti was cold and extremely windy that day as it had been for several previous days. The most recent Terminal Aerodrome Forecast (TAF) for KYIP expected sustained wind from 250 deg. at 32 kt. with gusts to 48 kt., visibility greater than 6 mi., and a few clouds at 6,000 ft. AGL. AIRMETs had been issued at 0945 for surface winds greater than 30 kt. and SIGMETs called for turbulence below 12,000 ft.

In fact, winds were so strong that morning that the tower controllers evacuated their roost at about 1139 when high wind and gusts from the west caused a power outage at the airport and disabled some of its weather observing equipment. The controllers issued a notification at 1217 advising that the airport had no air traffic control services (referred to as "ATC Zero"). Thus, the airport had become an uncontrolled facility.

Making matters worse, KYIP was a Limited Aviation Weather Reporting Station (LAWRS) facility. When the Automated Surface Observing System (ASOS) lost some of its sensor functions and the LAWRS observer failed to sign off from the ASOS operator interface device (OID), no one provided backup information to supplement the weather data that was missing from the ASOS.



ALL IMAGES: NTSB

Orthomosaic image of the airplane's path from the end of Runway 23L to its final location.

As a result, said NTSB investigators, throughout the day of the accident, the ASOS continued to automatically disseminate Meteorological Terminal Aviation Routine Weather Reports (METARs) that did not contain the AUTO modifier to show that they were not being augmented by a weather observer and did not contain complete weather information.

The winds were also whipping around a quarter-mile-long hangar adjacent to the west pad, sending swirling, accelerated gusts around the Ameristar MD-83 that had been parked on the pad for two days. No one knew, nor could they have known, that the high-velocity, ground-level turbulence was beating up the aircraft's elevators.

The pilots arrived at KYIP at about 1130 on the morning of the accident. The 54-year-old captain held a type rating for DC-9 airplanes, but that day was receiving differences training in the MD-83. Until differences training was completed, the captain could not serve as pilot-in-command (PIC) of an MD-83 operated under FAR Part 121 by Ameristar. He held an ATP certificate with type ratings for the Boeing 747, DC-9 and Saab SF-340. He also held a flight instructor certificate.

He had been hired by Ameristar on Jan. 25, 2016, and had flown the DC-9 as a first officer before upgrading to captain on Feb. 26, 2016. He was also a proficiency check airman for the company DC-9 flight simulator. The captain had accumulated 15,518 hr. total flight experience, which included 4,752 hr. as PIC and 8,495 hr. in the DC-9. He had flown 68 hr., 30 hr. and 0 hr. in the previous 90 days, 30 days and 24 hr., respectively. He had flown into KYIP 10 times between April 17, 2016, and March 6, 2017, and his last three flights had been with the check airman (Jan. 8, 2017; Jan. 15, 2017; and March 6, 2017).

The 41-year-old check airman held an ATP with type ratings for the Boeing 737, DC-9, Dassault Falcon DA-20 and Learjet airplanes. He also held flight instructor and advanced ground

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Rear view of the airplane wreckage.

instructor certificates. He was qualified for the company on the DC-9, MD-83 and 737 and was a check airman on the MD-83. He had accumulated 9,660 hr. total flight experience, which included 7,240 hr. as PIC and 2,462 hr. in the DC-9 (2,047 of which were as PIC). He had flown 50 hr., 19 hr. and 0 hr. in the previous 90 days, 30 days and 24 hr., respectively, and had flown 152 flights into KYIP (53 times on the MD-83) between Jan. 1, 2003, and March 6, 2017.

For this flight, the captain was to be the pilot flying (PF) in the left seat and the check airman the pilot monitoring (PM) in the right seat. The check airman was also to be the PIC.

The pilots found their airplane on the west apron, completed a walkaround and initiated their preflight planning. The crewmembers considered the high gusting wind when discussing the V-speed calculations. They chose to use a maximum thrust takeoff, which was their normal procedure. They calculated these V-speeds: V1 (takeoff decision speed), 139 kt.; VR (rotation speed), 142 kt.; and V_2 (minimum takeoff safety speed), 150 kt.

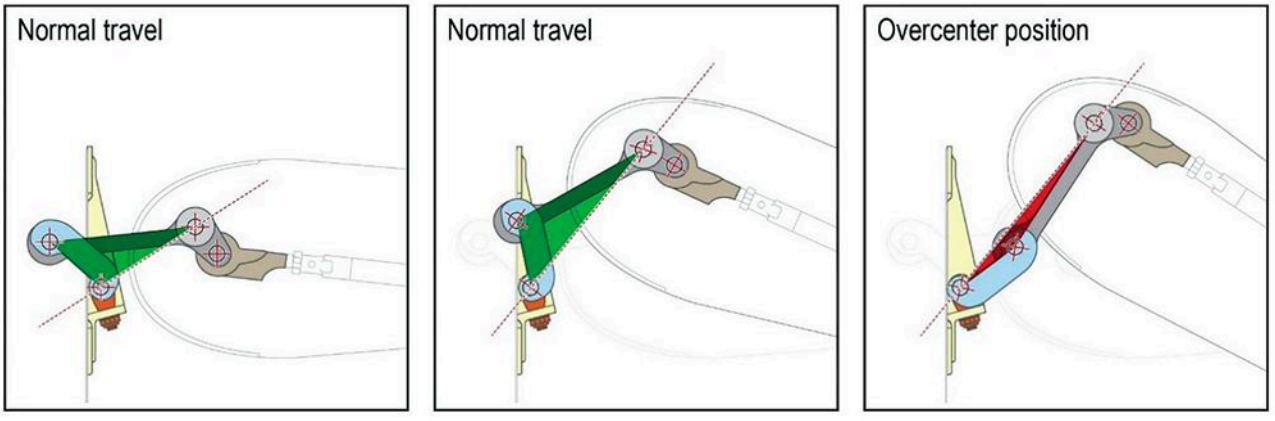
The check airman later told investigators the wind was "pretty gusty," so the pilots agreed to increase the rotation speed by about 5 kt. The CVR transcript indicated that the check airman advised the captain to "delay rotation until at least V_2 . . . wait for me to call it."

The captain conducted a briefing affirming that the pilots would delay rotation "because of the gusty, strong gusty winds." His briefing also considered wind in the event of an emergency. In the CVR transcript, he told the check pilot to "really keep an eye out on what our airspeed is doing today, ahm, in the event of an engine fire or failure at or after V_1, we're going to continue the takeoff. . . . If you get any kind of wind-shear warning — it's gonna be max thrust, ah, all the way to the firewall thrust, if necessary . . . we'll fly out of the shear, back me up on the, ah, airspeed calls."

The NTSB concluded later that "the flight crew's decision to use an increased rotation speed was appropriate for the known weather conditions and consistent with company procedures."

Neither pilot had observed any anomalies with the airplane while performing the walk-around inspection or their predeparture procedures and checklist items.

The airplane is a T-tail design with the elevators and horizontal stabilizer attached near the top of the vertical stabilizer at about 30 ft. AGL. The left and right elevators are attached by hinges to the rear spar of the horizontal stabilizer, and each is equipped with control, geared and anti-float tabs attached to the trailing edge. Each elevator can travel between 27 deg. TEU (trailing edge up) and 16.5 deg. TED (trailing edge down) between mechanical stops mounted on the horizontal stabilizer. A stop arm on each elevator contacts the mechanical stops to limit elevator travel.



Diagrams showing the relative positions of the links (blue) and actuating crank (gray) when moving within their normal range of travel (in green) and when locked overcenter after having moved beyond their normal range of travel (in red).

Each elevator also is equipped with a damper designed to prevent elevator flutter during flight and to dampen rapid movement of the elevator during gusty wind when the airplane is on the ground. When the airplane is parked, each elevator is free to move independently within the confines of the mechanical stops if acted upon by an external force, such as wind or manipulation by maintenance personnel. By design, the elevator system has no gust lock, and the elevators are not interconnected.

Elevator control is accomplished via the trailing-edge elevator control tabs, which are mechanically connected to and directly controlled by the cockpit control column. During takeoff (at VR or higher) and during flight, when a pilot provides aft or forward control column input to command a change in airplane pitch, the elevator control tabs mechanically deflect, and the resultant aerodynamic forces on the deflected control tabs move the elevator surfaces to produce the change in airplane pitch. For example, when a pilot pulls the control column aft to command airplane nose-up pitch (such as during rotation), the control tabs respond by deflecting TED, and the resultant aerodynamic forces move the elevators TEU.

Three potential problems exist with this configuration: (1) Pilots can't determine the mechanical integrity of the elevators during the walk-around; (2) an elevator-control check in the cockpit only confirms that the tabs are moving (as opposed to the elevators); and (3) elevators can be damaged when strong/gusty winds swirl around a parked airplane.

The airworthiness standard current at the time of the accident specified that flight control systems and surfaces of transport-category airplanes must be designed for the limit loads generated when the airplane is subjected to a 65-kt. horizontal ground gust from any direction while parked and taxiing.

Operating and maintenance manuals require a hands-on inspection of the elevators if the airplane was exposed to steady state winds or gusts exceeding this limit. That inspection requires the pilots or maintenance crew to mount some sort of lift and manually move the elevator surfaces to assure freedom of movement.

At the time of the accident, Ameristar had no provisions for monitoring winds during the two days the aircraft was parked. However, even if such a system had been in place, there would have been no requirement for a manual inspection on the day of the accident. Winds at KYIP over the previous two days had not exceeded 50 kt. Unknown to everyone, however, winds on March 8 streamed over and around a nearby hangar, accelerating locally over 65 kt. and becoming locally turbulent, thereby causing the parked accident airplane's elevators to bang from stop to stop. Internal linkage on the right elevator was damaged, but there was no way for the crew to know that.

Getting Weather Info

On March 8, nothing was easy for these pilots. The flight crew first powered up the airplane about 1236 and repositioned it to the terminal in preparation to board their passengers for a 1430 departure. At 1314:39, the flight crew listened to the ATIS recording that was from 1153. They were not sure this limited weather would meet the regulations for their flight, so they attempted to obtain the current weather information for KYIP from other sources. The check pilot told the Safety Board he used his cellphone to call the ATIS frequency but received a report that was "just an updated version of the previous weather with winds about 260 deg. at 40 kt."

Ultimately, the check pilot used his cellphone to obtain the weather observation at Detroit Metropolitan Wayne County Airport (KDTW), about 8 nm east of KYIP, and to call the Ameristar operations director to obtain a Real-Time Mesoscale Analysis

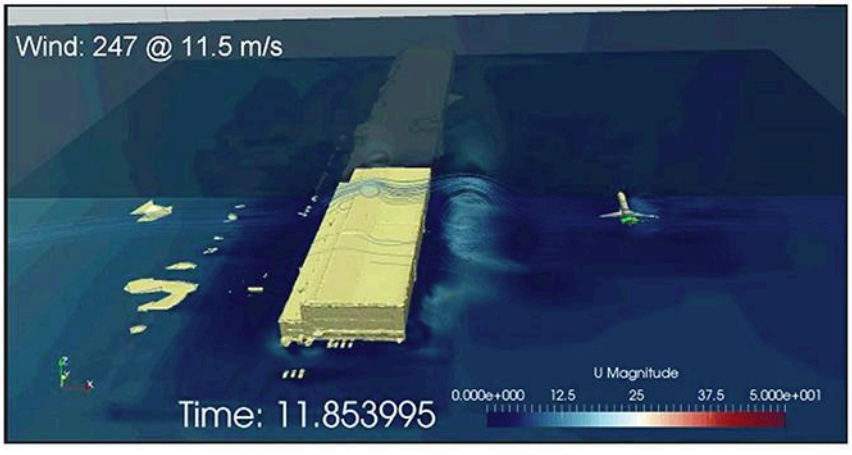
(RTMA) temperature at KYIP. The CVR captured numerous phrases from the check airman consistent with cellphone calls to obtain weather information and ATC clearances up until 1448:46.

The NTSB reached out to the FAA to see if Flight 9363's departure was actually legal under the circumstances faced by the crew. The agency stated:

"Although Part 121.651(a) is silent on the operational capabilities of weather facilities and the recency of reported weather . . . to operate consistently with this and other related regulations, a pilot must have a reasonable certainty that conditions existing at the time of takeoff have been accurately reflected by the weather report that is used to determine the flight will meet or exceed the required minimums and thereby ensure safe operation of the aircraft."

The Safety Board noted that the weather conditions at KYIP were VFR based on the most recent METAR received by the flight crew, KDTW was reporting VFR conditions when the check airman called to receive the information, and the flight crew visually verified that the conditions at KYIP were VFR at the time of the departure. Thus, the Board concluded "that the flight crew's preflight weather evaluation was sufficient to establish with reasonable certainty that the conditions existing at the time of takeoff met the required minimums for departure."

Anyway, they got their passengers settled on board, and, clearance in hand from an FSS, they checked CTAF for traffic and headed for the runway.



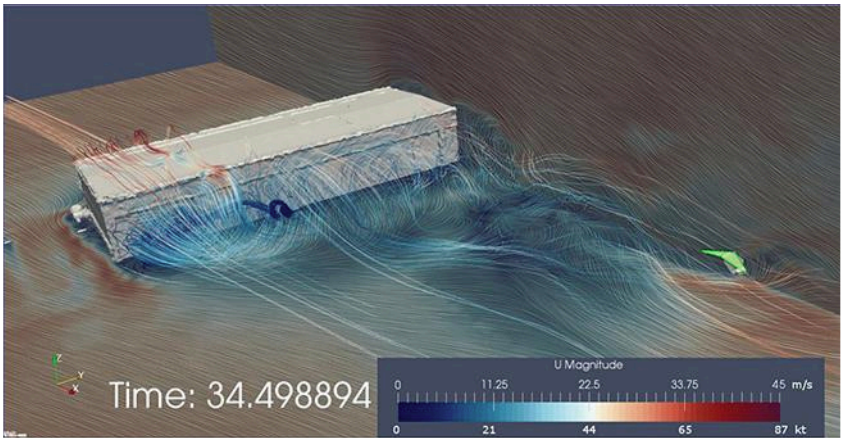
3-D visualization of wind simulation results for a discrete time showing the locations of the hangar and airplane. Wind flow from the west (left side) is disrupted downwind of the hangar.

The Takeoff

The check airman performed the flight control checks during taxi and felt nothing unusual when he moved the control column forward and aft. Taxi out was normal, and the pilots ran the checklist. They rechecked all of their V-speeds and increased VR.

All their conversation, said the Safety Board, was pertinent information during the taxi. They used Taxiway E1 to hold short of Runway 27. The check pilot coordinated with the FSS for their off-time, then they taxied toward Runway 23L.

Both pilots looked at the windsock and saw it was favoring Runways 23L and 27. They decided they would be more comfortable with 23L since they had typically



3-D visualization of wind simulation results for a discrete time showing turbulence generated downwind of the hangar.

used that runway for departure. They were aware of a Beechcraft Baron that had reported downwind to Runway 27.

The flight crew positioned the airplane for departure from Runway 23L. At 1451:12, the check airman called for the captain to begin the takeoff roll. At 1451:55, the check airman called "V_1." Six seconds later (at 1452:01), he called "rotate," followed 3 sec. later (at 1452:04) by "V_2."

At 1452:05, the captain said, "Hey, what's goin' on?" and, 3 sec. later, "Abort." The check airman stated, "No, not above . . ." and then ". . . don't abort above V_1 like that," and the captain replied, "It wasn't flying."

At 1452:23, the CVR captured sounds consistent with the airplane's excursion from the paved surface.

At 1452:37, the airplane came to a stop, and the check airman called "Evacuate, evacuate, evacuate" over the public address system. All 110 passengers and six crewmembers evacuated the airplane using four of the airplane's eight exits. Flight attendants reported that two overwing exits were not opened, and the right front door exit was unusable because the evacuation slide did not inflate.

During a post-accident interview, the captain recalled that, when he began a normal rotation of the airplane at the "rotate" call, it did not rotate, so he applied more back pressure. The captain said the control column was not quite to the physical limit of aft movement but was "farther back than for a normal rotation." Both pilots stated in interviews that, after the captain called for the rejected takeoff, they applied maximum braking, but the airplane went off the end of the runway.

During the overrun, the nose landing gear and both main landing gear had bent, fractured and displaced aft. The fuselage lower skin panel assemblies, including longeron and frames, buckled and some sections tore off. Internal structure at several locations had been sheared.

Later, investigators established flight control continuity for the elevator system by exercising the cockpit control columns

Accidents in Brief

Compiled by Jessica A. Salerno

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

▶ **March 31 — About 1439 MDT, a** Cirrus SR-22 (N173CT) crashed near Farmington, New Mexico. The private pilot was killed in the accident and the airplane was destroyed. The airplane was registered to Casey's Aircooled Engine LLC., and operated by the pilot as a personal flight. Marginal VFR weather conditions prevailed at the accident site, and a VFR flight plan had been filed. The cross-country flight departed Cal Black Memorial Airport (U96), Halls Crossing, Utah, about 1345 with a planned destination of Big Spring McMahon-Wrinkle Airport (BPG), Big Spring, Texas. According to the pilot's family, he had flown from his home base in Big Spring on March 29, and had spent the weekend in the Lake Powell, Utah area. He had flown the route at least a dozen times before, and was familiar with the terrain.

About 1400, the radar target had reached 14,000 ft., and about that same time the pilot made a call to the Denver Air Route Traffic Control Center (ZDV), requesting VFR flight following. Three minutes later, with the same, previously unidentified radar target about 30 mi. southeast of U96, and at 15,000 ft., the target was positively identified as the accident airplane. The controller advised the pilot that he had established radar contact, and provided the pilot with the altimeter setting for Cortez Municipal Airport (CEZ), Cortez, Colorado.

By 1409, the airplane had reached its highest altitude of 17,300 ft., and was about 50 nm southeast of U96. A few minutes later, the target turned left, and began to track east. For the next 7 min. its track began to slowly transition back to the southeast, after which the pilot was provided and acknowledged a frequency change by the ZDV controller.

At 1428 the airplane was about 24 mi. southwest of Farmington Airport (FMN), and the controller provided the pilot with the FMN altimeter setting. About that time, the airplane began descending, until at 1435, it had progressed another 24 mi., and descended to 9,300 ft.

The controller then provided the pilot with the frequency for Albuquerque Air Route Traffic Control Center (ZAB), and the pilot read it back correctly. No other radio transmissions were received by controllers from either ZAB or ZDV, and at 1438:10, the airplane had descended to 8,575 ft., and began a descending right turn. The radius of the turn was about 3,200 ft., and the last recorded radar return from the airplane occurred 16 seconds later, with the airplane at 6,850 ft., and on a southbound track.

Controllers from both ZDV and ZAB attempted to establish communications with the pilot. No responses were received, and an Alert Notice (ALNOT) was issued at 1512.

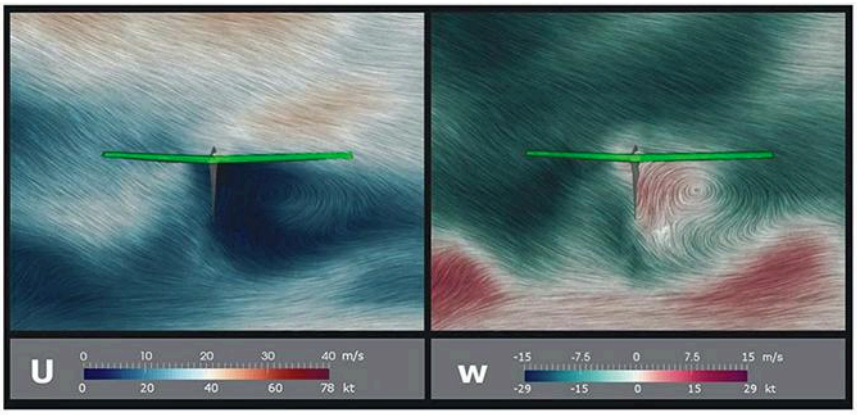
A search and rescue mission was conducted by the Civil Air Patrol and the New Mexico State Police, and the airplane wreckage was discovered about 1700.

through their full range to the control column stops in both the aircraft nose-up and aircraft nose-down directions. The left and right elevator control tabs responded with movement in the appropriate direction. Then they used a lift to inspect the elevators and found that the airplane's right elevator was jammed in a TED position and could not be moved when manipulated by hand. Examination found that the inboard actuating crank for the right elevator's geared tab was bent outboard, and the actuating crank and links were locked over-center beyond their normal range of travel.

Analysis

The Safety Board took a long look at the captain's decision to reject the takeoff beyond V_1 — the maximum airspeed at which a rejected takeoff can be initiated, and the airplane stopped on a runway that is limited by field length. What follows is the Safety Board's analysis of that action.

Company guidance specified that initiating a rejected takeoff even 4 to 6 kt. (about 1 sec.) after V_1 may result in a runway overrun at high speed. Although the flight crew's use of the increased rotation speed to mitigate a possible wind-shear encounter during takeoff was appropriate, it resulted in the check airman not calling "rotate" until 5 sec. after the airplane achieved V_1. By the time the captain recognized that the airplane would not rotate and called to abort the takeoff, 12 sec. had elapsed since V_1, essentially guaranteeing that the airplane would overrun the runway.



Vertical cross-section visualization of wind simulation results for a discrete time showing flow pattern and horizontal ("U") and vertical ("w") wind magnitudes near the accident airplane's elevators (view from behind looking forward).

Ameristar guidance and training specifically stated that the captain was solely responsible for the decision to continue or reject a takeoff and that the no-go decision must be made — and the appropriate procedures initiated — before the airplane reached V_1. The guidance stated that, in many cases, rejected takeoffs at high speed have resulted in far more negative or catastrophic outcomes than would

The wreckage was located in flat high desert terrain, at an elevation of about 6,185 ft., 450 ft. southwest of the last recorded radar target, and 30 mi.south of FMN.

The first identified point of impact was a 4-ft.-deep by 10-ft.-wide crater which contained the nose landing gear assembly, two propeller blades, and fragmented engine and airframe components. Two matching linear impact marks, the total length of which corresponded to the airplane's wingspan, emanated from the crater on a north-south heading. The right wingtip and green navigation lens fragments were found at the tip of the northern mark, and red navigation lens fragments were located at the tip of the southern mark.

The debris field was 450-ft. long, on a heading of about 210 deg. true. The engine came to rest about 30 ft. beyond the crater, and the remainder of the debris was composed of fragmented pieces of composite main cabin and wing structure, fanned out to a width of about 100 ft. The aluminum ailerons, elevators, and flaps were crushed and distributed throughout the debris field, and the farthest components were the left forward seat and a wing fuel cap.

The rocket-powered airframe parachute was located in the center of the debris field. The harness cables remained attached to their respective airframe fittings, and the top of the parachute canopy remained folded evenly along its pleats, and had not unfurled. Although the canopy lines had extended to their full length, the solid-fuel rocket motor remained attached to the parachute assembly and had not been expended. These findings were consistent with the parachute system not having been activated in flight.

Officers from the New Mexico State Police observed a storm passing through the high desert area south of Farmington on the afternoon of the accident. A Bureau of Land Management Law Enforcement officer who responded to the accident site that day, stated that upon his arrival skies were clear, but the ground was wet with rain from a shower that had passed through the area a few hours prior.

▶ **March 29 — At 1750 CDT, a Piper** PA-28-180 (N8397W) collided with an airport perimeter fence and a ditch after a runway excursion at Monroe County Airport, (M40), Aberdeen/Amory, Mississippi. The private pilot and passenger received minor injuries and the airplane sustained substantial damage. The airplane was registered to and operated by a private individual as a personal flight. It was VFR. The flight originated from Marion County-Rankin Fite Airport (HAB), Hamilton, Alabama about 1715.

The passenger, who is also student pilot, stated that he had recently purchased the airplane and planned to take lessons from a flight instructor at M40 on April 1, 2019. He and the private pilot intended to reposition the airplane to M40 where it was to be refueled for the upcoming flight instruction. The private pilot was acting as the pilot in command and was manipulating the flight controls. He added that the flight was uneventful until the landing at M40. During landing, the airplane was slightly left of the runway centerline when it suddenly veered left.

have been likely if the takeoffs had been continued. For decades, pilot training has extensively emphasized that the no-go decision must be made before V_1.

However, company guidance also stated that a high-speed rejected takeoff should be made only for safety of flight items, such as a condition where there is serious doubt that the airplane can safely fly. Boeing guidance also stated that rejecting the takeoff after V1 is not recommended unless the captain judges the airplane to be incapable of flight.

In the case of this attempted takeoff, it was not until after the airplane had exceeded V1 that the captain discovered that the airplane would not rotate in response to his control inputs. When the check airman called "rotate," the captain pulled back on the control column, observed that the airplane did not respond in pitch, then added more back pressure until the control column came "farther back than for a normal rotation," but the airplane still did not respond.

The captain called for the rejected takeoff, and the flight crewmembers applied maximum braking, but the airplane went off the end of the runway. The airplane performance study showed that, assuming the same deceleration profile as that of the accident flight, the captain would have had to start braking 4 sec. sooner for the airplane to have come to a stop on the paved surface. However, at that point in the accident flight's takeoff, the captain's control column input had been applied for only 3 sec.

A review of FDR data showed that, during the airplane's previous successful takeoff, at 3 sec. after control column input, the airplane had only begun to respond in pitch. Thus, the NTSB concludes that the airplane's lack of rotational response to the control column input during the accident takeoff did not become apparent to the captain in time for him to have stopped the airplane on the runway.

Rarely could all of the safeguards in place to ensure an airplane is airworthy before departure (such as proper aircraft maintenance, preflight inspections and control checks) fail to detect that an airplane was incapable of flight, as occurred with the jammed elevator on the accident airplane. Perhaps even more remarkable was that a flight crew would be placed in a situation in which the airplane's inability to fly would not be discoverable until after it had accelerated past V_1 during a takeoff roll. The captain had extensive flight experience with many takeoffs, but none of them presented a scenario like the one he faced during the accident takeoff. Although he was relatively new to flying the MD-83, because of his prior experience in the DC-9, the captain correctly assessed the state of the accident airplane and quickly called for and initiated the rejected takeoff. Thus, the NTSB concludes that, once the airplane's inability to rotate became apparent, the captain's decision to reject the takeoff was both quick and appropriate.

Crew coordination during takeoff is essential to managing one of the most critical phases of a flight. Effective crew coordination and performance depend on the flight crewmembers having a shared mental model of each task; such a mental model, in turn, is founded on effective standard operating procedures (SOPs) (FAA 2017b). Flight crew adherence to SOPs during a takeoff, including maintaining the defined roles of PF and PM, is of paramount importance to flight safety (FAA 2017b).

Although Ameristar's procedures for a rejected takeoff clearly establish that

Accidents in Brief

As the airplane continued off the left side of the runway, the private pilot attempted to go around. During the go-around the airplane collided with the north-south airport perimeter fence then continued into a ditch.

▶ **March 24 — About 1101 EDT, a** Pilatus PC-12/45 (N944BT) was heavily damaged when the pilot's windshield shattered while flying near Fort Lauderdale, Florida. The commercial pilot and two passengers were not injured. It was VFR and an IFR flight plan was filed for the flight that originated from the Fort Lauderdale Executive Airport (FXE), Fort Lauderdale, Florida, and was destined for Moore-Murrell Airport (MOR), Morristown, Tennessee. According to the pilot, he was climbing through 20,000 ft. when he heard a loud bang and the pilot side windshield shattered. He immediately notified air traffic control that he was returning to FXE and needed descend. After landing uneventfully, he examined the windshield and noticed that the seal was extruded in two places around the outer pane. The airplane was manufactured in 2002.

▶ **On March 23, 2019, at 1535 EDT,** an experimental amateur-built Commuter Craft Innovator (N257AR) was destroyed when it crashed after an uncontrolled descent after takeoff from Thomas B. David Field (CZL), Calhoun, Georgia. The pilot/owner/designer/builder was killed. It was VFR. According to employees of Commuter Craft, the accident airplane was the prototype for an airplane kit that was planned for mass production. The accident airplane was flown for the first time by a test pilot on February 25, 2019 at CLZ.

On the day of the accident, the pilot asked his assistant to fly in a "chase plane" with a camera and photograph the airplane "in case it takes off." The pilot said he did not intend to fly, would land if the airplane lifted off, and would only fly if "he had no other choice." According to his assistant, she watched from the chase plane as the airplane departed "barely above the trees," turned in the traffic pattern, and then descended from view. According to the chase pilot, the accident pilot/owner instructed him to depart ahead of N257AR.

The pilot/owner said he would takeoff, enter the downwind leg, "verify the plane was flying satisfactorily" and then climb the airplane to 3,000 ft. Once at altitude, the two planes would join up to capture footage of the prototype airplane in flight. Footage of the accident flight was not captured, but the chase pilot witnessed the accident flight from about 2,500 ft.

The chase pilot watched the accident airplane take off and turn to the crosswind and downwind legs of the traffic pattern. He estimated the airplane never climbed more than 200 ft. AGL, and that the airplane struggled "to maintain airspeed or a nose-up attitude." The chase pilot heard the accident pilot announce his intention to

the responsibility for the go/no-go decision is exclusively that of the captain, in this flight, the PM was also a check airman providing airplane differences instruction to the captain trainee; thus, the check airman was the PIC of the flight. This increased the potential for confusion as to who was truly responsible for the go/no-go decision during an anomalous situation. Instructors typically have more experience in the airplane than the pilot receiving instruction (as was the case with this crew) and are primed to assume control should the trainee's actions pose a risk to the flight.

Although the check airman instinctively reached toward the control column after the captain's "abort" callout (and stated to the captain that they should not reject a takeoff after V_1), the check airman did not take control of the airplane but rather observed that the captain had initiated the rejected takeoff procedures and then took action to assist the captain in executing those procedures.

The flight crew's coordinated performance around the moment that the captain rejected the takeoff showed that both pilots had a shared mental model of their responsibilities. By adhering to SOPs — rather than reacting and taking control of the airplane from the captain trainee — the check airman demonstrated disciplined restraint in a challenging situation. Had the check airman simply reacted and assumed control of the airplane after the captain decided to reject, the results could have been catastrophic if such action were to further delay the deceleration (at best) or to try to continue the takeoff in an airplane that was incapable of flight.

Thus, the NTSB concludes that the check airman's disciplined adherence to company SOPs after the captain called for the rejected takeoff likely prevented further damage to the airplane and reduced the possibility of serious or fatal injuries to the crew and passengers.

Probable Cause

The Safety Board determined the probable cause of this accident "was the jammed condition of the airplane's right elevator, which resulted from exposure to localized, dynamic wind while the airplane was parked and rendered the airplane unable to rotate during takeoff."

Contributing to the accident, it continued, were (1) the effect of a large structure on the gusting surface wind at the airplane's parked location, which led to turbulent gust loads on the right elevator sufficient to jam it, even though the horizontal surface wind speed was below the certification design limit and maintenance inspection criteria for the airplane, and (2) the lack of a means to enable the flight crew to detect a jammed elevator during preflight checks of the airplane.

And contributing to the survivability of the accident, it stated, was "the captain's timely and appropriate decision to reject the takeoff, the check airman's disciplined adherence to standard operating procedures after the captain called for the rejected takeoff, and the dimensionally compliant runway safety area where the overrun occurred."

Since this accident, Boeing engineers have designed new elevator stops that protect the tab linkage, and the FAA has impressed on rated weather observers the importance of properly configuring the ASOS. Ameristar (and many other operators) have worked up protocols to monitor winds during periods when their airplanes are parked. **BCA**

return to the airport, though a reason was not specified. He said the airplane was "porpoising" in flight before the nose "dipped down" and the airplane collided with trees and terrain.

▶ **March 20 — About 1610 CDT, a** Robinson RA Beta helicopter (N7782H) was heavily damaged during an emergency landing to a field near Madill, Oklahoma. The pilot was not injured. The helicopter was owned and operated by Rocking R Enterprises as a personal flight. It was VFR for the flight, which was not on a flight plan. The Robinson departed the Madill Municipal Airport (1F4), Madill, Oklahoma, about 1600 and was en route to the Ardmore Municipal Airport (ARD), Ardmore, Oklahoma.

The pilot reported that he conducted a preflight of the helicopter, which included checking the condition of the belts that drive the rotor, and they appeared to be normal. About 10 minutes after takeoff, he was in level flight about 700 to 800 ft. AGL, when the clutch light warning light illuminated. He stated that almost immediately after the clutch light illuminated, he heard a "bang" and felt the helicopter shudder. He entered an autorotation and landed in a pasture that was rough. The helicopter rolled onto its left side and sustained substantial damage to the tail boom, main rotor, and fuselage.

An examination of the helicopter revealed that both belts were missing. They were not located at the accident site.

▶ **March 20 — About 1500 EDT, an** Apollo Monsoon (N156AP) weight shift-control special light-sport aircraft was substantially damaged during landing at Rolling Meadows Airfield (29GA), Sharpsburg, Georgia. The private pilot was seriously injured. No flight plan was filed for the personal flight. Visual meteorological conditions prevailed at the time of the accident. The aircraft departed Atlanta Regional Airport (FFC), Atlanta, Georgia. The pilot was transporting the aircraft back to the his home airfield after undergoing maintenance at FFC. Before landing, the pilot made several low passes over the runway. Shortly after touching down on Runway 18, the aircraft veered to the right and impacted trees.

Following the accident, an FAA inspector examined the aircraft where it came to rest. The aircraft was on its side, resting against trees to the right of the runway. The fuselage was heavily damaged and was still attached to the wing. The wing was intact with damage to the wingtips. The wreckage was retained for further examination.

The two-seat aircraft was equipped with a Rotax 912, two-stroke,101-horsepower engine.

The pilot held a private pilot certificate with a rating for airplane single-engine land. His most recent FAA third-class airman medical certificate was issued on August 31, 2017, at that time he reported 250 total flight hours.

At 1700, the weather conditions reported at FFC, about 4 mi. southeast of 29GA included, wind from 140 deg. at 5 kt., visibility 10 sm, clear skies, temperature 17C, dew point -7C, and an altimeter setting of 30.12 in. of mercury. **BCA**

Unreliable Airspeed Readings

A condition made worse **by high-altitude ice crystals**

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

The accurate display of airspeed in formation at high altitude is vital because the margins between the low-speed and high-speed buffet margins can be thin. Thus, a small deviation in the aircraft's airspeed or an encounter with turbulence can put the aircraft into a threatening buffet condition.

If an airspeed indication malfunction occurs at high altitude, inappropriate pilot inputs to the flight controls can result in a temporary or permanent loss of control of the aircraft's trajectory.

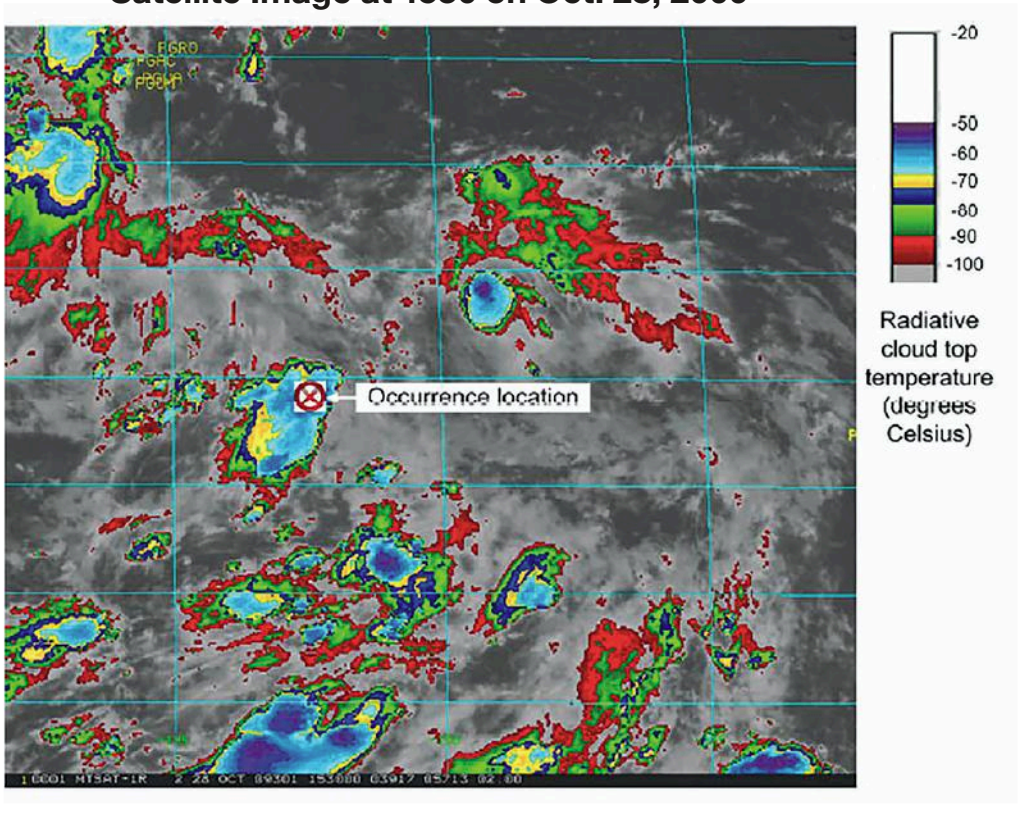
Conflicting warning indications, such as simultaneous overspeed warning from the failed airspeed system and stall warnings from the angle of attack (AOA) system could add further to the confusion.

On Oct. 28, 2009, there were disagreements in the three sources of airspeed information on an Airbus A330-202 (VH-EBA) operating as Jetstar Flight 12 on a scheduled passenger service from Narita, Japan, to Coolangatta, Australia. The event occurred soon after entering instrument conditions at FL 390. According to the Australian Transport Safety Bureau (ATSB) Final Report on the incident (AO-2009-065), the forecasted weather conditions for the flight included isolated, embedded cumulonimbus clouds in the tropical regions up to FL 540. An MTSAT (Japanese Meteorological Agency's multifunction transport satellite) image showed that the aircraft's position was located within or under a large, defined cluster of cumulonimbus clouds at that time. Measurements of the radiative cloud-top temperature were -71.6C, which corresponds to cloud tops over 47,000 ft.

The crew reported that the aircraft's weather radar only indicated an area of light green, and about 1 min. after St. Elmo's fire commenced, a 5-sec. decrease in the captain's airspeed indicator and the standby airspeed indicator, as well as a brief loss of availability of the autopilot and several flight guidance functions. In addition, there were temporary problems with at least one of the total air temperature (TAT) sources.

Both crewmembers were highly experienced. The captain had 18,722 total flight hours experience, including 2,123 hr. on the A330, and 1,183 hr. on the A320. Prior to this occurrence he could not recall having experienced an unreliable airspeed event, nor did he recall

Satellite Image at 1530 on Oct. 28, 2009



MTSAT (Japanese Meteorological Agency's multifunction transport satellite) image showed that the aircraft's position was located within or under a large, defined cluster of cumulonimbus clouds at that time. Measurements of the radiative cloud-top temperature were -71.6C, which corresponds to cloud tops over 47,000 ft.

Source: "Unreliable Airspeed Indication 710 km South of Guam, 28 October 2009, VH-EBA, Airbus A330-202." ATSB Transport Safety Report, Aviation Occurrence Investigation, AO-2009-065, Final Report.

receiving any training for it in the simulator. The first officer was also a qualified captain but was sitting in the right seat due to a shortage of available F/Os. He had 16,400 hr. total experience, including 1,800 hr. on the A330 and 2,400 hr. on the A320. He, too, did not recall ever having experienced an unreliable airspeed event, but he had received training for unreliable airspeed as part of his A330 endorsement at the aircraft manufacturer's facilities.

The crew performed the operator's procedures for responding to an unreliable airspeed indication, during which the captain's, F/O's and standby indicators resumed agreement. The crew reported that they closely monitored the airspeed indications for the remainder of the flight and noticed no discrepancies. The ATSB noted that although this airspeed disagreement event was relatively benign, airspeed is a critical parameter for aircraft control. The ATSB report stated that the most likely explanation for the error was the presence of ice crystals at high altitude. The report also noted that the observed conditions were outside of the design specifications (temperature and altitude) of the certifying authority.

The same aircraft, this time operating as Jetstar Flight 20, experienced a similar loss of airspeed information during high-altitude cruise flight on March 15, 2009, from Kansai International Airport, Japan, to Coolangatta, Australia.

On that earlier flight, the captain's airspeed disappeared, autopilot No. 1 disconnected and numerous maintenance system messages appeared on the electronic centralized aircraft monitor (ECAM). Tropical weather with thunderstorms was present at the time. The crew had been diverting around the worst of the weather and were crossing between cells when the captain's airspeed quickly went to zero.

The event occurred when the aircraft was in cloud at FL 390. Ice, turbulence and static (St. Elmo's fire) were present. There was a marked change in the static air temperature (SAT) from ISA+4 to ISA+23, which equated to an increase from about -52C to -33C. Again, an MTSAT image showed that the aircraft's position was located within or under a large, defined cluster of cumulonimbus clouds at that time. Measurements of the radiative cloud-top temperature were -71.8C, which corresponds to cloud tops over 47,500 ft.

The operator's A330 Flight Crew Training Manual included the following statement: "The most probable reason for erroneous airspeed and altitude information is obstructed pitot tubes or static sources. . . . Since it is highly unlikely that all of the aircraft probes will be obstructed at the same time, to the same degree and in the same way, the first indication of erroneous airspeed/altitude data available to flight crews will most probably be a discrepancy between the various sources."

Was it a mere coincidence that this problem occurred eight months apart on the same aircraft and thus was indicative of a problem with that particular airframe? Not likely. There are a considerable number of incidents in which flight crews have experienced inaccurate airspeed information while in high-altitude cruise flight, enough that this problem can't be ignored.

During its investigation into the Air France Flight 447 crash into the Atlantic Ocean on June 1, 2009, the French Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA) reviewed 13 unreliable airspeed events during high-altitude flight in which collaborating information from crews, flight recorder data and post-flight reports from the aircraft's central maintenance computer were available. (There actually are many more events in which unreliable airspeed indications occurred at high altitude, but the multiple sources of data from those events were not available.) All of the flights were between FL 340 and FL 390. The crews did not observe any significant radar echoes on the chosen flight path but they identified active zones lower or nearby. All the events occurred in instrument meteorological conditions (IMC). Recordings of SAT or TAT showed increases of 10C to 20C during the events. Turbulence was recorded in all of the cases. In nine of the events, a stall warning occurred. All of these experiences were outside of the Joint Aviation Requirements (JAR) icing conditions specified in Appendix C of JAR 25.

The European Aviation Safety Agency's (EASA) Safety Information Bulletin (SIB) No. 2015-17R1, issued Oct. 16, 2015 and titled "Unreliable Airspeed Indication at High Altitude/Manual Handling at High Altitude," reminds pilots that during cruise flight the aircraft should already be in trimmed flight. In case of a sudden loss of airspeed indication, only minor inputs (if any) to the flight controls should be required under most circumstances to keep the aircraft within a safe flight envelope.

According to David Carbaugh, Boeing's chief pilot of flight operations safety for commercial airplanes, maintaining an appropriate pitch attitude and thrust setting should normally be an adequate response. How do you know those? Familiarize yourself with the typical cruise pitch and thrust settings during normal operations.

Remember that high-speed, high-altitude flight produces considerable changes in an aircraft's stability and handling qualities. As air density decreases at higher altitudes, an aircraft's aerodynamic damping decreases, and thus the airplane becomes more responsive to control inputs.

Over-controlling is a distinct threat at high altitude. For the same control surface movement at constant airspeed, an airplane at 40,000 ft. experiences a higher pitch rate than an airplane at 5,000 ft. because there is less aerodynamic damping. Therefore, the change in AOA is greater, creating more lift and a higher load factor. It takes less force to generate the same load factor as altitude increases. Erratic and large pitch inputs, possibly from a startle/surprise effect, can very rapidly bring the aircraft into an upset. It is imperative to not overreact with large and drastic inputs. Pilots should smoothly adjust pitch and/or power to keep the aircraft within the center of its maneuvering envelope.

In many of the previously noted incidents, the aircraft were near the upper limits of their flight envelopes when they encountered high-altitude ice crystals. In that environment, the aircraft's margin between the low-speed and high-speed buffet is likely to be small.

Do not forget that the AOA for buffet onset is considerably less than the stall AOA at low altitudes. For example, a flight test

project conducted by the National Research Council of Canada titled "Aerodynamic Low-Speed Buffet Boundary Characteristics of a High-Speed Business Jet" and presented at the 24th International Congress of the Aeronautical Sciences involved an intermediate capacity, high-speed business jet with highly swept wings to conduct low-speed buffet testing. At an altitude of approximately 13,000 ft., the buffet onset AOA occurred at 16.84 deg. In contrast, in straight and level flight at FL 450 the buffet onset AOA was 6.95 deg. In other words, be wary of your pitch attitude while at high altitudes because of the limited range of AOA due to Mach effects.

This was tragically illustrated in the Air France Flight 447 accident. During the final minutes of the flight the pitch attitude of the aircraft at times increased from 7 to 15 deg., and later reduced slightly to 12 deg. before it slammed into the ocean at 16.2 deg. These pitch attitudes are extreme in the high-altitude environment and undoubtedly contributed to the aircraft's aggravated stall condition.

The sudden and abnormally warmer-than-standard air recorded in the noted encounters creates additional performance and handling considerations. First, the warmer air creates an immediate decrease in thrust. Second, the aircraft is suddenly at a higher density altitude where its buffet margins are thinner. Third, modest turbulence of 1.4 G (which is an increase of only 0.4 G over straight-and-level) can reduce an aircraft's margin over the buffet to no protection.

Carbaugh advises pilots to confirm suspected instrument anomalies by cross-checking with other instruments, and being aware of the reliability of each instrument used for the cross-check. An aircraft's pitch and roll attitude information is generally reliable, especially as comparators would quickly point out any discrepancies between the captain's and F/O's PFD. An engine's thrust setting using the N-1 gauge would also be considered a reliable source of information. The stick shaker may not always be available but reliable if activated. An aircraft's ground speed and position are likely to be reliable as well.

The list of unreliable information includes the airspeed and Mach indications due to the pitot tube possibly being blocked, the altimeter due to a blocked static system, as well as the vertical speed. The autopilot and autothrottles should not be considered reliable. The elevator feel may provide inaccurate feedback and the engine indicating and crew alerting system (EICAS) may not identify the basic problem.

The overspeed and wind-shear warnings will not be reliable, which brings up the difficulty that flight crews have experienced in flight because of the rapid succession of confusing warnings. EASA's safety bulletin reminds pilots that conflicting warning indications, such as simultaneous overspeed warning from the failed airspeed system and legitimate stall warnings from the AOA system, may be experienced.

High-altitude ice crystals pose a double threat to an aircraft's

More About the High-Altitude Environment

Although transport aircraft have three independent speed-sensing systems, environmental factors such as high-altitude ice crystals have the potential to remove this redundancy and create simultaneous failures. The Australian Transport Safety Bureau (ATSB) found that although the pitot tubes fitted to Airbus A330/A340 aircraft met relevant design specifications, those were not sufficient to prevent the probes from being obstructed with ice during some types of environmental conditions that aircraft could encounter in the high-altitude environment. The ATSB and other safety investigation authorities consider this to be a significant safety issue.

Including the Oct. 28, 2009, Jetstar occurrence and the Air France Flight 447 accident on June 1, 2009, aviation safety officials were aware of at least 38 unreliable airspeed events at high altitudes or in reported icing conditions on A330/A340s between November 2003 and October 2009.

The French Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA) review of 13 unreliable airspeed indication incidents revealed that all occurred in icing conditions that were outside of the JAR certification envelopes. The BEA's second Interim Factual Report on AF447 (Section 4.2) found "the certification criteria are not representative of the conditions that are really encountered at high altitude . . . it appears some elements, such as the size of the ice crystals within cloud masses, are little known and that is consequently difficult to evaluate the effect that they may have on some equipment, in particular the pitot probes. The tests aimed at validation of this equipment do not appear to be well-adapted to flights at high altitude."

An impressive international effort was launched in response to these events precipitated by the lesser known phenomenon of high-altitude ice crystals. Coordinated by Airbus, the HAIC (High Altitude Ice Crystal) Consortium brought together 34 partners from European countries as well as partners from Australia, Canada and the U.S. for the 54-month project. Participants included major airframe and powerplant manufacturers, respected engineering and atmospheric science research institutes and universities, all with multi-disciplinary expertise.

engines and airspeed indications. The attention of the aviation community to high-altitude ice was heightened in the aftermath of unexplained engine rollbacks and notable complete engine failures. A consortium of aerospace manufacturers and researchers have been studying how and where this occurs, as well as attempting to provide better avoidance information.

Common trends are apparent in the past incidents involving high-altitude ice crystals. Aircraft were in the vicinity of convective clouds/thunderstorms, although flight crews reported no flight-radar echoes at the altitude of the events. Precipitation in the form of "rain" has been noted on windscreens, which at first perplexed investigators because the events occurred at altitudes far higher than where super-cooled raindrops would exist. No airframe icing was noted in these incidents. It has since been determined that the "rain on the windscreen" was actually the melting of the high-altitude ice particles.

These events commonly occurred while diverting around a flight-level high reflectivity region associated with an isolated thunderstorm core, as well as in the broad anvil outflow regions from clouds associated with convective storm complexes and tropical storms. Overshooting tops (dome-like protrusions from the top of an anvil cloud) are an indicator that significant convection is occurring and that ice crystal icing may be possible. Downwind from the tops of large areas of convective clouds, which are often signified by the visible anvil shape, is the main risk area for encountering high crystal concentrations.

Satellite data confirms the existence of high concentrations of very small ice crystals in the vicinity of convective weather systems. Convective storms in the tropical latitudes contain much more moisture due to the warmer air in these storms. Why are these more likely to exist in the tropical latitudes? Because warmer air can "hold" much more moisture. In fact, these strong convective systems produce cloud tops that have been observed to burst through the tropopause.

How small are the particles? On the order of roughly 40 microns in diameter, and even in high concentrations, these are not visually detectable even in daytime conditions. Unfortunately, current aircraft weather radars cannot detect these zones for several reasons dealing with the limitations inherent with their returns. The temperatures at the altitudes of these events are far too cold for super-cooled liquid water to exist. With a radar reflectivity of only 5% of average size raindrops, there may be little radar reflectivity at flight altitude above the minimum threshold of the pilot's onboard weather radar. Today's pilot is not typically on guard for these conditions because our training has been focused on identifying conventional storm targets that provide strong radar returns.

Note there is a clear distinction between the high concentrations of very small ice crystals that cause obstructed pitot tubes at altitude (as well as the engine flame-out problem) versus the collection of larger crystals (at lower densities) seen in high-level

One major group of participants worked to design the proper probes for sampling microphysical properties of clouds in this high-altitude environment during flight testing. Four different aircraft conducted 48 flights and collected 298 hr. of data. In May 2015, the inflight data gathering campaign was based out of Cayenne, French Guiana, utilizing the specially modified atmospheric research aircraft to include the National Research Council of Canada CV580, SAFIRE (French Service of Instrumented Aircraft for Environmental Research) Falcon 20 and Honeywell's Boeing 757.

The inflight data sampling was used by atmospheric scientists to better understand the microphysical properties near the core regions of deep convective clouds, to include cloud liquid and ice water contents, as well as the size and shape of the particles. This information is expected to provide a better understanding and modeling of the icing phenomena and the development of numerical tools to predict the effects of this icing on various aircraft components during the design and certification phases. The European icing wind tunnels were upgraded to allow realistic reproduction of the high-altitude ice crystal environment (the scientific community refers to this as "mixed phase and glaciated icing conditions) allowing the aerospace industry to perform qualification of equipment tests.

Another important objective of the HAIC project was the improvement of flight operations by developing appropriate detection and awareness technologies to be fitted on aircraft and able to alert the flight crew. In January 2016, an Airbus A340 was based at Darwin, Australia, and Saint-Denis, La Reunion, to test the development of glaciated and mixed-phase icing conditions detection and awareness technologies.

The HAIC project also included investigating the potential of using currently available space-borne observations to detect and track cloud regions with high ice water content. A rapid developing thunderstorm tool was developed by Météo France for the tropical Atlantic region and successfully tested so that in the future, pilots might be warned well in advance of a flight route predicted to go through a region of high-altitude ice crystals and thus divert well in advance. **BCA**

FBW Precautions

Fly-by-wire (FBW) flight control systems present a special challenge in the event of inaccurate airspeed indications caused by reversion of such a system to laws/modes that provide reduced or no flight envelope protection. Flight control computers receive input from the pilot (i.e., nose-up command from the yoke or sidestick) as well as the aircraft speed, altitude, configuration, attitude, phase of flight and other parameters.

The sidestick and pedal commands are interpreted by the flight control computer, which determines how much control surface movement is allowed, then sends electronic signals to operate the surface. There are some differences in the electrical architecture among types of FBW transport aircraft. The following is a brief summary of the Airbus design.

FBW flight control systems have three general modes (or "laws") of operation: normal, alternate or direct. Under normal law, the computers prevent the exceedance of a predefined safe flight envelope, to include protection against excessive pitch attitude, load factor limitations, protection against high speed, high AOA and excessive bank angle. Low energy protection is available in normal law when the aircraft is between 100 ft. and 2,000 ft. with the flaps set at configuration 2 or greater.

If various types of system problems are detected, then the computers revert to alternate law. A reduction of electronic flight control can be caused by the failure of computational devices such as a flight control computer, an information providing device such as an air data inertia reference unit or multiple system failures, including dual hydraulic failure.

The two events involving the Jetstar flights investigated by the Australian Transport Safety Bureau exhibited a reversion to alternate law from normal law immediately following the indicated airspeed decrease. In the Oct. 28, 2009, incident, the aircraft's flight control system reverted to alternate law for the remainder of the flight, indicating that there were significant disagreements between the three airspeed sources over a period of at least 10 sec. Under alternate law, some of the protections are not provided. A good example of this would be the automatic AOA and overspeed protections provided under normal law.

Under direct law, no protections are provided and control surface deflection is proportional to the sidestick and rudder pedal inputs from the flight crew. Under direct law the autopilot function is also lost.

Turbulence can cause brief AOA fluctuations that can generate spurious stall warnings. In normal law, these spurious warnings are eliminated by setting a high AOA threshold to trigger a stall warning. In alternate law, this high warning threshold is removed.

The European Aviation Safety Agency Safety Information Bulletin urges pilots to have an adequate understanding of the interactions between the air data systems, autopilot, flight director, autothrottles, primary flight control and the instrument indication systems in order to maintain a safe aircraft state at all times. The agency strongly recommends practical training using appropriate simulators on manual handling characteristics of their aircraft at high altitude in normal and non-normal flight control laws/modes. **BCA**

cirrus, cirrostratus and cirrocumulus clouds. The latter are not hazardous.

The EASA bulletin emphasizes that strategic (planning) and tactical (inflight) weather avoidance represent the best practices to avoid these events. Tactical avoidance of high concentrations of very small ice crystals requires effective utilization of the aircraft's weather radar. The high reflectivity below the aircraft from rain associated with these cells may be a good indicator of high ice particle concentrations aloft since that rain would often have formed from falling ice particles.

At high altitudes, the pilot must tilt the radar down to scan for high-reflectivity rain below to determine the existence and position of a convective cell, and gauge the altitude of the high-reflectivity region. However, the height of the cell above this region, if not visible, may only be inferred. If the top is not visible, it is prudent to conclude that it exceeds the aircraft's cruise altitude, and the cell should be avoided by circumnavigation. Also be advised that high-altitude ice crystals may be present for some time after the active convection that produced them has begun to decay, creating a prolonged hazard.

Pilots are advised to avoid reflective regions by more than the typically recommended 20 nm from areas where large convective cells are present (and in engine types that have been identified as at risk while pending modification, a distance of 50 nm from such areas has been recommended). Pilots are advised not to overfly convective cells. Flight upwind of the cell is recommended to avoid the spreading anvil downstream and to limit exposure to high ice-particle content conditions.

High-altitude ice crystals illustrate yet another threat in the high-altitude environment that needs to be addressed in training. EASA strongly recommends training in the basic flight physics concerning flight at high altitude, with a particular emphasis on the relative proximity of the critical Mach number to stall, pitch behavior and an understanding of the reduced stall AOA. It also calls for practical training in appropriate simulators on manual handling at high altitude for all pilots, and for flight crews in fly-by-wire aircraft, handling during normal and non-normal flight control laws/modes. **BCA**

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Staying on Glidepath

The dangers of **the duck-under**

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

A Falcon 900 crosses the threshold at 10 ft., landing at Austin Executive Airport (KEDC), Texas, July 27, 2017.

Whenever I witness a transport category airplane cross a runway threshold by only a few feet, I think back to all the accidents in which aiming for "brick one" ended badly.

The dirty little secret about going below the glidepath is that it works. You can indeed aim for brick one, and flare the airplane so as to touch down very near the runway threshold or before the 500-ft. markers. I see it all the time. You can confirm it by looking at all the large aircraft tire prints just past the runway threshold. Of course, these pilots know there is a risk of a sudden wind gust putting the airplane down short of the threshold. But what many such practitioners don't appreciate are the other risks involved. These pilots may have failed to consider the variables of visibility, geometry and technology. There are, fortunately, easy methods to counter each factor.

When I started flying big airplanes for the U.S. Air Force, it seemed some pilots would fly a little low on glidepath, hoping to spot the runway early. They would then aim for the first inch of runway once visual. In theory, aiming for brick one was OK because the pilot would flare the airplane so as to touch down in the first 500 ft. of runway. This was called the "duck-under" and was officially frowned upon by the service — that is, except at some squadrons where it was an accepted way to land on short runways.

In 1981, I was a second lieutenant flying the KC-135A tanker and noticed some of the pilots would adjust their aim points short of the touchdown zone on short runways. "Gee sir," I would say in my "butter bar"-speak, "isn't it kind of risky intentionally flying below glidepath? What if we make a mistake?" The inevitable response: "I'm not planning on any mistakes. Are you?"

Last Flight of Cobra Ball

That same year, while I was wondering about aim points in my tanker, an RC-135S spy plane crashed short of the runway at Shemya Air Force Station (PASY), now Eareckson Air Station, on Shemya, one of Alaska's Aleutian Islands. The aircraft, Cobra Ball, was a highly modified Boeing 707 with huge camera ports on the right side designed to take high-resolution pictures of Soviet test missile shots. It was an important Cold War mission that required its crews to fly long operational and training missions and then fly a demanding precision approach radar (PAR) approach to the small island, where low ceilings and high crosswinds prevailed.

The pilot had flown most of his PAR approach "slightly below glidepath," briefly flew "slightly above," but ended "well below" after sighting the approach lights.

In a PAR approach, the controller views the vertical and horizontal progress of a descending aircraft's radar return, known as "skin paint," against a 3-deg. glidepath and an extended runway centerline. The pilot attempts to hold assigned heading and a vertical velocity rate down to a 100-ft. decision altitude. The Cobra Ball's vertical velocity indicator was a purely mechanical device that lagged actual vertical velocity by as much as 9 sec., so the pilot was required to factor this lag when turning the controller's instructions into pitch and power settings. The pilot's only situational awareness came from the controller's voice. A PAR approach is demanding on a good day; it is extremely difficult with low visibilities and high crosswinds.

One need only read the last 1 min. and 43 sec. of the PAR tape to understand what happened. RFC is the radar final controller; 66 is the aircraft's call sign, Exult 66; and TWR is the tower controller.

RFC: "Going slightly above glidepath; heading one zero six."

RFC: "Turn left heading one zero

U.S. AIR FORCE

The Shemya runway on Attu Island, Alaska.

four; 2 mi. from touchdown; slightly above glidepath."

RFC: "Heading one zero four, turn right heading one zero six."

RFC: "On course, heading one zero six; drifting left of course, turn right heading one zero eight."

RFC: "Turn right heading one one zero."

RFC: "On glidepath . . . left of course heading one one zero."

RFC: "Going slightly below glidepath; 1 mi. from touchdown."

RFC: "At decision height."

66: "Sir, we've got the lights."

RFC: "Roger."

RFC: "Slightly below glidepath, slightly left of course."

RFC: "Well below glidepath."

RFC: "On course; over landing threshold."

RFC: "Tower."

TWR: "He crashed close to the end of runway one five, I mean one zero."

The pilot exhibited very precise heading control but tended to favor the low side of the glidepath. Once he spotted the approach lights, he went well below the glidepath. That shows what happened but not why. The aircraft crashed into the approach lights that were built onto a cliff just prior to the runway, which did not have an overrun. The aircraft was torn apart. Six of the 24 crewmembers were killed. But why?

If Shemya had a standard 1,000-ft. overrun, the duck-under would have resulted in a hard landing and some good-natured ribbing from the crew to the pilot, and nothing more. But that runway didn't have an overrun. The Air Force blamed the crash on the pilot's misunderstanding of the impact of a headwind on his target vertical descent rate and the fact he "channelized on the approach lights."

But blaming the pilot's understanding of headwinds and target fixation on approach lights misses the point entirely. A year after that crash, I ended up flying a very similar model of the Boeing 707, an EC-135J. We were much heavier than the classic KC-135A tanker, had larger engines with longer engine acceleration "spool up" times, and flew a much faster final approach speed. And our brakes were fair, at best. It was a natural reaction for many of our pilots to aim short when faced with a contaminated runway. I've flown into Shemya a few times and the cliff that sits at the end of Runway 10 is intimidating. All of my landings to that runway were in good visibility underneath about a 400-ft. ceiling and a 25-kt. crosswind. You can get used to seeing the approach lights off to the side while crabbing the airplane just prior to landing. When ducking under, those approach lights appear higher in the windshield. I suppose you can get used to that, too. But the weather doesn't have to be rotten to pose a duck-under risk.

Last Flight of C-GXPR

Prior to upgrading airplanes, the crew of Bombardier Global 5000 C-GXPR were frequent visitors to Fox Harbour Airport (CFH4), Ontario, Canada, flying their trusty Challenger 604. The airport has a 4,885-ft. runway, with an 80-ft. displaced threshold on the end in use, thus reducing the available runway to 4,805 ft. Just short of the displaced threshold was an unpaved area of grass, sloping up from a road to the runway.

The crew computed that 4,300 ft. were required for landing and planned on a touchdown at 500 ft. Mathematically it all worked out with 5 ft. to spare, except the Global 5000 was designed with a 50-ft. threshold crossing height; a touchdown at 500 ft. would require a duck-under. As is usual with these accidents, the reasons behind the crew's duck-under decision are, well, complicated.

If you aren't flying something in the Boeing 747-size class, you should certainly know that the near and middle sets of a visual approach slope indicator (VASI) are for you, while the middle and far sets are for the jumbos. This makes intuitive sense, since the large jet's pilots are sitting higher and farther ahead of their aft-most set of landing gear. If you don't often fly into airports not designed for jets, you may be surprised to learn that not all precision approach path indicators (PAPIs) are installed the same distance along the runway. You won't find the explanation in the Aeronautical Information Manual or any other pilot resource. But FAA Order JO 6580.2B, Visual Guidance Lighting Systems, provides an explanation as to why not all PAPIs are created equal.

If an instrument landing system (ILS) glideslope is installed, the PAPI should be sited and aimed to coincide with the electronic glideslope. If an ILS is not installed, the PAPI is sited to provide a required threshold crossing height (TCH) and clearance over obstacles in the approach area. The required TCH depends on the primary aircraft type the airport expects and is selected by the airport manager. At issue is the height of the pilot's eyes in the cockpit above the wheel height when landing. Aircraft with 10 ft. or less cockpit-to-wheel height will be aimed to have a visual crossing height of 40 ft. Taller aircraft are aimed even higher, with Boeing 747s and similar aircraft at 75 ft.

The PAPI is typically installed 1,000 ft. beyond the runway threshold but can be installed closer on shorter runways. An abbreviated PAPI (APAPI) can be installed on runways with limited space. Whereas a PAPI provides five incremental indications (too high, slightly high, on path, slightly low, too low), an APAPI only provides three (too high, on path, too low). The APAPI at Fox Harbour was located 480 ft. from the threshold, well before the customary 1,000-ft. location. The maximum eye-to-wheel height for an APAPI system is 10 ft. The Global 5000's eye-to-wheel height was computed to be 17.2 ft.

Flying a conventional 3-deg. glidepath given by a PAPI designed for aircraft in the Global 5000 size category would have crossed the threshold at approximately 50 ft. but also would have touched down beyond the pilot's stated goal of 500 ft. Flying the APAPI would have made the touchdown goal attainable but would have eroded the TCH safety margin to less than 30 ft. But the pilots flew even lower, probably aiming for brick one. A classic duck-under. But they had gotten away with it many times before in the Challenger.

The captain had made this approach and landing successfully 75 times flying a Challenger 604. The accident flight

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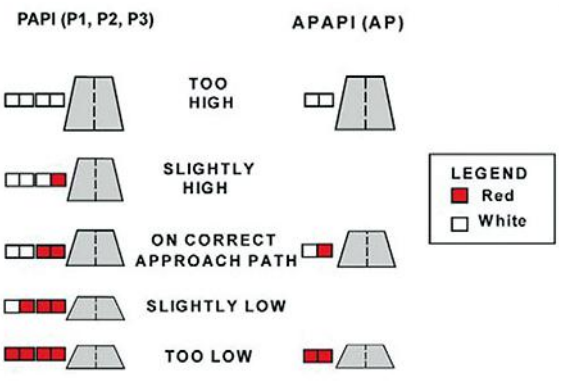

PAPI versus APAPI indications.

was his third attempt in the larger Global 5000. Besides being heavier (87,800 lb. versus 48,200 lb. maximum allowable takeoff weight) and longer (96 ft., 9 in. versus 68 ft., 5 in.), the Global 5000 has different landing geometry. The Challenger's eye-to-wheel height is about 12 ft., or approximately 5 ft. lower than the Global's.

But there is another factor, and that is the approach geometry of each aircraft. The Challenger flies relatively nose-low on approach, which means the landing gear are not so far underneath the pilot's eyes. The Global 5000, conversely, flies relatively nose high and the landing gear are significantly lower than the pilot's eyes. Had this Global 5000 crew flown the same approach profile in the Challenger, they would have made the runway. But, on the accident landing, the right main landing gear impacted the turf 7 ft., 6 in. short of the runway and collapsed. The Global continued down the runway with the right wing dragging. The aircraft departed the runway 640 ft. later and pivoted 120 deg. before coming to a stop. The only injury was to the first officer, but the aircraft was damaged beyond repair.

First, the mitigating factors. The crash of C-GXPR was an eye-opener for many. Few pilots have heard the term "eye-to-wheel height" and fewer still have given it any consideration. Most pilots would probably assume one set of PAPIs are much like any other. The approach geometry of the Challenger 604 is obviously different than that of the Global. But how many pilots with experience in both aircraft understand just how much lower the landing gear is on the Global?

Now, let the Monday morning quarterbacking begin. Many of us flying aircraft in the Challenger to Global weight classes consider 5,000 ft. to be a minimum runway length. When you approach such a runway there is a temptation to cheat and aim short of the normal 1,000-ft. aim point in an attempt to put the wheels down short of the normal touchdown point of around 750 ft. Every time you do this, you reinforce the idea into your subconscious that aiming short is OK. The next time you face the same situation but with a runway that is just a little bit shorter, a little bit contaminated, perhaps with an obstacle, and perhaps without an overrun, you will be tempted to aim for brick one. Every time a brick one landing is successful, it becomes another entry in the ledger: Brick one landings work. You have normalized a deviance from standard operating procedures.

It would be easy to say the only pilots at risk for the duck-under are those who have become habitually noncompliant or don't place enough emphasis on doing things the right way, every time. But even the most diligent pilots are at risk.

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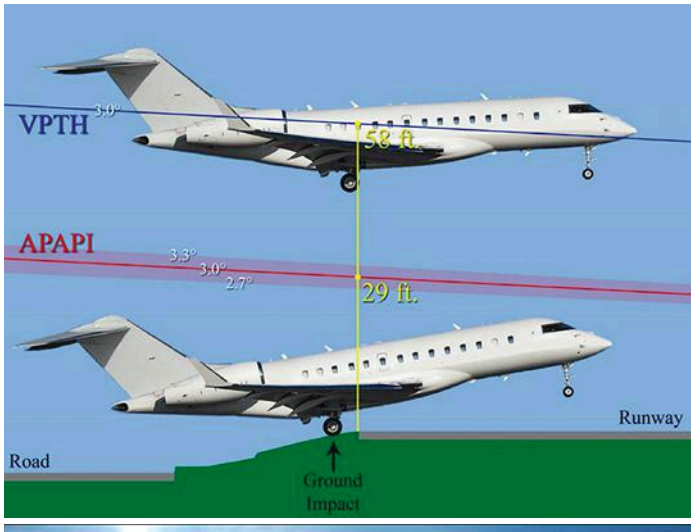


VPTH versus APAPI differences superimposed on side view of Fox Harbour Airport and Global 5000 landing geometry.

Global 5000 versus Challenger 604 attitude and threshold.

Last Flight of Air Canada 624

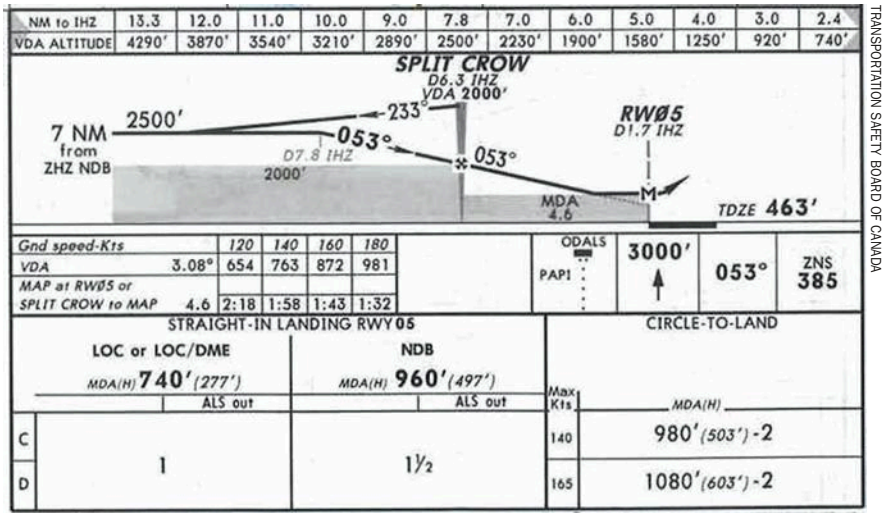
While sifting through an accident report, I am often struck by the crew's complacency, habitual noncompliance or lack of a critical piece of knowledge. Not so in the case of Air Canada Flight 624, an Airbus A320 that crashed during landing on March 29, 2015. The crew appeared to be doing everything by the book during their approach into Halifax-Stanfield International Airport (CYHZ), Nova Scotia, Canada. In fact, it appears to me, the pilots only made two mistakes. The first one seems trivial before further research. The second one could have bitten any of us.

It was a cold night in Halifax and the winds dictated the localizer-only approach to Runway 5. The crew determined a 200-ft. cold temperature correction to their final approach fix (FAF) altitude, raising it to 2,200 ft. They also adjusted their minimum descent altitude (MDA) to 813 ft. using a 23-ft. correction as well as their airline's added 50 ft. They also adjusted the descent angle from 3.08 deg. to 3.5

deg., to compensate for the higher adjustment altitude at the FAF as compared to the MDA. This adjustment surprised me. It was in accordance with a table in their airline Flight Operations Manual (FOM) and was mathematically correct. I don't have such a table in my FOM.

Another peeve of mine when reading accident reports is the cavalier nature of crews during critical phases of flight and quite often the need to redact cockpit voice recorder transcripts due to a proliferation of profanity. Not so with this crew. All briefings were thorough. Every call-out was made when needed. These guys were good.

The visibility was poor, oscillating between 0.25 and 0.5 mi. in snow. Air Canada's Operations Specifications allowed crews to conduct instrument approaches at 50% of published visibility values provided the approach was coupled. The airline's FOM further specified that in this situation the autopilot's lateral guidance had to come from the localizer and the vertical guidance from the flight path angle (FPA) computed to cross the runway threshold at 50 ft. If you are unfamiliar with an FPA, think of an autopilot's vertical velocity or vertical speed mode converted from feet per minute to degrees. It is in many ways superior as it doesn't require adjustment with airspeed. But it does have its limitations, as this crew discovered. And that leads us to their first mistake.



TRANSPORTATION SAFETY BOARD OF CANADA

Profile view of the approach into Halifax.

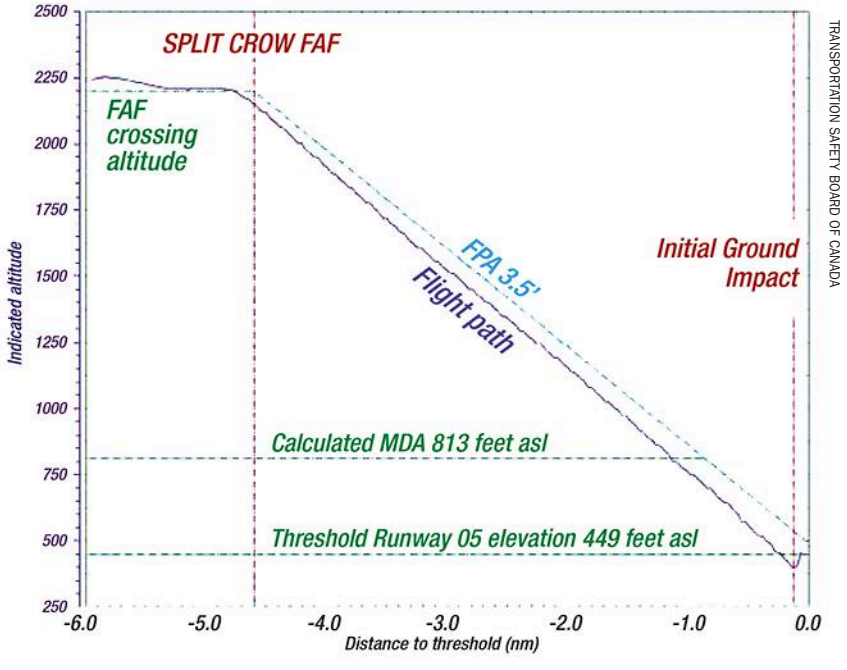

TRANSPORTATION SAFETY BOARD OF CANADA

Air Canada Flight 624 aftermath.

Their FOM specified that 0.3 nm prior to the FAF the crew should select the FPA mode of the autopilot and set it to 0.0 deg. to maintain level flight. At the FAF the pilot is to command the required descent angle. The pilot dialed the FPA to -3.5 deg. at 0.3 nm and the aircraft began its descent 0.2 nm early. That may seem trivial, but doing the math that comes to 0.2 x 6,076 = 1,215 ft. So, if everything else remained as planned, their vertical path would place them at runway elevation two-tenths of a mile before the runway. Of course, things rarely remain as planned.

As the airplane descended, changes in wind, occasional turbulence and other disturbances pushed the aircraft lower than the initial profile. Unlike an ILS glideslope or a Vertical Navigation's vertical path, the FPA is drawn from the airplane down, not from the ground up. It doesn't end at the runway's touchdown zone, it just ends at the selected angle from wherever the airplane happens to be. The crew ended up at the MDA 0.3 nm early, which comes to 0.3 x 6,076 = 1,823 ft. before the runway.

The crew spotted the approach lights and continued their descent further, still coupled to the autopilot. The autopilot, for its part, was content to aim 1,823 ft. short of the touchdown zone, well short of the runway. Doing the math, they should have been 5,182 ft. from the runway at the MDA, but they were actually around 7,000 ft. from the runway. Their view of the approach lights was



TRANSPORTATION SAFETY BOARD OF CANADA

FPA versus flight path.

at -2.2 deg., not -3.08 deg. Can you spot a difference of less than a degree? I certainly cannot.

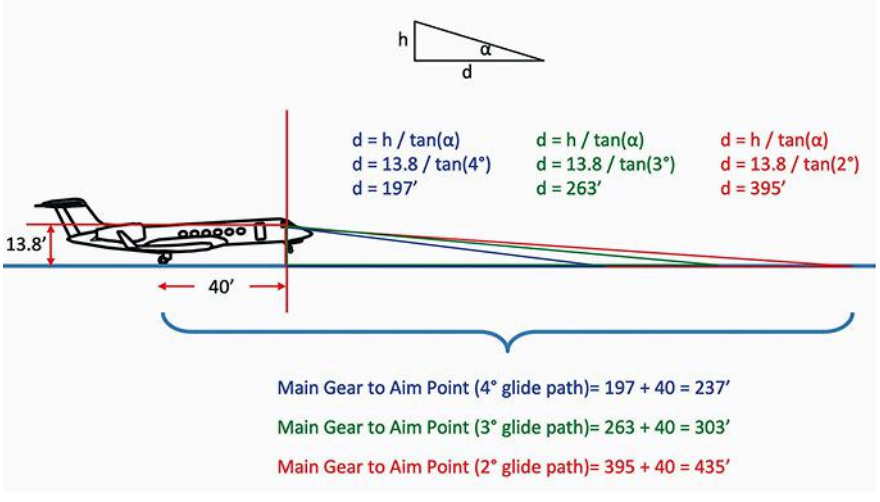
They continued the coupled approach until their system's automatic call of "100," at which point the autopilot was disconnected. At the "50" call both pilots realized they were aiming for the approach lights and not the runway. The pilot initiated a go-around, but it was too late. One of the left main tires contacted an approach light located 861 ft. from the threshold. The left main gear, aft lower fuselage and left engine struck the ground. The aircraft slid onto the runway before coming to rest just 1,900 ft. beyond the threshold. There were no injuries, but the aircraft was damaged beyond repair.

Many of these accident case studies are disturbing because they leave you wondering, "How could a professional crew have done this?" But this accident is disturbing for me because it leaves me wondering, "Could I have done any better?" The 0.3-nm start descent error seems almost trivial. If I had arrived at an MDA 1,823 ft. before I should have and spotted the approach lights, I would have left the autopilot engaged a little further, just as this crew had done. But a second reading of the report tells me I could have done better, I hope, because of a few techniques I've learned over the years. So, the only question left for me is if I would have had the presence of mind to use those techniques. But they are techniques worth knowing.

Curing the Problem With Geometry

When we start our flight training, we often hear that the spot on the windshield that isn't moving is where we are headed and when flying a very small primary trainer that is mostly true. That is where your eyes are headed, but your wheels are behind and below you; they are headed short of that point. In a Cessna 152 or Piper Arrow, the difference is too small to worry about. As the aircraft gets larger, those distances become more important.

One of the lessons learned from the Global 5000 crash at Fox Harbour was the need to realize there is a difference between the height of your eyes and your wheels in a landing attitude. In my Gulfstream G450, for example, my eyes are 10.5 ft. off the ground when the airplane is in a three-point attitude. But on landing, when the main gear touch, the nosewheel is still in the air and my eyes are 13.8 ft. above the surface. While my eyes cross the threshold at 50 ft., my wheels are at 36. My margin of error is reduced.



The effect of glidepath on touchdown point versus aim point.

Not only are my eyes above the wheels, they are 40 ft. in front of them. But the look-down angle from the cockpit to my aim point further changes the math. Off a 3-deg. glidepath, my eyes will be 303 ft. forward of the point my main gear touch. This distance varies with airplane geometry as well as the glidepath flown. For most business jets, aiming for 1,000 ft. puts your wheels down right around the touchdown zone, provided your flare isn't exaggerated. Aiming for 500 ft. gets you just beyond the threshold. Aiming for brick one makes you a sitting duck for those approach lights.

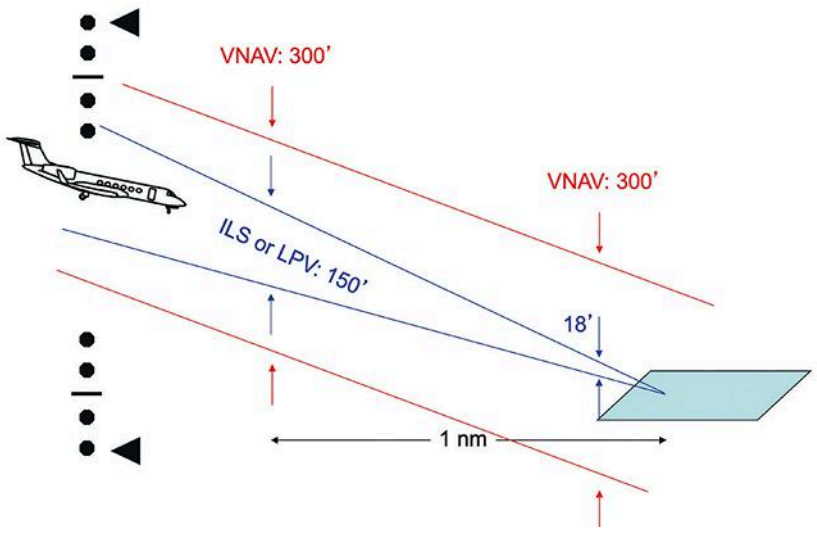
It is absolutely critical that pilots of transport category aircraft understand just how quickly any margin for error can be erased when failing to adhere to a 50-ft. threshold crossing height and a landing in the touchdown zone. With that understanding, pilots should realize what each type of cockpit glidepath indication is based on and what the displayed information actually means. There are four main players:

- An ILS glideslope.
- A localizer performance with vertical guidance (LPV) vertical path ((VPATH).
- A vertical navigation (VNAV) VPATH.
- An FPA.

An ILS glideslope signal is broadcast from antennas abeam your touchdown point; that's where they come from. If you follow the glideslope to landing there are two critical things to know. First, if you follow the beam, you will end up on the runway, no matter the winds or temperature. Second, the beam gets narrower the closer to the antenna you get. So, just when you want the signal to become more accurate, it does. A 3-deg. glidepath descends 318 ft. every nautical mile. The math: 6,076 ft. per nautical mile times sin(3 deg.) = 318 ft. At 1 nm, flying two dots low puts you at 6,076 times sin(1 deg.) = 106 ft. But crossing the threshold, 750 ft. from touchdown, the beam narrows and you will be at 750 times sin(3 deg.) = 39 ft. Flying two dots low puts you at 750 times sin(1 deg.) = 13 ft. over the runway.

For most LPV approaches, the tolerances are identical to the ILS. While there isn't an antenna broadcasting to your aircraft, your avionics construct the path so it appears just so. The bottom line for both the ILS and the LPV is that keeping that glideslope or VPATH needle centered ensures you end up over the threshold at an adequate height for a landing in the touchdown zone. Even flying two dots low keeps you out of the dirt, provided there are no obstacles in the way.

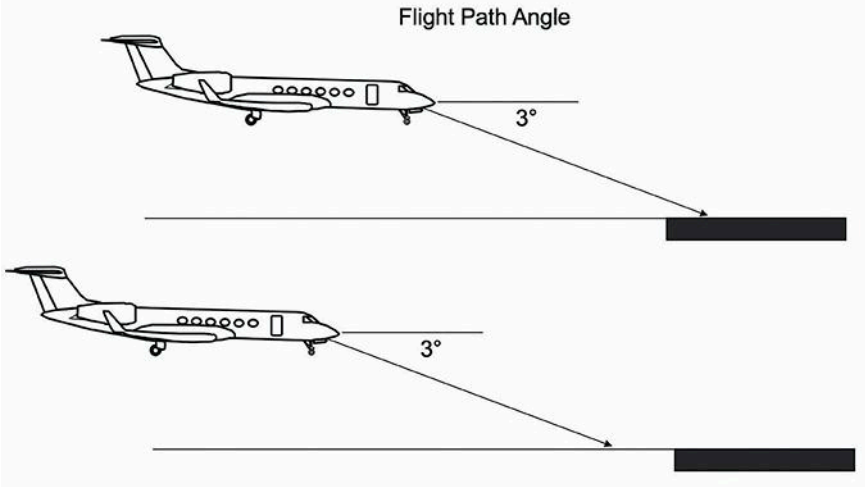
A VNAV vertical path is completely different. The tolerance remains constant no matter the aircraft's altitude or distance to the runway. Flying two dots low on a typical system can leave you 150 ft. too low at 1 nm, which means you will be at (318 - 150) = 168 ft. But the tolerance is the same crossing the threshold. Flying the VNAV centered gets you to the runway. Riding the bottom of the VNAV at two dots low means you will be at runway elevation (150 - 50) / tan(3



Typical full-scale deflection tolerances for ILS, LPV and VNAV glidepaths.

deg.) = 1,908 ft. short of the runway.

Unlike the ILS glideslope, the LPV VPATH or the VNAV path, an FPA is drawn from the airplane to the ground.



The flight path angle (FPA) function doesn't care where the runway is.

You can be precisely on the FPA while aiming several miles short.

There are obviously problems with flying a VNAV or FPA thinking you are guaranteed to end up in the touchdown zone of the runway. Either system can leave you well short of the runway. There are two methods for fixing all this: Cross-check your distance versus altitude or, if you have the technology, use the FPA and flight path vector (FPV) superimposed on the runway.

The easiest way to ensure you do not dip below a proper glidepath, even if you don't have an ILS or LPV guiding you to do that precisely, is to simply figure on being no lower than 300 ft. above the ground for every 1 nm from the runway. While the real number for a 3-deg. glidepath is 318 ft./nm, 300 ft./nm is easy to figure and pretty close. Having a GPS readout of distance to the runway is ideal. But let's say, for example, the DME is based on a VOR 1 nm past the approach end of the runway. Simply subtract a mile to each target. Back in the days when I didn't have a better option, I would pencil these target altitudes on the approach chart.

The crew of Air Canada Flight 624 had just such a table drawn on their approach chart for them. This is an invaluable technique, but if you have the technology, there is something even better.

Curing the Problem With Technology

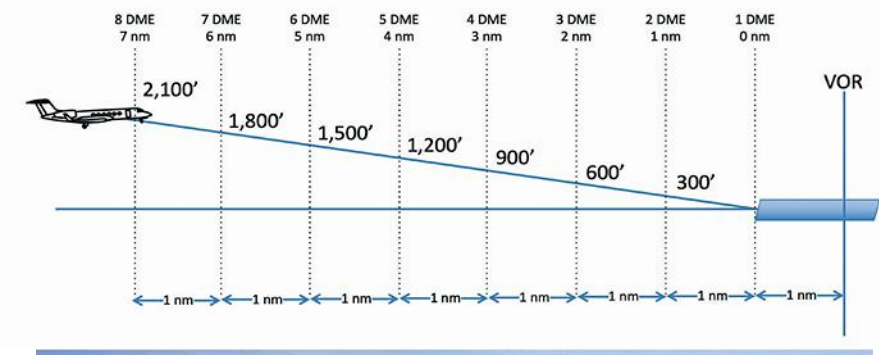
Many aircraft that display an FPA will also display an FPV. The FPA displays a line depicting where the airplane will end up if flown along a set angle above or below the airplane. As the crew of Air Canada Flight 624 discovered, the FPA doesn't care where it is in relation to the runway. The FPV displays where the airplane is headed. Both FPA and FPV show actual aircraft performance, which is of little use to the landing pilot unless presented with a third element: the location of the runway.

Aircraft with head-up displays (HUDs) or synthetic vision systems (SVSs) that will show the runway as well as an FPA and FPV have a distinct advantage in the need to arrive over the runway threshold at the correct altitude and on the runway in the touchdown zone.

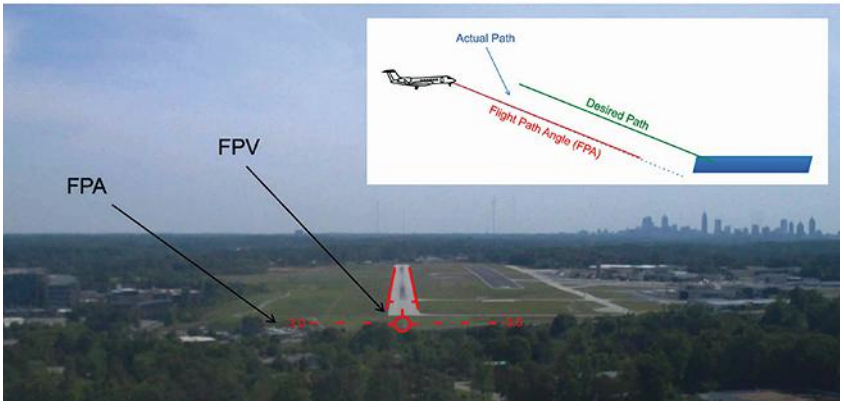
This technique doesn't need an ILS, LPV, or even a VNAV. It can be flown to a runway with no approach at all. Some call it "walking the FPA," which I suppose is as good a name as any. Let's put ourselves into Air Canada Flight 624's situation at the MDA for an example.

The aircraft's autopilot was precisely flying the selected FPA, but the crew didn't realize that FPA was pointed well short of the runway. If they had a synthetic depiction of the runway, they would have seen that the FPA and FPV were both aimed short. Simply lifting the FPV to the runway would have resulted in a shallow glidepath with their eyes aimed correctly but their landing gear still short. Adding two steps to the process guarantees not only a correct aim point but the correct glidepath as well.

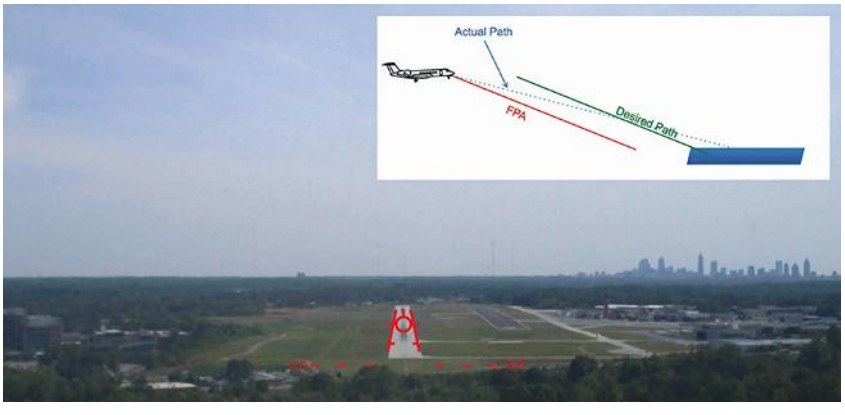
Instead of pulling back on the pitch enough to place the FPV over the touchdown zone, the nose should be raised enough to move the FPV beyond the touchdown zone in an effort to intercept the correct glidepath. Once this is done, the FPA will start to move forward, essentially "walking" to the touchdown zone. Then you will be on the correct glidepath but aiming long. Simply lower the nose so the FPV coincides with the FPA right over the touchdown zone.



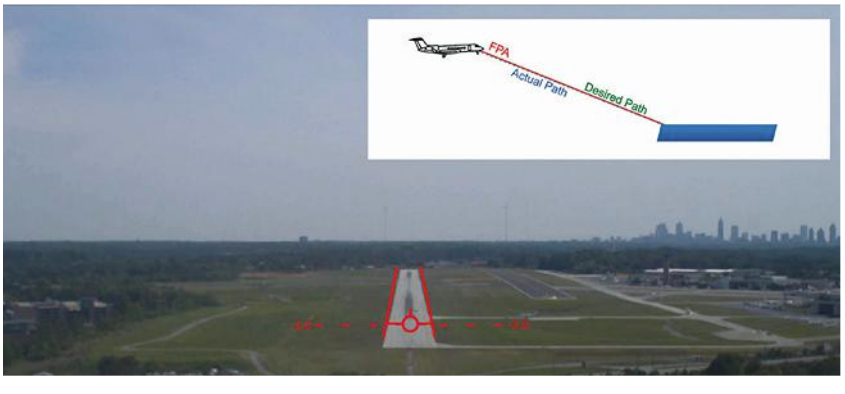
Example: Judging altitude above the runway versus distance.



An approach into Atlanta DeKalb-Peachtree Airport (KPDK) with FPA and FPV aiming short of the runway.



Raising the aircraft's FPV to "walk the path."



Returning the FPV to the FPA, right over the runway's touchdown zone.

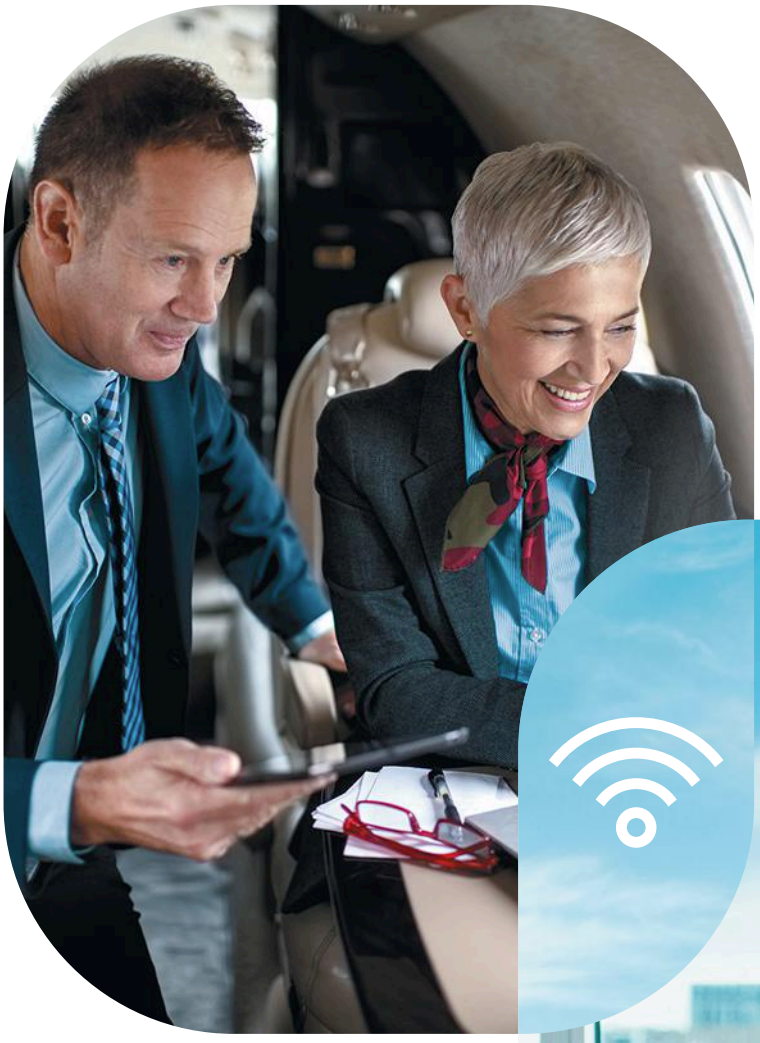
Curing the Problem With Repetition

I think understanding the geometry of your airplane when crossing the runway threshold is the first step to fixing a duck-under tendency. Knowing target altitudes with distance to go is a great way to ensure you aren't suckered in to a duck-under. Realizing that a dot or two low doesn't mean the same thing with various glidepath measuring systems should go far to prevent accepting a below-glidepath approach. But what about the problem of a visual illusion?

My most recent dive into the duck-under occurred as a civilian pilot while flying into Atlanta's DeKalb-Peachtree Airport (KPDK). At first glance, Runway 21L isn't short. In fact, at 6,001 ft. it borders on being comfortable for most business jets. But it has a 1,200-ft. displaced threshold and for some reason passing that much pavement was more than I could resist. So, I adopted a technique of aiming for the displaced threshold. After doing this for a year or so I asked the flight department about ways we were normalizing deviance. The No. 1 answer was Runway 21L at KPDK.

With some soul searching we realized that our performance numbers were based on landing in the touchdown zone. We agreed to straighten up and fly right. Our next approaches into Peachtree were right on glidepath and stopping wasn't a problem. We recently made an approach to minimums on Runway 21L; we crossed the displaced threshold at 50 ft., landed in the touchdown zone, and were at taxi speed well before the runway's end.

Thinking about that approach, I have to wonder about the view from the cockpit of RC-135S Exult 66. I wonder if the pilot had internalized the view of the approach lights from slightly below glidepath over the years and on the fateful day his eyes told him he was only slightly below his usual slightly below glidepath. I think he would have been well served by having the proper sight picture drilled into his head. The best way to do that is to fly the proper glidepath every time. **BCA**



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On Being a Flight Attendant

The toughest job **you'll ever love**

BY **KIRBY HARRISON** kirbyjh12@hotmail.com

The job of the business aviation flight attendant is one of myriad opportunities and challenges, from two days in Paris with a view of the Seine, to a day visiting the mud volcanoes of Azerbaijan, to serving meals and providing onboard tech support to eight intense executive travelers in tight quarters during 12-hr. nonstops.

It may, or it may not, require FAA-mandated safety training, and the cabin service role might range from dog walker to the correct protocol for an Arabic coffee service. In fact, passenger services comprise the greatest part of the role. It demands knowledge and experience across a broad range of subjects — complex cabin digital systems, placing catering orders, inflight food preparation and meal service, care of pets and children, and arranging transportation and hotel accommodations. And that is just the beginning of passenger expectations.

According to Susan Freidenberg, former corporate flight attendant and now president and CEO of Philadelphia-based Corporate Flight Attendant Training & Consulting in Phildelphia, there is always something new to learn.

"When I began flying, everything was analog — the circuit breaker was an actual device to break the circuit, and now it's a touch-screen monitor," she said.

Training that extends to cabin systems is something also emphasized by Louisa Fisher, program manager for cabin safety at FlightSafety International in Savannah, Georgia.

"Crews are becoming more adept at non-aviation connectivity and are putting those skills to work in the aircraft cabin," said Fisher. "And the fact is that they are evolving with and embracing the new technology."

In a recent online search for a flight attendant by charter broker VistaJet, the role of "assisting passengers in use of cabin systems, such as entertainment

Removal of an emergency egress hatch is just one aspect of cabin safety training.

FLIGHTSAFETY INTERNATIONAL (2)

Cabin services is one of the most important parts of corporate flight attendant training.

and high-speed internet connectivity" was among them.

Freidenberg took note as well of the latest emergency medical equipment, in particular the automatic external defibrillator (AED). "In a medical emergency, the flight attendant may automatically assume the role of first responder, which includes use of the AED." And she added, "The CEO may be in charge of the entire company, but if he's suffering sudden cardiac arrest, he'll not be in any condition to apply the AED."

Satcom Direct is a digital training partner with FlightSafety, offering its aeroCNCT cabin inflight connectivity instruction for flight crews since 2017.

The training is also available at Satcom Direct facilities in Melbourne, Florida, or at customer on-site locations as required, according to Director of Training Mark Mata. "On-site works particularly well for customers to gather their crewmembers in a single location where it enables them to ask specific questions related to the company aircraft fleet."

The course was designed and developed with input from crewmembers to give students the confidence to tackle problems related to applications and connectivity on personal devices during flight. It covers the internet and connectivity familiarization, network basics, flight operation preparation, data management fundamentals, proper use of applications and troubleshooting tips.

Training is instructor-led and a day and a half in length. A total of 150 trainees have completed the course and in 2018, 72 certificates were issued to students completing the course and choosing to take the final exam.

Recognition of aeroCNCT continues to grow as do new and expanding partnerships. "In 2019, Version 2.0 course content will be updated to keep current with industry needs, wants and evolving technology," said Mata.

Satcom Direct will also be adding resources to its Learning Management System, including short learning videos and questions to help reinforce the learning. Mata further noted that students are primarily business aviation flight attendants, or come from associated areas of business and private aviation, such as schedulers and dispatchers, and flight department managers.

The brave new digital world has also found its way into the galley. One example is the induction cooktop platform from VIP cabin interiors specialist Lufthansa Technik in Hamburg, Germany. "Fresh food can be prepared on board quickly, safely, cleanly and economically . . . from perfect fried eggs to a sizzling medium-rare wagyu steak," said lead project manager Franziska Voerner.

The appliance includes a power source, exhaust and special "smart pot" containment cover to ensure that pots and pans remain in place, even during turbulence. It measures 11.6 x 22.4 x 10.5 in. and fits into any aircraft kitchen, explained Voerner. It not only allows an onboard chef or flight attendant to use a pan, toaster or pot to prepare meals, but cooking smells are eliminated by the integrated fume hood and odor filtration system. The device is already finding its way into the larger-cabin business jets.

Iacobucci HF has upgraded its Gusto induction oven for business aircraft, described by the Italian supplier as "a cooking revolution with induction technology for a five-star food experience on board." This new generation oven also incorporates integrated software, allowing the user to run specific programs to automatically execute a variety of recipes, in particular fish- and meat-based meals.

And flight attendants will soon be talking to their galley appliances, thanks to Amazon's Alexa and Google Assistant.

Consider the Behmor "connected" coffee maker. You can ask Alexa to brew a cup for you and your passengers, and even control the temperature through a smartphone app. And there's the Anova French sous vide system that allows the user to slow cook anything to perfection, thanks to an accompanying app. Or the General Electric smart countertop microwave oven that connects to Alexa so the user can control it by voice.

Cabin Safety Comes First

General emergency training is required by the FAA and it is rare that a flight attendant gets onto a business aircraft without it. The courses, no matter where they are offered, are designed to prepare the student for a position with an operator of business and general aviation aircraft, as described by the NBAA, and is typically for FAR Part 135 and occasionally Part 91 operations.

The courses meet most recommendations for the International Civil Aviation Organization (ICAO) and the International Business Aviation Council's International Standard for Business Aircraft Operations (IS-BAO) certification, as well as many of the regulatory requirements for Part 135.331.

According to Fisher, the number of corporate flight attendants undergoing cabin safety training is increasing, primarily because operators today are uniformly using a safety management system (SMS) such as IS-BAO, and because, "More than ever, corporate and private aircraft operators understand the need for emergency training for the cabin crew."

Scenario-based cabin safety training is now held in classrooms and in

From its Melbourne, Florida, facilities, Satcom Direct offers cabin inflight connectivity aeroCNCT training.

specialized training devices, allowing students to acquire the knowledge and skills to efficiently manage a variety of situations, routine or emergency. For example, full-cabin corporate cabin trainers that can produce smoke-filled scenarios and appropriate audio are becoming more common. These large devices include FAA-accepted emergency exits and a realistic cabin environment, complete with assorted emergency equipment. Additional emergency training aids include large "dunking" pools, life rafts, emergency slides, fire trainers and rescue hoists.

According to Fisher, pilots and maintenance technicians alike also benefit from the training, and it is not unusual to have company executives go through the training as well.

▶ According to the FAA, no safety training is required with aircraft of 19 seats or less, unless the pilot in charge determines that the crewmember is to have safety-related duties. While Part 91 operators flying aircraft of 19 or fewer seats are not required to have flight attendants with FAA emergency training, many owners and operators nevertheless list it as a job requirement.

▶ If the cabin crewmember is assigned safety-related duties, that person must be trained under an FAA-approved flight attendant safety training program. (Some Part 135 operators of aircraft with 19 seats or less may opt for a cabin attendant who provides only cabin services and has no safety-related duties assigned, and is not officially listed as a crewmember.)

▶ Most SMSes require recurrent emergency training for aircraft crewmembers every year, with hands-on drill training every 24 months.

For the entire flight department, FlightSafety also offers FAA-, EASA- and Transport Canada-compliant Human Factors Crew Resource Management training. It covers initial and recurrent requirements and is applicable to all roles of the flight department, said Fisher.

Aircare International has been in the business of crew training for more than 35 years and now has six fixed-based centers in the U.S. and Europe, including its headquarters and main facility in Tacoma, Washington.

The company also has the ability to use a customer's own facilities and aircraft to train the entire crew, as well as company executives, said Vice President of Operations Brian Hayvaz.

"In fact, a couple of times a month we provide safety training for executives and their families, although not as in depth as that demanded of pilots and flight attendants." The training includes fighting a fire, emergency egress from cabin exits, how to use smoke hoods and other devices, as well as a sudden cabin depressurization and the basics of water survival, including use of life rafts and life vests.

"We made our bones with pilot training, but cabin crews are near and dear to our hearts," said Hayvaz. He pointed out that while Part 135 requires safety training of pilots and cabin crew, "We've taken it a lot further and cabin resource management is now a major part of the course, in particular management of emergency communication under high stress and fatigue."

Part 91 operators tend to be among Aircare's most important clients. They typically have a strong safety culture and often choose to go through a slightly modified Part 135 safety syllabus. "They're doing it because they see the value in it; in particular, their executives. We have a fleet of simulators that we can take around the country, along with our own equipment, to the client's flight department."

The Aircare trainers will also introduce crews, and in particular pilots, to the effects of hypoxia (oxygen deprivation), simulating an approach to a high-altitude airport like Colorado's Aspen-Pitkin County Airport/Sardy Field (KASE). "We demonstrate it every year at the Bombardier Safety Standdown, and it's an eye-opener," said Hayvaz.

Aircare is also training crews on use of its remote visual station (RVS), a lightweight, easy-to-use system for the purpose of remote diagnostics and physician observation of a medical patient in flight.

"The connectivity brings the doctor on board to see and hear the patient, allowing clinical decisions and recommendations based on a patient's vital signs, which are transmitted in real time from the aircraft," explained Hayvaz.

The equipment includes a blood pressure cuff, electrocardiogram, thermometer, glucometer, pulse-oximeter and macro cameras. All are wireless and designed for easy use.

The flight attendant is an extension of the crew up front, explained Hayvaz: "What we do at Aircare is everything we can to ensure that that relationship works anytime, anywhere."

"We are the only dedicated telemedical and tele-assistance company for business aviation flight departments across the globe," said Hayvaz. "We provide services for hundreds of flight operators who fly in aircraft as small as King Airs and as large as VIP Boeing 767s."

Since its launch in 1985, Phoenix-based MedAire has become one of the foremost providers of aviation medical and security training for flight attendants, pilots and passengers as a means to mitigate risk exposure.

FlightSafety and MedAire have teamed to provide Management of Inflight Illness and Injury and medical

training classes focused on handing medical events in flight. The training also includes the use of CPR and automated external defibrillators, as well as the study of human anatomy, altitude, physiology, oxygen systems and the proper assessment of the severity of infight illness and injuries.

Initial training is typically one to two days and recurrent training is one-half to one day. Management of Infight Illness and Injury training courses offer flexible options to fit crewmember schedules, available via eLearning, on-site at the operator/owner client facilities, or at an FBO.

The onboard clinically and logically assembled medical kit is designed to save time when treating any type of medical incident. The kits are reviewed every year by a panel of aviation medical, regulatory and operational experts to ensure the best solutions for private and corporate aircraft.

Describing the cabin crew as "first responders," MedAire also offers its RD Tempus IC as a fully integrated kit to maximize its MedLink inflight connection for the "ultimate medical assistance."

Tempus is regularly used by non-medical experts, such as pilots, cabin crew and key staff, to transmit medical data that would routinely be collected in an emergency room — such as blood pressure, cardiac conditions, pulse and respiration — to ground-based doctors from an aircraft in flight. It enables doctors on the ground to help manage the medical incident and guide decision-making with regards to treatment and any potential flight diversion decision.

Cabin Service Training Is Critical

It should be noted that while cabin safety is the primary responsibility of the business aviation flight attendant, cabin service remains a major concern for owners and operators, and in particular their passengers.

A recent "corporate cabin attendant wanted" afiche (aka, ad) carried with it a list of cabin qualifications that went on for nearly three pages, double-spaced. Qualifications and requirements for a business aircraft flight attendant are at the least extensive, for the most part, but occasionally jarring.

Food preparation for inflight service is always challenging for corporate flight attendants and caterers.

A recent listing by the Glassdoor.com job search site for a major corporate flight department carried more than 30 personal and professional qualifications and training requirements for those seeking a cabin staff position. An emphasis was placed on digital skills, including operating full cabin management systems, managing a seamless inflight virtual onboard office environment and being familiar with Apple devices, Microsoft Windows, and print processes for computer and iPad equipment. It went on to require Satcom Direct aeroCNCT training certification for aviation communications, avionics and network systems in the aircraft cabin.

Also expected was the ability to multitask, as well as a "highest level" of customer service skills, experience tending to executive level clientele, and the capacity to quickly identify problems, as well as determine possible solutions and to act quickly to provide resolutions.

Cabin safety and emergency training was emphasized, and at times in great detail. One major charter operator required an ability to "successfully launch a life raft weighing approximately 60 lb. and to lift, open and manipulate aircraft door and window exits weighing up to 130 lb." It further noted that a candidate should be able to safely open and jump from emergency exits approximately 6 ft. from the ground."

Physical capabilities even went further than launching a life raft and successfully wrestling with a heavy door. The help wanted ad also pointed out that candidates would be required to stand for prolonged periods and to "stoop, kneel, crouch or crawl." And it noted candidates "should be able to endure extended work periods that may exceed 14 hr., as well as pass an FAA criminal background check."

And finally, the ad pointed out that the job would include: "exposure to wet and/or humid conditions, fumes or airborne particles, as well as to vibrations and pressured aircraft cabins, along with aircraft engine and other loud noises for extended periods of time."

Aircare even takes cabin familiarization training on the road. As part of any new aircraft acquisition from Dassault Falcon Jet, Aircare provides the training on board the aircraft at the location of choice by the new owner.

The Catering Challenge

Of all the elements of cabin service, food preparation is often the most important, at least from a passenger's perspective.

The DaVinci Inflight Training Institute opened a bit more than a year ago. Founded by Managing Partner Paula Kraft — who also founded Atlanta's Tastefully Yours caterer — the new operation is providing a full suite of training programs to suit the needs of basic, intermediate and advanced trainees. (See "Fast Five With Paula Kraft," *BCA*, March 2018, page 20.)

Among the "experts" teaching at DaVinci's center in Fort Lauderdale, Florida, is Daniel Hulme. According to Kraft, he is a subject matter expert in a variety of cuisines and cooking techniques and several years ago introduced the concept of molecular gastronomy. Today, he is considered to be on the cutting edge of the culinary new wave, in particular the French sous vide style that ensures the steak or salmon is done to perfection.

"He was one of the first to introduce this food preparation technique on

corporate aircraft," said Kraft, who added that his high-tech presentations have become the most-sought-after videos in the industry and his work has become the standard.

In addition, Dr. Shari Frisinger, a behavioral analyst, works with individuals on "maintaining their composure when they just want to strangle someone," explained Kraft with a chuckle.

Also, there's Alexa Sorrentino, Aviation & Marine Safety Solutions International's lead food & catering safety management system consultant. She provides hands-on training and food safety hygiene consulting. And Tamara Collum, a lead flight attendant with Fortune 500 companies, coordinates aircraft checklists, customer service for FBOs, menu planning, customs arrangements, culinary specifications for clients, and assists in writing resumes.

"These and other members of the team," said Kraft, "are all certified experts in their respective fields of training, coaching and consulting specific to corporate aviation."

Catering continues to be one of the most challenging aspects for flight attendants.

Mastery begins with knowing the dietary needs as well as culinary tastes of the passengers, creating a menu, and then double checking it with them. The flight attendant will then select a business aviation caterer by phone or by email with the specific menu and explain how it is to be packaged for the aircraft. The order is followed up by a phone call confirming the order in detail, as well as when, where and how it is to be delivered. Then when it arrives, it is the responsibility of the flight attendant to check and confirm that the order (all of it) is correct. Even then, you can have a trip come out of left field.

Contract flight attendant Teresa Grzywocz out of Warsaw recalled a flight in China. "I don't speak Chinese, so I ended up showing photographs of various dishes to my passengers, and then showing those they picked to a restaurant manager to prepare for the next leg of the flight.

"Dealing with a different culture and language you don't speak," she said, "is definitely interesting, and sometimes very tiring."

There are growing trends of which private and business aviation flight attendants are rapidly becoming aware. Among them is a tendency by hotels and restaurants in Europe to refuse to fill takeout orders. "They've begun to realize that they have little or no control over the chain of possession of an order once it leaves the kitchen, and they see it as a growing liability issue," explained Kraft.

Another trend creating a challenge for the flight attendants is that of dietary restrictions, and it is common now for caterers to receive an order that includes a list of passenger and crew dietary requirements — such as for gluten-free or vegan passengers, among others — and those special requests are growing. "Some vegans will object to orders by other passengers on the same flight who are not vegan," said one caterer.

She added that allergies are also a growing problem. "For example, a flight attendant may order separate meals for a passenger who is allergic to peanuts. But there is a possibility of cross-contamination at some point and a passenger going into life-threatening anaphylactic shock at 40,000 ft. is not something you want to have happen."

How It All Began

In aviation's early days, there was barely room for a pilot aboard those fabric and tube aircraft, much less passengers. However, by the 1920s, it had become apparent that with larger aerial vehicles carrying growing numbers of people on regular inter-city schedules, there was need for a cabin crewmember whose primarily responsibility was to see to the safety and well-being of passengers.

Multiple sources claim that the first flight attendant was cabin steward Heinrich Kubis, who attended passengers on the Zeppelin airship LZ 10 Schwaben in 1912. He was also a steward aboard the Hindenburg and survived the fire that destroyed the great airship while landing at Naval Air Station Lakehurst, New Jersey, in 1937.

In fact, the earliest flight attendants were exclusively male. Imperial Airways of the U.K. had "cabin boys" or "stewards" in the 1920s. In 1926, Stout Airways was the first U.S. airline to employ stewards. Male stewards also were employed by five other U.S. airlines in those days, including Pan American World Airways.

The first commercial airline to hire a female "stewardess" was United Airlines in 1930 — Ellen Church, a registered nurse. In fact, many of those first female flight attendants with United were also registered nurses.

For those early airlines, marriage, pregnancy or weight gain were grounds for dismissal, and as their numbers grew, reaching age 32 was added as a reason for termination.

With airline ticket prices in those days set by the government, the carriers quickly hit upon the idea of using cabin service as a marketing differentiator. National Airlines took it past the edge with an advertising campaign that featured young and attractive flight attendants in its ads, one of them with the banner, "I'm Cheryl. Fly me."

That was nearly 50 years ago and the title stewardess has evolved to that of flight attendant and business aviation or corporate flight attendant, and cabin safety and emergency training has become a major part of overall training for a flight attendant career.

But even as ever greater emphasis has been placed on passenger well-being, flight attendants also have become an integral part of the aircraft crew — in a very real sense, the pilots' eyes and ears in the cabin.

One thing hasn't changed, however: The great majority of them are women and almost universally competent, well-traveled, resourceful and much appreciated by those they serve. **BCA**

Food service aboard a corporate aircraft will include everything from champagne to dessert, and many unexpected (or expected) food items in between.

About the Pay

The salaries of business aviation flight attendants vary widely, depending on such factors as geographic location, aircraft type, individual experience, training qualifications and whether the job is full-time or by contract.

For example, a NetJets flight attendant salary listed on Glassdoor.com described an average annual base pay of $60,000, with a range from $42,000 to $87,000. The $60,000 average, noted the job search website, factored in "bonuses and additional compensation."

According to Freidenberg, salaries in the U.S. for a full-time flight attendant differ based on location. "The West and East Coast employers offer more, to match the higher cost of living, compared with the rest of the country. Full-time salaries for flight attendants with 'corporate specific' training and a strong resume range from $80,000 to $120,000, plus benefits. In other parts of the country, $50,000 to $75,000, plus benefits, is more common."

Contract flight attendants with corporate-specific training may earn between $500 and $700 a day, plus all expenses, or more for international flights. "But I always say in my training, 'In life and in business, you don't get what you don't negotiate for, and when you do negotiate, always start high,'" Freidenberg advised.

Salaries, she said, may also be higher for flight attendants with a dual role, which might include anything from registered nurse to personal assistant.

Per diem policies, she noted, also vary, but are typically from $5 to $8 an hour, block to block. "Or it might be $75 a day for domestic flights and $125 a day for international flights. Other clients might only reimburse based on receipts."

Benefits for a full-time flight attendant also differ from one corporate flight department to another, and between charter and fractional operators. Employers may offer a 401K profit-sharing plan; relocation allowance; health, dental and vision care or some form thereof; as well as paid recurrent training; and vacation and time off. It is unusual, but some will also include a clothing allowance.

When negotiating for a job as a business aviation flight attendant, said Amanda Jenkins of Bizjetjobs.com, consider not merely what the prospective employer is asking of you, but what questions you should ask them.

Jenkins suggested that the following salary relation queries be considered:

- How often will I be flying; what are the usual destinations; and will international flights be typical?
- How many days a month can I expect to be flying?
- Will I be on call?
- Will I be working in an office when not in the air?
- What additional duties will I have, such as playing nanny, taking care of pets, providing medical support?
- Will my responsibilities include supervisory or management duties?

A Flight Attendant Profile

They come from every corner of the globe, and the path to employment as a business aviation flight attendant is generally through the front door, which frequently means after serving as an airline flight

It's All About Etiquette

The Corporate School of Etiquette was launched in 2004 by Donna Casacchia, a former corporate flight attendant with a self-confessed dream "to give back to the flight attendant community by establishing a center that encompasses the finer areas of service skills and culinary arts training."

The practical, hands-on experience and knowledge of skills, international etiquette and protocol, customer service and culinary arts are necessary to ensure a successful career in corporate aviation, she said.

The school, a FlightSafety International vendor, provides advanced service and culinary arts training to thousands of corporate flight attendants, as well as military flight attendants, from around the world.

Casacchia noted as well that with the ever more sophisticated galley equipment in new aircraft, "being able to prepare meals on board gives the flight attendant the ability to offer more of a variety of menu options, especially during long-range flights."

The Corporate School of Etiquette, which is located in Long Beach, California, offers a variety of courses lasting from one to four days. And, according to Casacchia, the school continues to see a growth in attendance, with courses that can be tailored to meet specific flight department service standards and requirements. **BCA**

Teresa Grzywocz is a London-based corporate flight attendant who intends to "keep flying for the next 10 to 15 years."

attendant. Others have hailed from an FBO, charter aircraft management company, or some other niche in the field of business aviation. Some, however, like Dennis Burke, took the long way, via 20 years in the U.S. Army.

During his military career, Burke spent most of his time as a flight attendant on Gulfstreams, providing cabin service to the upper echelons of government, Army brass, heads of state and members of the U.S. Congress. He retired with the rank of master sergeant and a service record that included a tour in Iraq. But he wasn't ready to stop flying. When a friend recommended he look into a fresh career as a business aircraft flight attendant, Burke thought, "It just might be a perfect fit."

Even before joining the Army, he had gone through a chef apprentice program, and later during his military career he attended the prestigious Culinary Institute of America, as well as being immersed in additional courses offered through the Army. Perhaps most impressive, he completed the distinguished Starkey International Institute, a school best known as "the Harvard of private service training."

Burke had also gone through the required Army safety training syllabus, which unlike most civilian training, required ground survival training and time in the altitude chamber to experience hypoxia.

He is now flying full time for a major U.S. company, where much of his military experience has been invaluable, even to the point of keeping a "go bag" prepared for pop-up flights. There are numerous long-range international trips, but Burke doesn't get involved in ordering catering, as the company has its own commercial kitchen, and he will typically prepare meals in flight. Looking ahead, he sees many more years in the cabin. "I've been in corporate aviation now for 10 years, and I see myself doing it as long as I can."

Ashley Mayne has gone in the other direction. After 10 years as a contract flight attendant, she was flying for a private owner who decided to retire and sell the aircraft. "So the entire crew — four pilots and two flight attendants — were released within a few months.

"Now I live in Putney, in southwest London, where I work at Victor, a tech-focused jet charter company. It's my first ground job in a very long time, and I'm enjoying it a lot," she said. "I had already lived in London for a few years, but I still felt like a tourist because my job as a flight attendant kept me away so much. But now I truly feel like London is my city."

Teresa Grzywocz expressed a desire to continue flying as a flight attendant for the next 10 to 15 years. But she added, "If for some reason I am not able to do this, I would love to work as a trainer and teach future corporate flight attendants." **BCA**

Traditions, Cup by Cup

Respecting different cultures while serving is high on a flight attendant's list of considerations, as explained by two veterans who know.

According to Monica Lazar and Simona Netejoru of Cabin Crew Excellence training, a coffee service for Middle East passengers demands attention to proper protocol, requiring that only the right hand be used to hold the Arabic coffee pot and the left hand to hold the cups.

The initial service typically requires two flight attendants, explained Lazar in an Air Culinaire teaching video. The first server brings fresh dates in a bowl held in her right hand and additional cups in her left.

The second flight attendant follows with the coffee pot, or dallah, in her left hand and five stemless Arabic cups, or finjaans, in her right, stacked one atop the other. It should be noted that the bottom cup is merely a tray to hold the others and is never offered to a passenger. The cups held by both servers will have been warmed in an oven.

It isn't necessary to ask aloud if the passenger wishes Arabic coffee but by means of a simple gesture. If they wish coffee, they will nod. Coffee is poured carefully, filling the cup no more than two-thirds. The spout is then tapped gently on the edge of the cup to shake any excess drops into the cup.

For a second round, dates may or may not be offered. The flight attendant will pass through, again with the coffee pot in the left hand but this time with a single cup in the right. If the passenger wishes more coffee, he will hold out his cup to be placed atop the tray/cup in the flight attendant's hand for pouring fresh coffee. If he does not wish more coffee, he will wiggle it slightly or cover the top with his hand. Then the flight attendant will place the used cup below the tray/cup.

If it seems a bit complicated, it should be noted that the protocol for high tea in England, or a formal tea ceremony in Japan, are also steeped in tradition. Lazar and Netejoru are cofounders of Cabin Crew Excellence. They have a combined total of more than 25 years of commercial and business aircraft experience as flight attendants. **BCA**

Operating Into Moscow

What has changed in **business aviation travel to Russia's capitol city?**

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

Business aircraft travel to Moscow over the last two years has declined by at least 50%, continuing at that level into 2019, according to security expert Charlie Leblanc, who tracks business aviation risk management for UnitedHealthcare Global. He attributes the reduction to the economic sanctions the U.S. and its allies have imposed on Russian business enterprises and certain individuals who control them, in other words, the infamous post-Soviet "oligarchs."

"The operators and companies that are going there have had long-standing business relationships with Russia," Leblanc said. "In regard to overall threats, they haven't changed much — the biggest threat in the cites is petty crime from the street level, and while terrorist attacks there have dropped dramatically, there is always a threat with terrorist groups that work in that region."

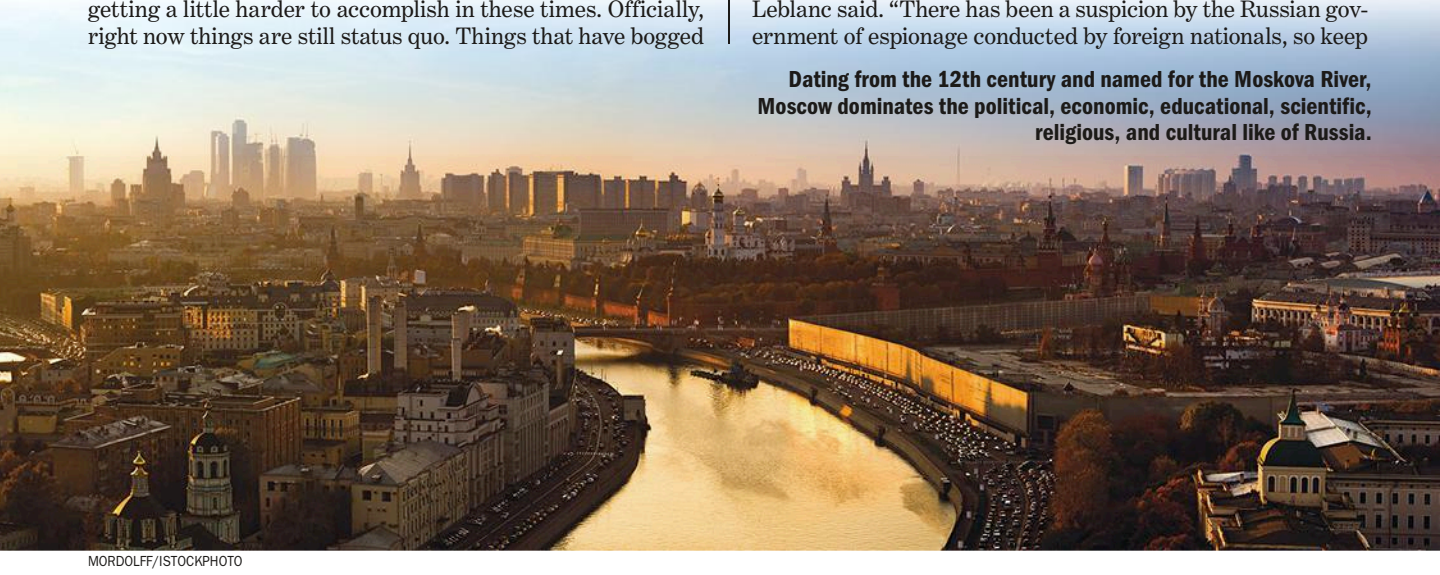
Henry LeDuc insists that the reduction in Moscow-bound business jets has been smaller, based on his experience as a regional operations manager for UAS International Trip Support. "The processing of the permits remains the same and there has been no pushback from the government," he said. "Of course, they don't agree that the sanctions are fair, but from a policy standpoint, there has not been a big change."

Robert Moya, senior operations manager and an old Russia hand at Universal Weather and Aviation, agreed that "probably not much" has changed in Western transit into Russia. "As with anything else," he said, "the political climate dictates how things are handled for short periods of time. One thing we're looking at is the Venezuela situation with the Russians moving troops and battle equipment in there and whether there will be a U.S. response. Sometimes, events like this can have an effect on obtaining permits. In my business, you get a feel for things getting a little harder to accomplish in these times. Officially, right now things are still status quo. Things that have bogged down are more directed toward companies and individual Russians in terms of the sanctions."

The reductions in visits contrast with the open political climate two decades ago, when business aviation activity in Russia, particularly into and out of Moscow, rivaled that in Western Europe. But the tensions in recent years between both the U.S. and EU and the Russian Republic under President Vladimir Putin have constrained the former openness in relations. This has been exacerbated by interference in the U.S. 2016 presidential election by Russian cyber espionage activity — as charged by U.S. intelligence agencies and in the Robert Mueller special investigation — leading to imposition of the economic sanctions already mentioned. In his campaign to destabilize Western democracies, Putin leaves no opportunity unexploited, as seen in his dispatching this winter of Russian troops and armor to Venezuela to support beleaguered President Nicolas Maduro – and poke a metaphorical stick in America's eye.

So, to some extent, this has placed a damper on international business in Russia, especially with individuals and entities targeted by the sanctions. It has also led to subtle demonstrations of an anti-American bias in Moscow, according to Leblanc. "We have seen an increase of an anti-American bias in the form of harassment," he said. "We have had crews and passengers state that they have been sought after for security checks and detained to show identification at numerous points of their trips."

Under the Putin reign, it is now a requirement in Russia for non-citizens to carry their passports with them at all times, and those who are stopped for any reason and are found not to have theirs can be detained, interrogated and fined. "One crew was asked for IDs over 11 times in a one-day period in Moscow," Leblanc said. "There has been a suspicion by the Russian government of espionage conducted by foreign nationals, so keep



Dating from the 12th century and named for the Moskova River, Moscow dominates the political, economic, educational, scientific, religious, and cultural like of Russia.

MORDOLFF/ISTOCKPHOTO

JOEL CARILLET/ISTOCKPHOTO

Aerial view of Domodedovo International Airport (UUDD). Runway 14C/32C is closed, leaving Runways 14L/32R and 14R/32L to handle the airport's high traffic levels. Nevertheless, UUDD is the only one of Moscow's three main fields that does not maintain slot control.

in mind that all communication in the country is being monitored and recorded by the government: email, cellphone, text and browser activity. And they openly admit that they store it for three years." The agency conducting the monitoring is the GRU (Glavnoye Razvedyvatel'noye Upravleniye), Russia's principal intelligence agency and successor to the Cold War-era KGB, Putin's one-time employer

Nevertheless, Business Continues

Nevertheless, business at a reduced rate continues with the West supported by commensurate business aviation operations into the country. And the permitting and customs climate remains sufficiently friendly to be welcoming — greased by the high prices the Russians charge visitors for almost everything, especially aviation services. "Flying into Russia is open and easier than ever," Chris Cartwright, a director for EVO Jet Services, told BCA.

"Permits and slots are fast and unrestrictive," he continued. "Air traffic control facilities are now familiar with business jets. Airports understand and know the needs and requirements of operators, pilots and passengers. Infrastructure is improved, not just in terms of FBOs, but taxiways, runways, terminals, fuel trucks, deicing rigs, and so forth. We see better and newer ground service equipment in service. We do not have fuel or deicing delays due to shortages of equipment as we did years ago."

On the other hand, Cartwright cautioned, the aviation climate for foreign businesses trying to provide services inside Russia is pretty hostile. "Foreign companies seeking to work in Russia face political and business challenges and impediments. Costs for land-use, leases and facilities are prohibitive, with no real way to recoup investments." As we'll detail, the Russians are vigorously guarding their commercial aviation operations from outside interlopers, especially in terms of cabotage.

Cartwright, who lived and worked in Russia on and off from 1992 until 1996 and cofounded a business there that was a precursor to EVO, points out that the Russian civil aviation industry "has matured, though the sanctions have slowed growth. There is a widespread familiarity with business aviation at most airports — particularly in cities of over 1 million population. Most airports are now experienced in supporting business aviation. In the 1990s, there was no real understanding of the VIP services and facilities required by business jet operators. Since Russian business jet owners and users are very demanding, this has helped force development of the market."

FBOs in Moscow and St. Petersburg are high-standard facilities. Hangarage is expensive and occasionally available at some locations — but don't count on it. Even maintenance and spares are much easier to obtain locally or can be imported into the country quickly.

Though the FBO at Vnukovo International Airport (UUWW), dubbed "Vipport," is an airport/joint venture monopoly, there are competing FBO-type facilities in busy airports like Moscow-Sheremetyevo International (UUEE) and Moscow-Domodedovo International (UUDD). "Most airports outside of Moscow lack the traffic to support competing FBOs," Cartwright said, "so they all tend to be monopolies owned by airport authorities or licensed handlers. Supervision and

Vnukovo 3, or the Vipport," is the full-service FBO at Vnukovo Internatinal Airport (UUWW), the most popular destination field for business aviation.

coordination of facilities and handlers still survives due to language barriers, rule opacity, and the security and peace of mind that comes with an agent looking after you and your passengers."

In terms of indigenous business aviation, the population of based aircraft peaked around 2011. Currently, between 85 and 115 business jets are based in the Moscow area, predominately at Vnukovo. (Included in the Moscow estimate are 12 Dassault Falcons — a mix of 900 and 7X types — plus a Boeing BBJ owned by Gazpromavia, the aviation department of the Russian petroleum giant Gazprom, all based on the company's private airport at Ostafyevo [UUMO].) The sanctions imposed by the U.S. have reduced the wealth of the oligarchs and, thus, the local population of business jets has somewhat declined. Of the total population, only 35 to 45 aircraft are registered in Russia, as many Russian owners have their aircraft registered outside the country, including at least 20 in Bermuda, 15 on the Isle of Man and five in Aruba.

Riga, Latvia, also has a strong base of jets for charter and management due to its proximity to Moscow and St. Petersburg. It is one of the preferred places for wealthy Russian nationals and companies to base jets, regardless of registered domicile.

Pre-Trip Planning for Russia

The first item of business for American operators planning a trip to Moscow is to conduct a U.S. Treasury Office of Foreign Assets Control (OFAC) search to determine which business aviation service providers (e.g., handlers or FBOs) may be on the sanctions list. Cases exist of FBOs owned by sanctioned persons, which automatically places their facilities on the sanctions list, thus eliminating them as options for U.S. operators — unless they want to be heavily fined or prosecuted for "sanctions busting." And Leblanc adds, "We are advising that you ensure the mission of your execs is not violating the sanctions against Russia imposed by our government."

According to Universal's Moya, Russian landing permits are very easy to obtain "as long as you submit the right information." It takes one to three business days for an ordinary permit, but in some instances, lead time can extend up to 14 days based on number of seats in the aircraft and whether the operator is planning domestic operations between non-international airports. That means flying between, say, Moscow and St. Petersburg, both international destinations, is fine and will be easily permitted.

But add in domestic stops, and things get very complicated involving permits and the issue of 19 or more seats, generally not a problem for the majority of business aircraft. Cabotage has been a "hot topic" in Russia for quite some time, Moya pointed out. "You come in with 'X' number of passengers, pick up more and transport them within Russian borders, and that is frowned upon big time. In applying for the permit, we will send the itinerary and passenger manifest for each city pair, and when the permit is awarded, the operator will have to stick to it. Also, for legal domestic operations between non-international airports, navigators may be necessary. We have our own office there, and they source the navigators. CAA-Russia provides the permits."

Dustin Duke, a senior captain with Anadarko Petroleum, which operates its stable of Gulfstreams frequently into Russia and within its interior, advised, "You can't add passengers to the aircraft when making multiple stops." He recalled that on one of his company's flights, "we were intending to add company people based in Russia to fly to destinations within the country, and [the authorities] didn't allow that when we applied for our permits. Work all this out before you're in the country."

Cartwright offered his perspective on cabotage, based on his several years of residency in Russia. "In the freewheeling days after the fall of the Soviet Union and formation of the Russian Republic, foreign operators moved aircraft into the country, basing them there permanently, mostly in Moscow, and flying charters. Among other things, these companies operated illegal flights with foreign-registered aircraft for distinguished Russian politicians, economists, businesspeople and bankers without assessing taxes on them and in competition with legal Russian operators."

In recent years, however, the government has clamped down, forcing foreign operators to curtail illegal activities and requiring all foreign aircraft based in Russia to be converted to Russian registry. Foreign-registered operators are strictly prohibited from performing domestic charter operations, and a current goal is to ensure that Russian commercial operators are correctly paying taxes on chartered flights. Foreign

Taking off from snowbound Sheremetyevo Airport. All Moscow airports offer deicing services, as the Russians are well adjusted to winter operations.

ALEKS0629/ISTOCKPHOTO

operators flying charters into Russia must be vetted as part of the permitting process and customs forms must be filed and approved.

Private-use aircraft with non-Russian registration need special customs permission to operate domestically. "Multiple-stop flights inside Russia by foreign-registered aircraft can be viewed as cabotage even when operated privately with no change in passenger manifest," Cartwright explained, "so special customs permissions need to be obtained prior to operating." Finally, the Russian government is pushing for Russian-owned but foreign-registered aircraft to be put onto Russian registry.

Here's an exercise operators planning domestic flying in Russia can use to ensure they are operating legally. If an operator of a private aircraft wants to make a flight within Russia with stops at multiple locations with the same passengers on the airplane that were brought into the country and no one else added to the passenger complement at any of the stops plus no one leaving the aircraft, is this allowed? Yes, but note that no one is being charged to fly aboard the aircraft, and no Russian nationals will be brought on board at any time, so it isn't cabotage. Also, passengers and crew have been listed on a manifest when the operator has applied for landing permits. Finally, if the Russian CAA requires the operator to hire a Russian navigator/pilot to accompany the flight and assist the crew in operating into the domestic airports, will it then be considered cabotage? No, since the navigator is a CAA-Russia requirement.

Crew and passengers will need valid Russian visas prior to flying into Russia. An exception exists, however, for flight crews, who can obtain visas on arrival at Moscow airports through Ministry of Foreign Affairs offices on site with validity up to 10 days. (Moscow is the only location in Russia where this is possible.) There's a caveat for this option, however: It can be time-consuming — up to 5 or 6 hr. — so most flight planning agencies do not recommend it. There are for-profit agencies in the U.S. that can obtain visas in reasonable time, but a multi-visa, which allows multiple visits within a specified time period, will take longer — about three weeks — as applicants will need "invitation letters" from sponsors in-country.

The 'Strange Nature With Which Rules Are Ignored'

It's recommended to hold visas for tech stops — even though regulations do not require them. Cartwright explained: "This is because a few times we faced problems when local airport customs/immigration officers were demanding that crew and passengers must hold visas even on fuel-stop flights, when nobody leaves the airplane. It can happen at airports that are not accustomed to aircraft making tech stops. So we always check with local handlers for visa requirements for tech stops. Even then, that is no guarantee that shift managers at local immigration might decide visas are needed. Also, you cannot do two tech stops without visas anyway."

Cartwright also cautioned that it's essential for operators to understand "the strange nature with which rules are ignored or applied in Russia based on shift managers at specific airports. It is very inconsistent and is one of the challenges we face in regard to answering questions from operators. A shift leader at an airport in Siberia may decide you need a visa when in fact the rules say you don't." The way to address this is simple: Obtain visas even for tech stops, just in case, unless it is possible to unequivocally secure confirmation that they are not required. It's also worth considering multi-visas if entering Russia more than once a year; these vary from one to three years but are expensive.

And of course, no one can enter Russia without a passport that, in this case, must have at least six months remaining on its duration. Note that driver's licenses, EU IDs, etc. are not accepted for identification.

Aircraft documentation is the usual "international package": aircraft registration, airworthiness and noise certificates, and proof of insurance. Moya at Universal also advises that the insurance policy should include a war-risk rider — just in case.

LeDuc at UAS added that for a trip involving more than a one-night stop, "they will want to know who is on the aircraft and why they are going there plus contact details of the receiving party — they will contact them, as well. This is not specific to Russia, as a lot of countries are doing this. The stated reason for the visit can be as simple as 'business.' If you let them know it's a tech stop, they will not apply that level of scrutiny, and if no one leaves the airplane, visas are not required."

Which brings us to customs policy in Russia. A new item that's important for FAR Part 91 operators to understand is the Customs Import Form EM53, Cartwright reported. Completed with "flight purpose" identified as "private" or "non-commercial" and subsequently approved, it allows the operator to perform flights within Russia. The aircraft is allowed to remain in-country for 30 days, followed by the operator closing the EM53 and departing. However, the operator can return the same day and, upon successfully opening a new EM53, can stay for another 30 days, and so on, to a maximum stay of 180 days per year. This can be done through customs brokers, Cartwright said. "There are restrictions to opening an EM53 based on aircraft empty weight — not MTOW — and number of seats. The largest aircraft permitted to open one is the Challenger 604. The Gulfstream 550, for example, is already under restrictions due to its weight."

But further note that "serious inconsistencies" exist in how rules are applied and enforced in Russia. "For example," Cartwright continued, "Sochi-Vnukovo-Domodedovo customs told us that they can permit a Gulfstream 450, for example, despite exceeding the EM53 weight restrictions. St. Petersburg and Sheremetyevo customs took a stricter approach, saying they would fine a G450 operator attempting an EM53 visit."

As always, Cartwright added, "things like art and caviar will get you stopped on departure." Do not bring weapons of any kind, *e.g.,* hunting rifles, into the country unless prearranged with a written permit. "Customs is inconsistent with enforcement; it depends on the shift supervisors or agents and how relaxed or vigilant they are."

Operating in Russian Airspace

In terms of planning for domestic operations in Russia, LeDuc pointed out that "Airport facilities and services at the smaller airports in remote areas like Siberia need to be considered if you're going there. Understand what's available and what isn't, like medical facilities. In terms of routes, know what to avoid, like the Crimea and Eastern Ukraine." Duke added: "Remember the Malaysian flight that got shot down in Eastern Ukraine. The problem is that there are more and more areas where '25,000 ft. and below' is dangerous. Sometimes you may not have a choice, but if you do, avoid them."

Nevertheless, overflight permits of Russian territory are easy to obtain, Moya claimed, "with the exception of certain airways between Russia and Ukraine. A good service provider can keep you safe and out of the wrong airspace."

At most domestic Russian airports, controllers do not speak English, hence the need to carry a Russian navigator, who generally will be an off-duty airline or military pilot. Here's more on navigators from Duke: "The navigators are arranged through the Russian civil aviation authority, which controls the airspace, and you will be informed when you apply for your permits whether you will need one. You will usually pick up the navigator at your POE before heading out to the domestic destination. Controllers may not speak English at the airport you are going to, and the navigators will bring their own charts for those airports. On the descent, the navigator will pick up the comm in Russian and manage the conversion to millimeters and the QFE altimeter."

QFE — measuring altitude above ground level — is standard throughout Russia, with one recent exception: St. Petersburg, which is now operating on QNH altimetry, or height above sea level. Moscow, however, remains QFE, as do all other airports in Russia.

Western pilots unaccustomed to operating QFE when visiting Russia often set their altimeters to QNH and then convert their height to QFE, an arduous procedure. Duke explains how they do it at Anadarko: "We operate exclusively QFE when we go there and change the altimeters to support that. We also run our checklist for QFE ops. You don't want to have to convert when you are busy doing other stuff. Most U.S. operators will convert QFE to QNH and fly QNH, but I highly recommend flying everything in QFE so you don't have to reference a chart."

Furthermore, he continued, the Russian controllers assign altitudes for QFE. "When they say descend to 800 meters, that's a QFE instruction. To avoid any confusion, we set our altimeters to QFE and just descend to the altitude they give us. They use millibars instead of inches of mercury, and in the remote locations they use 'millimeters,' and you will have to do a conversion. Also, make sure everything is WGS-84 [World Geographical Standard-1984, the current ICAO cartography standard]. If you are going to a remote area, try and get local approach plates, as many of the approaches are restricted to Russian operators, and so you cannot download them into your FMS."

Duke rates Russian ATC as "pretty good," noting that flight levels "are now expressed in feet, but once in the arrival phase, [controllers] will go back to meters for the descent. Radar coverage is good in the western part of the country, but once you get to the eastern side it isn't as good. Smaller airports will not have it. And there is no ADS-B or CPDLC service in the country at this time."

Moscow Airports: Business Aviation Friendly

Of the three major Moscow international airports, Sheremetyevo, Domodedovo and Vnukovo, the last has traditionally been the most popular for business aviation, both visiting and based. (Actually, there is a fourth, Zhukovsky-Ramenskoye [UUBW], 36 km southeast of the city, but few business aircraft go there due to the distance from downtown Moscow and the lack of an FBO and VIP services. The field hosts mainly airline traffic as a reliever for the other three and is the venue of the annual Moscow Airshow. Also site of the Gromov Flight Research Institute, it boasts one of the longest

Business jets taxi at St. Petersburg Pulkovo International Airport. The Gulfstream carries an Isle of Man registration, meaning it is probably Russian-owned but registered offshore, a common practice in Russia.

AAPSKY/ISTOCKPHOTO

runways in the world, 17,723 ft., used as a backup landing strip during the test program for the Buran space shuttle in the 1980s.)

All three major Moscow airports have FBOs with decent service levels. Vnukovo and Sheremetyevo are slot-controlled, while Domodedovo is not. Currently, there are no problems with parking at Vnukovo and Domodedovo even for long periods, but at Sheremetyevo, it's better to check parking availability for more than a 72-hr. stay. Note, however, when Moscow hosts major events like forums, football cups, political summits, etc., there can be limitations on parking, so plan ahead if attending one and make your reservations early. While all three airports have hangars, it is rare that business aircraft operators can obtain reservations for hangarage, so don't count on it in the wintertime. It may be worth a try, however, so coordinate with your handler, with the understanding that hangarage will be very expensive.

"Regarding FBOs," Cartwright observed, "competition between airports is strong, which puts pressure on pricing and service levels. So, though there may be only one FBO at Vnukovo, it has to compete with FBOs at nearby airports Domodedovo and Sheremetyevo. Note that some alleged FBOs may actually be handling agencies operating out of a designated airport VIP facility like a general aviation terminal." As this was written, FBOs at the three major airports were:

▶ Vnukovo: Vipport Terminal 3. Note that Jet Aviation operates a line maintenance and AOG facility associated with the FBO, specializing in Bombardier, Embraer, Gulfstream and Hawker types.

▶ Domodedovo: Domodedovo Business Aviation Center (formerly AVCOM).

▶ Sheremetyevo: Premier Avia and A-Group Terminal A (previously Avia Group). Terminal A is dedicated exclusively for business and private aviation.

"We usually go to Vnukovo," Duke said, "which has a nice general aviation ramp and a separate VIP lounge. All the airplanes are staged together, and there are good services. As far as winter ops are concerned, deicing is available due to their familiarity with winter ops. And for Russians, winter is not a big deal." Consequently, deicing is available at all three airports.

Operators applying for permits at Vnukovo will need a PPR (Prior Permission Required) approval, according to Mayo, due to competition for parking. "There are two agencies to apply to: One is the CAA for entry into the country, the other is the airport authority for entry to the airport," he said. "For the latter, the handler will arrange slots applicable 24/7 with a 15-min. tolerance. If you exceed the tolerance you get into a safety-of-flight issue, as you may have to burn a lot of fuel holding until they can work you into the flow. Weather will play a factor, too, but with our technology today, it is more predictable. If you are going to go out of tolerance, start pinging your service provider immediately to work with the airport authority on your behalf."

Vnukovo requires the PPR once an operator's stay is approved. "Apply at least four days prior to your arrival," Mayo said. "If they can't provide you a PPR, the most they can do for you is allow a drop-and-go elsewhere. Among other things, this ensures you will have parking."

But there are "other options," not as convenient on the ground, but they can save a cycle on an operator's aircraft. These, of course, are the other two airports. Both Domodedovo and Sheremetyevo are non-PPR, meaning they will probably have more parking available at any given time. "One way to trim expenses in Moscow is with parking," Mayo said. "At Vnukovo, they will charge you more to incentivize you to park elsewhere. All three fields have FBOs for clearing customs. The only one with parking congestion as a norm is Vnukovo. There is no problem with fuel at any of them."

A few other details concerning Moscow airports: "Security is better than ever," Mayo claimed, "but make sure you have a crew ID when leaving the aircraft. All airports and FBOs are available 24/7, but arrangements must be made to escort you out to the aircraft if you need to open it up for something. Always consult your service provider or handler to walk you through the process." And while there are SAFA (Safety Assessment of Foreign Aircraft) ramp inspections in EU countries, in Russia, Mayo advised, operators should always assume they might be subject to a random customs inspection of their aircraft. It's rare, but it happens. "Be mindful and respectful — always," he said.

No Fuel Issues

Fuel — especially good quality Jet-A — is always a concern for operators, but, according to LeDuc, they have no worries in Russia. "Years ago when business aviation first came into Russia," he said, "there was some initial concern about fuel that it wasn't exactly the same as what we use, but by and large now, the fuel is compatible. If you are going to smaller airports, though, check to ensure they have what you use."

And you want to make sure that you have your fuel set up in advance and have a name as a point of contact for any airport, LeDuc advised. "Get that in advance of the trip, and communicate that name and phone number to your receiving party so there is a positive communication and pre-coordination."

As in many countries, fuelers will tend to give the airlines priority, so allow time for fueling. "If you can, fuel on arrival or make sure you show up at the airport early for departure, and alert the handler to have the fuel available at a specific time," LeDuc added. "Have a fuel release and send a copy to the handler and the fueler beforehand, and reconfirm with the fueler."

Another bit of advice from LeDuc: "Always relay your business point of contact to your handler so the handler will know who is meeting the aircraft and the driver. Today you have to be meticulous about the details of your security arrangement."

Duke added that "When we get transportation from the airport, we try to get a photo of the driver or a description of the vehicle, but that doesn't always work out. Make sure the handler is connected to the transportation. Traffic in Moscow is horrendous, so be ready for long transits. Also, drivers don't all speak English. Give yourself plenty of time in getting back to the airport —an hour's drive can often turn into 3 hr."

Airports in Russia are high-security facilities where access by unauthorized persons is not permitted. Every field has its security personnel who monitor and perform checks. Security control of all crew, passengers and personnel is mandatory. According to Cartwright and others, the security situation is normal on the ground, with no persisting threats, only petty crime like pickpocketing, purse and phone snatching, etc.

Russian airports are guarded by federal police working in tandem with private security. "This a problem because private security is just another arm of the federal police," security gumshoe Leblanc said, "so make sure that aircraft do not have any anti-government literature or propaganda on board. The airports themselves are fairly well guarded because of the potential of terrorist attacks, but we recommend, at a minimum, to security-tape the doors and access panels of the aircraft."

A "positive" on the transportation front, specifically in

Moscow," Leblanc continued, "is that public transportation has been upgraded and now contains English signage, thanks to the recent World Cup. But keep in mind that a significant number of terrorist attacks have taken place on the public transportation system."

As for petty theft, if anyone approaches you on the street or on public transportation and tries to strike up a conversation, smile and politely decline the conversation — as this could either be a government sting or criminal mark.

Travel outside of Moscow and St. Petersburg at night is not advised, Leblanc further recommended, "due to an increase in crime — petty stuff, robberies, usually not violent, but it can be, if you resist." His employer, UnitedHealthcare (which acquired Leblanc's company Air Security International several years ago), has observed an increase in activity among Russian police being "very aggressive" in questioning people taking photos of security-sensitive sites including government buildings, military and police facilities, and transportation hubs.

"We've become so accustomed to our phone cameras, that we take it for granted that we can take photos casually of just about anything we encounter," he observed. "So, think about where you are and be careful taking your selfies. Identity theft via credit cards is a large concern, so keep them in your possession at all times. It should go without saying that you should avoid all open criticism of the government, so keep your mouth shut and don't leave any literature criticizing the Russian government or Putin on the plane or in your hotel rooms; better yet, don't bring it into the country."

After Russia hosted the World Cup in 2018, Cartwright reminisced, "We heard first-hand stories of how friendly Russia feels to visitors. The exposure helped Russia re-embrace visitors without the animosity to foreigners that the sanctions have brought. But as in any less-safe environment, let common sense prevail. Don't call attention to yourself or make yourself an obvious target for petty crime, as you will find in many cities outside Russia. Keep a low profile, don't advertise your expensive laptop, backpack or watch. Don't walk down the street staring at a map with your laptop bag over your shoulder."

Yet, like developed countries elsewhere in the world, Russia offers a unique culture and a diverse and vibrant population. "Many restaurants have at least a few staff that can speak some English," Cartwright, the former émigré, said. "You should not expect any interference or trouble. You should not expect to be followed by Russian security personnel."

When the Soviet Union dissolved some 28 years ago, there was great hope that Russia — "Mother Russia," the progenitor of such rich and beautiful art, music and literature — would integrate with the West, take its place in the global economy, and engage in the international communion, to come into the light, as it were. There was so much to exchange on so many levels after nearly 50 years of the Cold War and Iron Curtain. And for about a decade, it seemed that this would be the new paradigm in Russian-Western relations as the nascent Russian Republic struggled to establish a democracy.

But the honeymoon was short-lived. The Russian people have traditionally had a predilection toward "strong-man leadership" dating from the pre-1917 czarist era, and democracy presented too many alternatives, required too much work, and over time, the people again gravitated toward a strong leader. Enter Vladimir Putin, a former KGB colonel, who co-opted his predecessor, alcoholic Boris Yeltsin, into naming him successor as president. Putin has turned the nation back to the dark days of the Cold War and taken an antagonistic stance toward the West, intimidating former satellite states into his orbit as a buffer against the EU and U.S. Meanwhile, the Russian economy suffers and the country has become an outlier among the world community.

At some point the Putin era will pass into history, and one can only hope that over time, the Russian people will reject authoritative government and open themselves to a new comity of nations. In the meantime, there is still business to be done in Russia, and business aviation will continue to facilitate it. **BCA**

Yes, It's Expensive

It sure is, and we're talkin' about the fees assessed against operators visiting Moscow's three principal international airports for landings, ground services, parking and related services: Vnukovo (UUWW), Domodedovo (UUDD) and Sheremetyevo (UUEE). BCA has come into possession of invoices from visits of business aircraft to each airport during late 2018 and early 2019. Here's what we found.

In September 2018, one Gulfstream operator visited Vnukovo for three days. Among (but not all of) the charges were the landing fee of $588, a "terminal passenger fee" of $1,925, parking fee of $1,844, aircraft "guarding fee" of $335, passenger luggage clearance fee of $314, lav purging fee of $376, "traffic handling" fee of $530, towing charge of $333, ramp handling fee of $567, a catering bill of $541 and passenger transport charge of $379. Along with miscellaneous ancillary charges, this visit totaled $9,544.14.

Over at Domodedovo in November 2018, another Gulfstream, again visiting for three days, racked up a $1,004 landing fee and security charge, $1,080 for parking, a $2,392 passenger arrival and departure fee, a $3,947 hangar fee (which must have supplemented parking for one night), handling fees of $2,057, a single airside pass for $155, a $753 towing bill, a catering (one expensive meal) fee of $868, and a crew visa charge of $835. This and other charges came to a total of $14,898.

Finally, in January this year, a Bombardier Global Express visited Sheremetyevo, remaining for five days. This operator was docked $2,985 for parking, passenger (four) fees totaling $2,225, $796 for "airdrome security," $1,220 for "traffic handling" (possibly, a navigation charge), $482 for ramp services, a $1,115 charge for handling, $1,366 for deicing fluid, $772 for one crew visa, a $542 "commercial fee," $277 for crew transportation, an "urgent landing permit" fee of $355, plus a $114 "permit revision." All this plus ancillary fees totaled $15,527. **BCA**

Moscow at a Glance

Status: Capital (Moscow), largest city, financial and cultural center

Country visa requirement: Required for passengers and crew; for tech stops, generally unnecessary, but as this policy varies from airport to airport, operators are advised to obtain visas as a backup. At Moscow, flight crews can obtain visas on arrival. However, the process is time-consuming and not recommended by flight planning agencies.

Landing permit requirement: Yes, for landing at any Russian airport; three to four business day lead time. Permits are linked to routing, so adhere to flight plan (no changes).

Sponsor required: Yes, for "business landings" in Russia, a sponsor, or "invitation letter," is required.

Aircraft documents required: For FAR Part 91 operators, airworthiness certificate, aircraft registration, noise certificate and insurance documentation with worldwide coverage or a rider covering Russia. A "war risk" rider is also recommended at this time. Part 135 charter operators must meet the foregoing plus provide passenger names, dates of birth and passport numbers with expiration dates.

Other requirements for visiting aircraft: Part 91 operators must complete Customs Import Form EM53.

Carbon trading requirement: No

ATC procedures: ICAO/Pans Ops

Unique procedures: Maximum altitude restrictions on many Russian airways. However, enforcement is inconsistent, e.g., typically, aircraft entering Russian airspace above restricted levels are permitted to remain at that altitude. If departing any Russian airport earlier than filed time, the operator must reconfirm permit. (Being late is not a problem.) It is recommended that an operator's handler make the reconfirmation. Flight levels are now defined in feet, but ATC reverts to meters in approach phase.

Altimetry: QFE in terminal control areas throughout Russia except St. Petersburg, which now operates in QNH.

RVSM: On Nov. 17, 2011, RVSM extended from the Baltic and Black Sea areas to all Russian airspace, FL 290 to FL 410.

Meters or feet: Above transition level, aircraft position "in the vertical plane" is assigned (and expressed) in flight levels rather than in meters; below transition level and for approach procedures, altitude is assigned in meters. Transition altitude/level is variable according to local conditions.

WGS-84: Partially compliant.

Local navigator required: Yes, for flights within Russia to domestic airports where controllers generally do not speak English.

* * * * * *

Airport (preferred for business aviation; see text):

Name & ICAO identifier: Vnukovo International Airport (UUWW)

Coordinates: 55 deg., 35 min., 46 sec. north latitude; 37 deg., 16 min., 03 sec. east longitude

POE: Yes

Elevation: 686 ft.

Runways: 6/24, 9,842 ft., and 2/20, 10,039 ft., both concrete

Slots: 0001-2359 local, valid +/- 15 min., all week. Ongoing Russian head-of-state flights occasionally result in closure of airport.

Curfew: Airport closed 0330-0600 local, all week, March 25-Oct. 27.

FBO: Vipport, aka Vnukovo-3 (see accompanying text)

CIQ: at Vipport/Vnukovo-3 (www.vipport.ru)

Parking: Vipport ramp and, when UUWW is congested, other parts of airport; Vipport will send transportation to and from aircraft.

Fuel: Jet-A available at reasonable prices (for Russia) by Vnukovo Fuel Uplifting Co. through Vipport.

Credit: Can be arranged; most fuel cards accepted. Recommended to have fuel releases.

Hangarage: Vipport, 50,000 sq. ft. (ad hoc when available, long-term rentals available); Jet Aviation maintenance facility, 16,146 sq. ft.

Maintenance: Jet Aviation (Vipport tenant), line service and AOG support for Bombardier, Embraer, Gulfstream and Hawker types

Lav service: Yes

Catering: Through Vipport Catering Dept., which contracts with local restaurants and hotels, offering worldwide cuisine, special diet considerations; dishwashing available.

Fees: Among highest in Europe; typically, ground handling for all services except cost of fuel can exceed $5,000. (See "Yes, It's Expensive" sidebar.)

Security: Controlled by state; aircraft guards generally not necessary at UUWW but can be arranged through handlers.

Ground transportation: Expensive, *e.g.,* an E-class Mercedes from Vnukovo to downtown Moscow runs approximately $150.

Distance and driving time to downtown: 17 sm southwest of downtown; approximately 40-min. ride. In rush hour traffic, this can exceed 2 hr.

* * * * * *

Airport:

Name & ICAO identifier: Sheremetyevo International Airport (UUEE)

Coordinates: 55 deg., 58 min., 22 sec. north latitude; 37 deg., 24 min., 53 sec. east longitude

POE: Yes

Elevation: 622 ft.

Runways: 7R/25L, 12,139 ft., and 7L/25R, 11,647 ft., both concrete

Slots: 0001-2359 local, valid +/-15 min., all week

Curfew: No

FBOs: Premier Avia, A-Group Terminal A

Distance and driving time to downtown: 18 sm from city center; approximately 45-min. drive

* * * * * *

Airport:

Name & ICAO identifier: Domodedovo International Airport (UUDD)

Coordinates: 55 deg., 24 min., 31 sec. north latitude; 37 deg., 54min., 22 sec. east longitude

POE: Yes

Elevation: 588 ft.

Runways: 14L/32R, 12,467 ft., and 14R/32L, 11,483 ft., both reinforced concrete. Note that Runway 14C/32C has been closed.

Slots: No

Curfew: No

FBO: Domodedovo Business Aviation Center

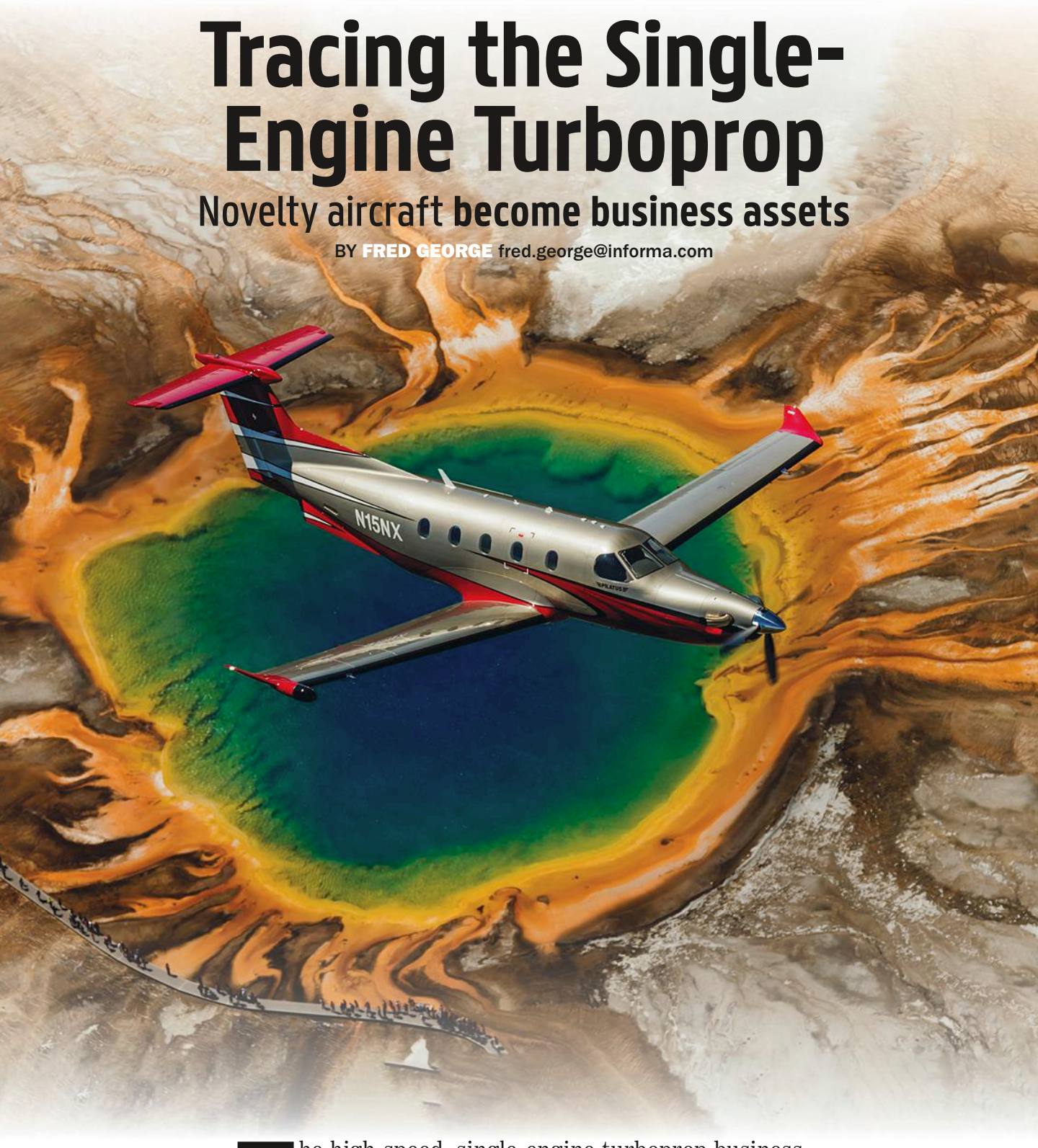
Distance and driving time to downtown: 26 sm south-southeast of Moscow city center; about an hour drive from airport

Remarks: Note that in response to transient operators dropping passengers at Vnukovo and repositioning aircraft out of the country to avoid high service fees, a significant service charge (as much as €2,000) has been levied against them by UUWW management when they return to pick up their passengers. (Russian-registered aircraft are exempt from the fee.) Reportedly, Sheremetyevo and Domodedovo airports do not engage in this activity. Operators are advised to consult their handlers for updates on the UUWW policy. **BCA**

Tracing the Single-Engine Turboprop

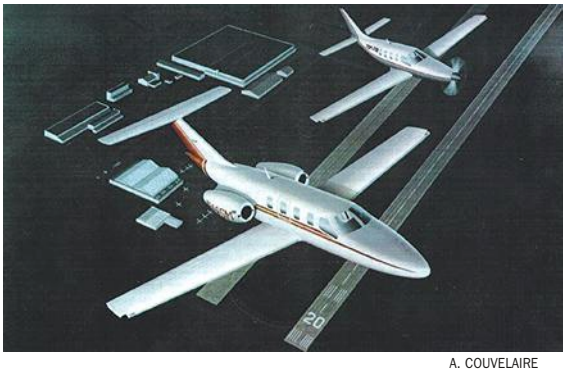
Novelty aircraft become business assets

BY FRED GEORGE fred.george@informa.com



PILATUS

The high-speed, single-engine turboprop business aircraft that has become a business aviation mainstay during the past three decades ironically has roots in the 1950's vintage Morane-Saulnier MS.760 Paris jet, built in Tarbes, France.



A. COUVELAIRE

Couvelaire dreamed of creating a twin-turbofan version of the TBM 700. But, turboprop power proved a better choice.

Former Mooney Aircraft owner Alexandre Couvelaire flew the Paris jet while a pilot in the French Air Force and dreamed of creating a modern civil version, carrying six to eight people, cruising at 350+ kt. and capable of flying 1,500 nm. Key to the upgrade was finding a pair of modern, small turbofan engines that would replace the 30+ year-old, fuel-thirsty and noisy Turbomeca Marboré turbojets on the new model.

But it would be years before lightweight, fuel-efficient 1,000- to 2,000-lb.-thrust-class turbofans from Williams and Pratt & Whitney Canada would make their debut. This steered Couvelaire toward alternate turbine engines. At the time, this turned out to be Pratt's PT6A turboprop, which he regarded as an interim powerplant for his personal business aircraft concept.

When Couvelaire and a group of investors bought Mooney in 1984, they saw potential for a single-engine turboprop in design chief Roy Lopresti's six-seat Mooney 301, so named for its top speed in miles per hour. The 301 was developed in response to a new generation of turbocharged, pressurized, piston singles being designed by Beech, Cessna and Piper. But Couvelaire's team determined that it was too heavy and 40 kt. too slow to vie with competitors' new models.

The energetic French businessman had no interest in building a "me, too" Mooney single-engine piston that would offer performance equal to that of a Cessna P-210 or Piper Malibu. He was convinced that the decline in light general aviation aircraft in the 1980s was due to manufacturers' failures to develop innovative new products, claiming that they "had rested on their laurels" too long. Typical business aircraft missions were 300 to 400 mi. Couvelaire wanted to create a completely new aircraft that was tailored to these trips, one that would leapfrog competitive piston aircraft, thus bridging the gap between 200-kt. piston twins, cruising in the teens, and 400-kt. jets and soar in the thirties and forties.

Aérospatiale, the successor company to Morane-Saulnier, also saw the potential of this new class of executive aircraft. Couvelaire's team started discussions with the French firm about building a turboprop derivative of the Mooney M301 shortly after acquiring the iconic, Texas-based planemaker. Their goal was to create a new class of single-engine turboprops that would cruise considerably faster than twin turboprops of the era, while also offering markedly better fuel efficiency.

At the 1987 Paris Air Show, the two companies announced their intent to build a clean-sheet, owner-flown, pressurized, single-engine turboprop. Aérospatiale's mock-up at Le Bourget showed visitors two pilot chairs up front and a four-seat club section in the middle. Power would come from a single 700-shp PT6A-40. And thus its name: TBM 700 — TB for Tarbes, M for Mooney and 700 for its power rating.

A. COUVELAIRE

Morane-Saulnier MS.760 Paris Jet III was Couvelaire's inspration for creating the TBM 700.

The companies promised the aircraft would have a 300-KTAS cruise speed at FL 250 and a seats-full 1,150-nm range. Pressure differential was nearly as high as that of the Beech King Air 200, giving the TBM 700 a 6,400-ft. cabin altitude at FL 250. With a full fuel load of 2,000 lb., max range could be stretched to 2,000 nm. The initial price was $955,000.

By the time aircraft design was frozen, Aérospatiale had upgraded to the PT6A-64, a 1,583-thp engine rated to 700 shp, which provided substantially better hot-and-high airport performance and higher cruise speeds at altitude.

Heavy design work and component manufacturing would be done by Aérospatiale in Tarbes. Couvelaire intended to set up a production line at the Mooney factory in Kerrville, as it would be able to assemble the aircraft at low Texas non-union labor rates with parts supplied by Tarbes to keep costs in check. However, Couvelaire's investors couldn't stomach the investment, so Aérospatiale became the sole manufacturer. At that point the new aircraft rightly should have been renamed the TB-700, but the TBM 700 label remained.

Even so, Couvelaire continued to dream of building a twin-turbofan variant. In November 1986, he wrote his friends at Aérospatiale, "Originally, it was foreseen that the TB 700 would be the starting point for a range of single- or twin-engine business aircraft, with different types of engines." The twin turbine design would cruise at least as fast as 350 kt., or about Mach 0.65. "The cost of developing a twin turbine at the beginning of the TB 700, will be reasonably reduced compared to a clean-sheet twin-turbine design. In fact, from the moment when one admits that the cylindrical fuselage section is identical for both of these airplanes, certain elements of the twin turbine could be derived from the TB 700, thanks to the addition of reinforcements and local modifications, design and manufacturing costs can be reduced. He continued, "The development of the twin turbine will thus permit to draw the best part of the studies made for the TB 700."

Deliveries of the TBM 700 began in August 1990, but Aérospatiale showed little interest in developing a twin-turbofan variant. And perennially cash-strapped Mooney didn't have the resources for such an investment. This was even more evident during development of the 1988-1989 Porsche Mooney M20L, equipped with the 3.2-liter Porsche Flugmotor. Funding primarily came from Stuttgart, Germany.

Crossroad in the Marketplace

Time was not on Couvelaire's side in launching his dream jet. The entry-level light jet market was heating up at a record pace. Cessna was proceeding with development of the CE525 CitationJet, the start of a new family of faster, higher flying, more efficient, entry-level turbofan aircraft. Adam Aircraft, ATG, Avocet, Century Jet, Eclipse, Epic, Piper, Safire and VisionAire, among others, would soon join the fray.

All this activity may have been a blessing in disguise for Couvelaire. As the light jet competition became more intense, the appeal of high-performance single-engine turboprops became stronger. While most of the new light jet entries boasted 350- 400-kt. cruise speeds and promised at least 1,200 to 1,500 mi. of range, most owner-flown business jet trips were no longer than 300 to 500 mi. Such short mission lengths made them direct competitors to the TBM 700. And while some could save 15 to 20 min. on such trips, they consumed nearly twice as much fuel and had considerably higher direct operating costs. This gave the new TBM 700 quite an advantage.

Piper M600, a substantially upgraded version of the Meridian turboprop, follows in the footsteps of the pioneering TBM 700.

Twin turbofan advocates fired back. Having but one engine, they lambasted the TBM 700 for its lack of powerplant redundancy. It just wasn't as safe as a twin turboprop or twin turbofan, they asserted. But the -64 Pratt proved impressively reliable in day-to-day operations and the popularity of the aircraft grew, paving the way for many more single-engine turboprops.

The Swiss were next to jump on development of a high-performance, pressurized, single-engine turboprop. At the NBAA's annual convention in 1989, Pilatus took the wraps off of its PC-12, a secret project that had been under development in Stans for several months. The aircraft was so named because of its 1,200-shp PT6A-67B engine. Assembly of the first prototype was well underway, with certification originally planned for 1991. Subsequently, Pilatus redesigned the wings and added winglets to production aircraft to assure they met performance projections. Swiss certification of the first production units occurred in March 1994 and the FAA issued a type certificate in July of that year.

The Swiss airplane couldn't match the TBM 700's climb performance or cruise speed, but its large, left rear, 4.4-ft.-wide-by-4.3-ft.-high cargo door, along with its flat floor, gave it superb utility. And it also had a left-side forward pilot door for direct access to the cockpit.

The PC-12's interior dimensions actually were larger than those of a King Air 200. Overall cabin volume was 360 cu. ft. Standard interior furnishings were work denims and farm gloves tough, but many buyers ordered the posh six-chair executive cabin. The wingspan was longer than that of the Cessna Citation II. One operator told BCA during a PC-12 Operators Survey that he used the aircraft to move his daughter's household goods, including refrigerator, washer, dryer, televisions and bed, from one city to another. Another owner told BCA that he intended to haul around Caterpillar turbodiesel engines in the back of the airplane.

The PC-12 also earned plaudits from Australia's Royal Flying Doctor Service as an air ambulance aircraft that could shuttle patients between short, unpaved runways in the outback and larger airports serving major medical facilities at coastal cities.

Not Resting on Laurels — In Tarbes or Stans

Even as early deliveries of the TBM 700 and PC-12 began, growth versions were in the works that offered more utility, better loading flexibility, more range and higher cruise speeds. In 1992, the TBM 700 was upgraded with EFIS, becoming the "A" model. The 3.9-ft.-high, 2.1-ft.-wide clamshell rear entry door was replaced by a 3.9-ft.-high, 3.5-ft.wide swing-up cargo door for the 1999 "B" model, providing easy access to the cabin for combination passenger/freight missions. And the "C2" in 2003 was structurally beefed up and fitted with 20-G chairs, plus 10-ply tires to make possible a much-needed 815-lb. MTOW increase.

Pilatus also had many opportunities to improve the original PC-12. Similar to the TBM 700, it needed a series of weight boosts to increase its useful load. First-generation aircraft had onerous roll control forces because the Pilatus design chief didn't believe in aileron servo tabs to provide aerodynamic boost. Later models had the tabs, which reduced roll control force by two-thirds.

Key milestones were achieved in 2008 by both Socata, successor to Aérospatiale, and Pilatus. Both manufacturers upgraded their aircraft with more-powerful versions of the PT6A, boosting both climb and cruise performance. The TBM 850 was fitted with a 1,825-thp -66D in place of the 1,583-thp -64. While retaining the 700-shp rating for takeoff, power could be pushed up to as much as 850 shp for climb and cruise. Similarly, the PC-12NG was equipped with a 1,744-thp -67P in place of the original 1,605-thp -67B. In addition, the new engine was rated at 1,200 shp for all operations. The older engine was rated at 1,200 shp for takeoff, but power had to be reduced to 1,000 shp at all other times.

Both aircraft were upgraded with full glass cockpits. The Garmin G1000 was installed in the TBM 850 and Honeywell Primus Apex was fitted to the PC-12NG. In 2014, Socata upgraded its aircraft with two dozen improvements, including a more-efficient engine-inlet ram recovery duct, winglets, a five-blade Hartzell carbon-fiber prop that reduced interior sound levels and several aerodynamic refinements that allow the -66D's 850 shp to be used for all phases of flight. The TBM 900 series aircraft officially made their debut. Pilatus subsequently upgraded the PC-12NG with a similar Hartzell five-blade composite prop that cuts cabin sound levels.

Two-plus decades of improvements added capabilities to both aircraft, but their prices climbed even as demand remained strong. Today's TBM 900 series aircraft sell for more than $4 million and the PC-12NG retails for well over $5 million. TBM 900 series aircraft can cruise as fast as 330 KTAS and the PC-12NG now speeds along as fast as 285 KTAS. That's tough competition for most twin turboprops and ample speed to be viable with twin-turbofan aircraft on shorter trips. With six occupants

aboard, TBM 900 series aircraft actually can beat some twin turbofans on longer range missions because it can fly nonstop when the light jet has to stop en route for fuel.

The escalating prices of the European single-engine turboprop contenders opened the door for Piper to develop a more-affordable turboprop derivative of its pressurized, single-engine piston PA-46 Malibu/Mirage in the late 1990s. Piper's PA-46-500TP Meridian, powered by a single 1,000-thp PT6A-42A flat rated to 500 shp, made its debut in September 2000. It offered two-thirds as much long-range cruise speed, two-thirds the cabin volume, two-thirds as much payload and two-thirds the price of the TBM 700. Buyers loved its price/performance value point.

The Vero Beach, Florida, manufacturer delivered more than 550 Meridians before it was succeeded by the Piper M500, available with a Hartzell five-blade composite prop, plusher interior furnishings and upgraded G1000 NXi avionics. The M500 is off to a strong start with more than 70 deliveries to date.

Many Meridian and M500 operators longed for greater range, more useful load and higher operating speeds. So, Piper upgraded the aircraft with a new wing holding more fuel and more robust construction and dialed up the -42A's output to 600 shp. The new model, appropriately named the M600, can fly 70% farther. With a maximum range of more than 1,400 nm, it can fly coast-to-coast missions with one fuel stop, unless westbound into especially stiff winter jet-stream winds. Priced at $3 million, it's a strong competitor to TBM 900 series aircraft, even though it's up to 50 kt. slower. Piper has delivered more than 80 M600 turboprops since it was certified in 2016.

Textron Aviation's upcoming Denali, its first high-performance, single-engine pressurized turboprop, takes dead aim at the Pilatus PC-12NG. It's the first aircraft to be powered by General Electric Aviation's Catalyst turboprop, a 2,000-shp-class engine that promises a 15% improvement in fuel efficiency owing to its 16:1 pressure ratio, single-crystal, internally cooled turbine blades and 3-D printed components. It's the first general aviation turboprop to be equipped with a FADEC/computer-controlled prop governor for carefree handling and health trend monitoring and recording. For the Denali, the Catalyst is flat-rated to 1,240 shp up to FL 280, as much as 10% more power than its competitors, and it powers a Hartzell five-blade carbon-fiber prop. Initial TBO is 4,000 hr.

The Denali is slightly larger than the PC-12NG in all exterior dimensions and it appears to be a touch heavier in weight, although Textron has yet to release final specifications for the aircraft. It will have a 1,100-lb. tanks-full payload, a 285-KTAS top speed, an FL 310 ceiling and 1,600-nm, four-passenger range.

The aircraft will be certified for up to 10 occupants. Similar to the PC-12NG, there is a forward main entry door, providing easy access to the cockpit and cabin, plus a large, swing-up aft cargo door. The standard six-chair executive interior is available with an optional, fully enclosed, externally serviced lavatory. At 7.55 psi, the Denali will have the highest pressurization in class, promising low cabin sound levels and improved comfort for passengers. First flight is slated for later this year and certification is due in 2020.

Epic Aircraft, located in Bend, Oregon, at the former Cessna Corvallis production plant, has its sights on taking the top speed crown from TBM 900 series aircraft. Its all-composite Epic 1000, the production variant of the Epic LT kit airplane, again is due for certification "later this year," according to sales director Mike Schrader, who has made this prediction in years past. The latest delay was caused by a redesign of the engine air inlet in late 2018. A single PT6A-67A turboprop provides propulsion.

Epic promises that the E1000 will be "the fastest, highest performing, most affordable and comfortable" pressurized single-engine turboprop. Similar to the TBM, the cabin is 15-ft. long, but it's 9-in. higher and 6-in. wider. The company estimates the E1000 will have a 3,000-fpm initial rate of climb, a certified service ceiling of FL 340 and top speed in excess of 330 KTAS.

DAHER

Daher's TBM 900-series aircraft are the reigning speed champs of the single-engine turboprop segment.

Cabin pressurization is 6.6 psi, actually slightly higher than the Beech King Air 250. Max range is projected to be 1,650 nm at 265 KTAS and estimated tanks full payload is 1,100 lb. The flight deck features Garmin G1000 NXi avionics. The interior appears to be considerably larger than TBM series aircraft, but *BCA* has not yet evaluated the aircraft or measured its dimensions.

The future looks bright for single-engine turboprops. Aérospatiale, and successor companies Socata and Daher Aerospace, have delivered more than 780 TBM series aircraft. Pilatus has built more than 1,600 PC-12/PC-12NG single-engine turboprops. Piper has produced a total of more than 700 Meridians, M500s and M600s. Textron Aviation is on track to start deliveries of Denali next year and Epic arguably could enter service in the next several months.

This entire class of 3,000+ business aircraft traces its roots back to Alexandre Couvelaire and Aérospatiale's TB 700 concept airplane of the mid-1980s. While Couvelaire's twin-turbofan variant of the TB 700 never came to fruition, he can take a large part of the credit for pioneering the concept of today's fuel-efficient, high-performance, single-engine turboprop. His visionary leadership has changed the business aircraft industry for decades to come. **BCA**

Thinking Back Globally

A former skeptic recalls **encountering Bombardier's big bird**

BY **ROSS DETWILER** rossdetwiler@gmail.com

In January 1999, our department was flying a Gulfstream GIV-SP and two Falcon 2000s. We did some European flights, flew once a year to Asia, and did some South American trips in the Falcons, but basically, we were a domestic operation.

That pattern aside, I was one of three pilots, along with a flight attendant, who got assigned to an around-the-world trip in the GIV-SP. The first leg was New York to Tel Aviv. To accomplish that required a middle-of-the-night fuel stop, in a driving rainstorm, in Shannon, Ireland. About halfway through the trip, another leg took us from Delhi, India, to Sydney, Australia, with a second middle-of-the-night stop, this time in Singapore. We finished our portion of the trip with an 8.5-hr. night leg from Taipei to Anchorage, Alaska — the limits of performance. If we were going into international flying in a big way, more range was needed.

As it happened, a corporate merger was then in the works that would blend our large department, based at Westchester County Airport (KHPN) in White Plains, New York, with a huge operation based in New Jersey. It was a good time to push for long-range capability as a lot of Asia-Pacific travel was in the future of the new combined company.

I remember one or two other long nights of GIV flying before the merger. Execs went north to Alaska after work in New York City. One crew would fly them to Ted Stevens Anchorage International Airport (PANC), where the second crew — after trying to sleep since 1500 that afternoon — would meet the plane and depart at 0300 for an 8+ hr. trip, usually to Osaka, Japan, refueling and pressing on from there. Those were long rides in the dark, over a lot of closed airports and a lot of open ocean and, most importantly, at the very limits of the SP's range.

Our chairman was very aviation friendly and he knew that the new corporation would require the ability to travel great distances according to the dictates of the business to be done. The entire flight department thought the world of and wanted to support him. He even told the now-combined force of some 22 fixed-wing pilots that we would all vote on which long-range airplane, the GV or the Bombardier Global Express, we wanted for our new international department.

Pilots, being predictable animals, would all vote for the Gulfstream. Here

> The Global was a workhorse . . . **and the corporation continues to fly newer models to this day.**

was the perfect airplane to carry on the work of the three GIV-SPs that our combined departments were currently operating. We'd all spent from 10 to 25 years operating Gulfstreams, each one propelled through the atmosphere by trusty Rolls-Royce engines. We liked that combination.

Bombardier sent Borden Schofield, then a company pilot, to KHPN with a Global demonstrator for our pilots to fly. We smiled politely and enjoyed ourselves but weren't convinced the Global was what we needed.

However, Bombardier had been very smart in their marketing push. They'd let us handle their machine, sure, but they didn't come to the flight department to get their "new bottom-up design" in the door. Rather, they went to the head shed downtown and offered the boss a trip aboard a Global to a location of his choice.

Off we went with four execs, the Bombardier crew, me, another of our pilots and one of our own flight attendants. We headed from New York to São Paolo, Brazil, a nonstop walk in the park for the big jet. After a layover in São Paolo, it was down to Buenos Aires for a day. The following evening, we headed back to Westchester County with an overnight 10+45 nonstop flight plan.

The Vote Is Tallied

After the trip, word came up to the hangar from New York. The vote was 22 to one for the GV. Only one person voted for the Global — the chairman. His vote carried the day. He announced that we were getting not one, but two, Globals to handle our international travel needs. We were instructed to be cool, and line up the order. It was a rather inauspicious start for what turned out to be such a good airplane for the company.

Like most pilots, I pride myself on never paying the asking price on any vehicle, winged or wheeled. In this deal the Bombardier guys knew that our boss wanted the Global but would have our hides if we paid too much. We told them we were interested.

Part of the purchase deal was two more support flights, one to Shanghai and the second to Tokyo.

As an aside, the airplane we used on the Shanghai trip belonged to an FAR Part 135 West Coast customer of Bombardier that leased the plane back to them for demonstration flights. It had the best crew rest area I've ever seen on a business jet to this date, and that covers 45 years since my first Falcon 10 and Gulfstream II flying.

As you came up the stairs, there was a 6-ft.-long couch, right across from the cabin door. If desired, that couch could be hidden behind folding wooden doors. The unique thing was that the back of this couch frame was hinged at the top, folded up from the bottom and could

be supported by two aluminum posts against the lower frame. This yielded two full-length bunks. You wanted to make sure that the person in the top bunk was not a porker, of course, but this was and remains to this day the best crew rest business airplane I've ever seen. I smile when I tour 15-hr. airplanes that still have room for only one person to recline in a chair next to the galley, but that's another story.

The Shanghai trip went off without a hitch. We waited in Anchorage for the aircraft to come up from New York. Then 9 hr. to a rainy Shanghai. I appreciate a 12-hr. airplane most when making a 9-hr. trip into weather. We hopped up to Beijing and flew home from there, but still through Anchorage. The GVs were making that trip nonstop.

Try Nonstop or Go Home

On the final support trip, the boss and entourage flew through Anchorage to Tokyo for a quick two-day stay. At dinner the night before the return trip, the demo pilot, Roger Noble, then a top sales executive with Bombardier and now a good friend pitching for Aerion, told Jim Moore, the manager of our new combined department, that it made more sense to fly at Mach 0.85 and stop in Anchorage than it did to fly long-range cruise and try to make it all the way to Westchester. Jim responded in no uncertain terms that if Roger didn't think we could make New York from Tokyo without stopping, we might just as well buff up the shine on the GIVs and cancel the two-plane order under consideration.

They made it nonstop. Good winds, Mach 0.82 and an 11-hr., 40-min. ride home, and the only people with long faces were the pilots waiting in Anchorage when they found they would be coming home commercial.

The Longest February

The die was cast, the deal signed and we were off to Montreal for our initial training. Montreal is one of the world's prettiest cities . . . in the summer, but during February 2000, we two pilots lived through constantly gray skies, snow squalls, endless days of classroom, and then classroom and simulator. It went on forever.

Bombardier had a different take on training than I had experienced at FlightSafety International over the previous 25 years I'd been in business aviation. FlightSafety always taught what I called a systems-oriented course. They'd take you "into the mechanics behind the switch." Often an instructor would take you to one of the planes that happened to be around, and point to and touch every component talked about in class. You could see the lines and wires coming from them and the buses to which they attached. I liked that idea.

Bombardier, at that time, was teaching what I called a procedures-oriented course. To me it seemed like:

"If that light comes on, push this button."

"What does that do?"

"It puts out the light."

What if it doesn't?"

"It will."

I didn't like that as much and we got into the systems more when we went to FlightSafety in Wilmington, Delaware, for our Global refreshers. Nevertheless, it's hard to argue that either system is better in terms of its results.

Narita — Half a Day to Home

The nonstop home from Narita became the standard by which we measured our Globals' range capability. Although some departments were flying that trip more frequently, we found ourselves going to Hong Kong, Shanghai, Beijing and Tokyo at least once a month. When Narita was on the end of those trips, I'd plan the nonstop back to Westchester. I did that trip three more times after the support flight and always required that KHPN be dead serious VFR when we were scheduled to arrive.

Yes, the Global was a 5,900-mi. airplane and yes, the distance was only 5,800 mi., but there were a lot of hitches in that get along. We did it once at Mach 0.82 in 11+20 and landed with over 4,000 lb. of fuel, VFR. On the other two occasions we had weaker winds for most of the flights and did long-range cruise or Mach 0.80 for the entire trip. This wound up being a 12+30 flight and we would land with just NBAA reserves, using Stewart International Airport (KSWF) in New Windsor, New York, as the alternate. Tokyo-Westchester, in my opinion, was a stretch for the early Globals.

There were several factors working against attempting that trip and those that have flown it are well aware of them. The first is that although Narita functions like a finely oiled watch, the process of getting from where business jets are parked to the farthest point on the property, from which we usually took off, required about 35-40 min. of engine run time on that well-oiled watch. The second and more pressing problem was the high temperatures at altitude on the North Pacific. Climbing out of Narita, there would usually be a nice push and decent temperatures for the first hour or so. Then the wind would stop and the temps would start to climb. Globals were not happy campers at FL 370 with a nearly full center tank (9,000 of 11,150 lb. of Jet-A, if I remember) and those temperatures. It wasn't until coast-in around Anchorage that the trip began to look like the FMS knew what it was talking about fuel- and time-wise.

Global Express approaches New York after a long trip from Asia.

Mach 0.82 and Low Temperatures Were the Way to Go

We did some other long-range trips in which the Global could really shine. One of our most experienced captains flew from Westchester to Doha, Qatar, in 13

hr., 25 min. and still landed with over 4,000 lb. of fuel. That was the difference that the cold North Atlantic temps made. I flew two trips from New York to Kuwait City. The first was through Nice, France, so it was no problem at all. The second we made nonstop at Mach 0.82 in 11+25 and landed with 5,600 lb. of fuel. Another young captain (now the corporation's chief pilot) made New York to Dubai in just over 12 hr. and landed with 4,000 lb. of fuel. We regularly flew the Buenos Aires to New York trip, but that was a no-brainer as was the 10+30 Anchorage-Hong Kong leg.

The Global was a darn good long-range airplane, if the temperatures were ISA or colder.

What were some of the other pluses?

The Folks Loved the Plane

The Global was comfortable for the passengers. This had been the Bombardier sales team's main marketing push to the boss and they delivered well on that promise.

The cabin was huge. That point alone probably had more to do with our folks liking the airplane than any other. It was designed for comfort. All of our airplanes were open in the back, with only a folded curtain on each side of the mid-cabin when the sleeping area was open. We didn't believe in chopping interiors into little compartments. Our planes looked enormous to people coming from other business jets or even from other Globals with divided interiors. There's no denying that Bombardier was first to the market with a widebody non-airliner and the folks downtown loved it. It was also our first satcom and sat-TV airplane. More big pluses for the paying seats.

The design was well-thought-out and well-engineered. Other planes at that time often sounded, on the ground, like the APU was under the dining table, but all you heard in the Global was a quiet sound of air moving when the APU was the only engine running.

And the plane felt big. I've flown much lighter airplanes and much heavier airplanes. I don't know what the weight is where a plane begins to just feel heavier — read, more secure and safe — than others, but it's somewhere between 70,000 lb. and 90,000 lb. in my experience. While the plane to me always looked like it was about to sit down on the ground, it was a pure joy to see one in flight. And those big, long thin wings and the heavy feel gave a very nice ride through the air.

Crew Privacy and Operational Ease

The Global was the first airplane we'd flown with a complete crew area up front. We elected for electric doors between the cabin and crew area and with these shut, the crew had an area in which to walk around, eat, talk, sleep and use the restroom without even being seen by the passengers.

To me this privacy was a wonderful advantage of the airplane and for some reason made flying more relaxing to me.

Additionally, the Global was the first airplane in which to start an engine I merely reached down and moved one switch, sat back and monitored the computer bring the engine and alternator on line. Then, with the FMSes ready and the flight plan loaded, it was a matter of doing a flight control check and the plane was ready to taxi.

The nosewheel steering was a little hard to get used to at first as the Bombardier folks told us not to touch the tiller once on the runway. They wanted pilots to control the plane through the rudder pedal nosewheel steering in that portion of a flight. This was a big change for Gulfstream pilots.

The airplane was easy to handle in a crosswind until the nosewheel touched the ground. I had trouble at first because when the nose gear touched down a little more rudder pressure was required on the nosewheel steering, but that also moved that great big rudder that made the airplane so easy to handle while airborne and could result in over-correcting, at least for me. That took some getting used to. The gusty fall crosswinds at Westchester were attention-getting at first.

It was also the first plane I ever flew with autobraking. I used low autobraking all the time. The deceleration was no greater than the average pilot would ever use and not even noticed by the passengers. Nevertheless, all the time between the pilot mentally patting himself on the back for a nice touchdown, easing the nosewheel to the ground and then slowly bringing his feet up to the brakes was time spent braking. It resulted, all else being equal, in about 1,500 ft. less distance to taxi speed. If runway contamination or crosswinds were a factor, I would select high. There was still enough control to ease the nose to the runway, and the airplane was taxiing just a few seconds after that occurred. It was marvelous.

Looking Back

The 1990s and early 2000s were a period of transition for us. We went from basically domestic operations to going to Asia once or twice a month and Europe with a day's notice. We had two Falcon 900EXs that flew alongside the Globals when the long-range movement of a lot of personnel was involved. It was, in my career, the peak of what we were providing to our company.

To lend a closing perspective, I remember an old business pilot telling me, in early 1975, that he'd had to turn down a request to fly a New York to San Francisco trip the next day because 24 hr. was just not enough time to "put together all the details and planning it takes to get that 'big Geee 2' to the West Coast."

We flew the Globals for the last nine years I was at the corporation. I don't remember losing a trip to maintenance during the time, although there was an instance or two when it helped to have a second to roll out. That's a credit to both the airplane and our outstanding maintenance department. Overnight requests to go to the West Coast weren't even mentioned as out of the ordinary. We did Europe on overnight requests. Asia still required two days' notice to obtain permits and pre-position crews. We could do Singapore through Athens and save an hour and a stop on that destination out of New York.

The Global was a workhorse for us and the corporation continues to fly newer models to this day.

I'd bet flying a Global 7500 would be a wonderful way to make a living. BCA

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Improving Charter Safety

NTSB puts **Part 135 ops** on its **Most Wanted List**

THE NTSB RECENTLY ISSUED ITS 2019-2020 MOST WANTED LIST, and prominent among the top 10 is "Improve the Safety of Part 135 Aircraft Flight Operations." As a former charter pilot, I ground my teeth a little bit when I read the headline that the FAA doesn't require on-demand flights to "meet the same safety requirements as commercial airlines." I have seen that statement many times over the years, and I have a timeworn "apples and oranges" response as to why you can't compare the two commercial operations.

However, when I sat down with NTSB Chairman Robert Sumwalt to discuss the recommendations, he challenged me: "Why not compare 121 and 135?" He made some good points, and I found myself agreeing with the NTSB's goals.

According to the Safety Board, most of the companies that conduct Part 135 operations do not have (and are generally not required to have) a safety management system (SMS), flight data monitoring (FDM) or controlled flight into terrain (CFIT)- avoidance training program. The NTSB doesn't know how many such operators have SMS or FDM programs because the FAA doesn't require them to implement or report on them. However, since third-party auditors such as Wyvern and ARG/US International look for SMS and CFIT training in their reviews, most of the top Part 135 operations have embraced these programs.

> The NTSB has recommended that the FAA require all Part 135 operators to **install FDRs capable of supporting an FDM program.**

CFIT-avoidance training programs are required for Part 135 helicopter operations, but not for Part 135 fixed-wing operations. The NTSB has investigated several fatal CFIT accidents involving flights operated under visual flight rules at low altitudes where terrain awareness and warning system (TAWS) alerts were inhibited due to the lack of effective TAWS protections and nuisance-alert mitigations.

The NTSB's investigation of the Oct. 2, 2016, crash of a Cessna 208B Grand Caravan into steep, mountainous terrain northwest of Togiak, Alaska, identified safety issues related to a lack of SMS, FDM and adequate CFIT training and technology use. Following this accident, which killed two pilots and the passenger, the Safety Board commented on the need for improvements in the operator's CFIT-avoidance training, and the need for SMS and FDM programs (and supporting devices) for Part 135 operators, among other issues.

The Safety Board is making recommendations to the industry and to the FAA. To the industry, it is calling for installation of flight data recorders (FDRs) as part of FDM programs. That is an expensive recommendation. The easier recommendations are to adopt SMS and CFIT-avoidance training.

SMS has been adopted by most major Part 135 operations because it is required when they fly to Europe. In addition, Class C TAWS have been installed in numerous Part 135 aircraft of all sizes. A TAWS works by using digital elevation data and airplane instrumental values to predict if a likely future position of the aircraft intersects with the ground. Are Part 135 operators adopting CFIT-avoidance training to match their equipment? Apparently this has not been surveyed by the FAA.

The NTSB has recommended that the FAA require all Part 135 operators to install FDRs capable of supporting an FDM program. From an operator perspective, installing an FDR when it is not required is a hard sell since doing so represents a hefty expense that won't add to the resale value of the aircraft. But what about all of the money spent on FDRs that are required? Some of the largest Part 135 operations are now looking at implementing FDM to take advantage of the technology that is already in their aircraft.

The NTSB is also recommending that the FAA require SMS programs in Part 135. This is a much easier proposition for operators. In fact, one of the consequences of the FAA's recent implementation of the Safety Assurance System (SAS) is that Part 135 operators are incorporating non-required processes and procedures. Why? Because SAS was originally designed for Part 121 operators, and the data collection tools (DCTs) used in SAS have not been adequately redesigned for Part 135. But Part 135 operators often implement distinct elements of SMS in order to avoid saying "no" on a DCT. However, many charter operators report that they find it difficult to incorporate SMS elements into their training, manuals and procedures because some FAA inspectors reject inclusion of SMS programs that are not FAA required, approved or accepted.

The NTSB's recommendations for SMS, CFIT-avoidance training and FDM are all within reach for the charter industry today. Given the cost and sophistication of today's jet charter market, Chairman Sumwalt's question is timely and fair: "Why not compare 121 and 135?" **BCA**

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Piper Meridian

Least expensive **high-performance single-engine turboprop**

PIPER'S PA-46-500TP MERIDIAN, REBADGED AS M500 IN 2015, made its debut in September 2000 as a 2001 model. It has been the lowest priced pressurized, single-engine turboprop offered by an airframe manufacturer for nearly two decades. Piper created the Meridian by modifying a Malibu Mirage to handle and additional 500+ lb. of weight and higher cruise speeds and then replacing its 350-hp piston engine with a 500-shp Pratt & Whitney Canada PT6A turboprop. Meridian most assuredly was a design-to-cost development program as reflected in the final product.

The Malibu, launched almost three decades ago, was the product of Jim Griswold, head of Piper engineering in the early 1980s. The aircraft was a near-perfect, clean-sheet, pressurized cabin-class piston single, one with clean aerodynamics, a high aspect ratio wing and low empty weight. It was the first single to offer cabin-class twin comfort and speed with much lower operating costs. But Malibu's turbocharged Continental engine and succeeding Mirage's boosted Lycoming piston engine both failed to provide sporty performance or stellar reliability.

To correct that deficiency Meridian's 1,100 shp Pratt & Whitney PT6A-42A engine was flat rated to 500 shp up to ISA+55C. Then, Piper engineers added wing root filets to increase fuel capacity by 342 lb. and to increase wing area. The aircraft was fitted with a larger horizontal stabilizer to provide enhanced longitudinal stability at higher cruise speeds, the wing spar was reinforced and stronger landing gear was installed to handle higher weights.

Early Meridian aircraft were handicapped by a relatively low 4,850 lb. MTOW that reduced tanks-full payload to one to two occupants, depending upon options. Starting at s.n. 157 in 2003, Piper boosted MTOW to 5,092 lb., affording operators a 350-lb. tanks-full payload. For a limited time, the firm also offered Kit 767-360 to Piper dealers, a service bulletin that increased MTOW up to 5,092 lb. on earlier aircraft. It's no longer available.

Aircraft up to s.n. 148, manufactured in mid-2002, were fitted with S-Tec Magic 550 autopilots having relatively weak servos. This caused some pitch instability with the autopilot coupled during high-altitude cruise. Meggitt Magic 1500 autopilots, having more robust servos, were fitted to later aircraft, including ones equipped with Avidyne Entegra avionics systems.

Starting with s.n. 399 in early 2009, Piper began offering a Garmin G1000 package, including the super-smooth GFC700 autopilot, as a $50,000 factory option. Now it's standard kit. G500 aircraft now are further upgraded with Garmin G1000NXi avionics having brighter, higher resolution displays and a plethora of optional features.

Compared to plusher single-engine turboprops, Meridian's 165 cu. ft. cabin has lean dimensions. It's easy enough to board through the 3.9-ft. high by 2.0-ft. wide center club door and belt into any of the four passenger chairs. But squeezing between the forward chairs into the cockpit isn't easy. Admittedly, TBM7/8/9XX aircraft are just slightly roomier, but Daher made a second, left front pilot door standard kit, in addition to its large swing-up aft cargo door, making for ready access by both pilots and passengers.

Operators say the Meridian is easy to fly, very reliable and relatively economical to operate. Top cruise speed is 260 KTAS. Block fuel for a 1,000 nm trip is only 985 lb., but block speed is less than 233 KTAS, according to *BCA*'s May 2018 *Purchase Planning Handbook.* They also say that the aircraft pushes its 188 KIAS redline when the aircraft is at max cruise at altitude and that the 127 KIAS maneuvering speed is a severe limitation when encountering turbulence. Other pressurized single-engine turboprops are clean-sheet designs, not adaptations of piston engine aircraft. As a result, they have 160+ KIAS maneuvering speeds. But they also cost $1 million to $2 million more.

Basic inspection intervals are 12 months with 50-hr. flat-rates for scheduled inspection tasks, according to Dave Eddo, owner of Advanced Aircraft at San Diego-Montgomery Field. Few airworthiness directives apply to the aircraft, but there are several mandatory service bulletins. Check with an authorized shop for details.

The PT6A-42A has an 1,800-hr. HSI interval and a 3,600-hr. TBO. Plan on $225,000 to $250,000 a first-fun overhaul. The Hartzell prop has a six-year TBO and overhaul cost is about $10,000.

Lawson Brown, president of Aviation Unlimited, said that many of the aircraft's apparent shortcomings seem to be related to its low-cost, evolutionary development program. But he also noted that Meridians have suffered no inflight structural failures and that aircraft values are steady. According to *Aviation Week*'s *Aircraft Bluebook Price Digest,* early 2001 models retail for about $750,000, assuming a midlife engine. That increases to $1.9 million for 2012 models in large because they incorporate the M-class upgrade package. The package features LED lighting, improved ventilation, folding seat backs for easier cockpit access and unpaved runway approval, among other upgrades. **BCA**

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Gone West

Thomas Hirschmann, 64, former Jet Aviation chairman and CEO, died April 3 in Zurich, Switzerland, of an undisclosed illness. Hirschmann, the second son of Jet Aviation founder Carl Hirschmann, served the company for 29 years. He launched the company's completion business, boosted its marketing and communications department, established a presence in the U.S. and expanded into Asia. Jet Aviation, founded in 1967 in Switzerland, is now a subsidiary of General Dynamics.

On Duty

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

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


LEE LIPTON


ANCA MIHALACHE


THIERRY BARRE


BEN DIACHUN


MICHAEL ADAMS


DAVID CARTER

▶ **Aerion**, Reno, Nevada, appointed **Douglas Coleman** general counsel and executive vice president of governance and compliance. Coleman comes to Aerion from Spirit AeroSystems where he served as deputy general counsel.

▶ **Airport Strategy and Marketing**, Manchester, United Kingdom, announced that **Lee Lipton** has been appointed senior vice president, Aviation Strategy based in Vancouver, Canada.

▶ **APOC Aviation**, Amsterdam, has named **Anca Mihalache** to head up its new engine trading division.

▶ **Asian Business Aviation Association (AsBAA)**, Hong Kong, appointed **Omar Hosari** to the AsBAA Board of Governors. Hosari is co-owner, founder and CEO of UAS.

▶ **BACA—The Air Charter Association**, London, United Kingdom, named **Nick Weston** as the new chairman. He succeeds Richard Mumford who has held the position since 2018.

▶ **Hartzell Propeller**, Piqua, Ohio, named **JJ Frigge** as executive vice president and general manager. In his expanded role, he will the company's business leader with a focus on long-term strategy.

▶ **Jet Aviation**, Zurich, Switzerland, appointed **David Paddock** president, succeeding **Robert Smith**, who has assumed the position as executive vice president of General Dynamics' Marine Systems division. Paddock previously served as senior vice president and general manager of U.S. aircraft services at Jet Aviation.

▶ **National Business Aviation Association**, Washington, D.C., named **Mike Nichols** senior vice president of strategy and innovation for the new Strategy & Innovation division. **Joanne "Jo" Damato** has been named vice president of educational strategy and workforce development. **Dina Green** was promoted to vice president of events. Nichols joined NBAA in 2003 as manager of tax and finance issues and has held a variety of leadership positions. Damato joined NBAA in 2001, most recently serving as senior director of educational development and strategy. Green joined NBAA in 2003, serving as senior director of conferences and forums.

▶ **TAG**, Farnborough, England, appointed **Thierry Barre** managing director of Aviation Maintenance Services, based at TAG's primary location at Farnborough Airport in the UK. He formerly served as technical director of a business jet maintenance, repair and overhaul company in Europe.

▶ **The Wings Club Foundation**, New York, New York, elected **David Davenport** president. Davenport is co-CEO and president, commercial, of FlightSafety International. He will serve a one-year term.

▶ **Opener**, Palo Alto, California, appointed **Ben Diachun** president. He comes to the company from Scaled Composites.

▶ **TrueNoord**, Amsterdam, The Netherlands, appointed **Michael Adams** as European sales director, based in the company's Dublin office. He will support the existing customer base in Europe as well as source and close regional aircraft leases with new customers.

▶ **Universal Avionics**, Tucson, Arizona, announced that **David Carter** has joined the company as regional sales manager for the northwestern U.S. Carter previously was with L-3 Aviation. **BCA**

AircraftBluebook

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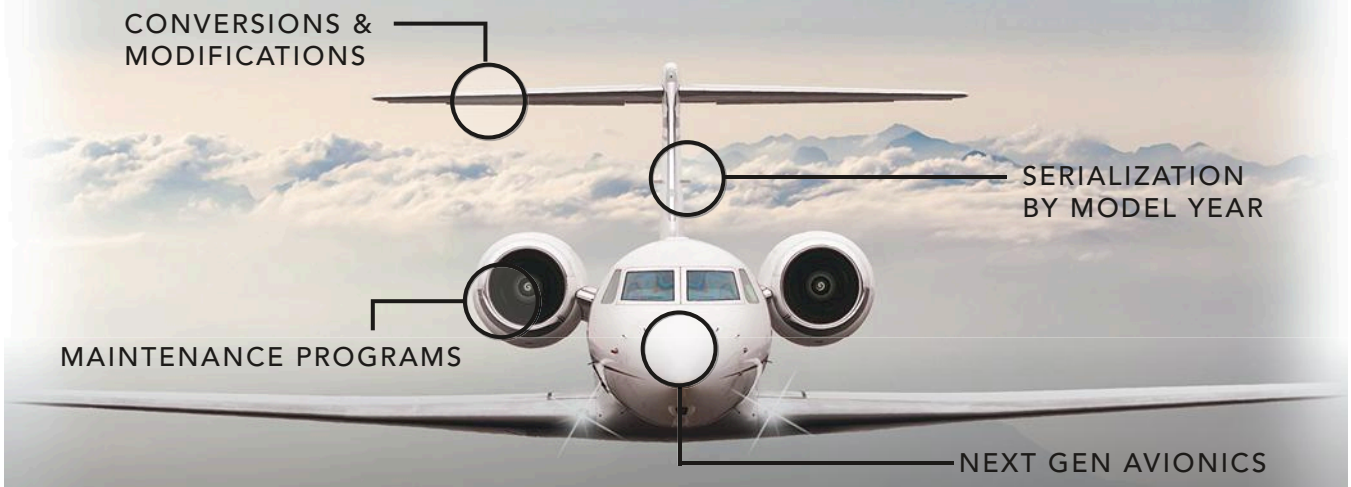

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Products & Services Previews

By Jessica A. Salerno jessica.salerno@8nforma.com

1. FSI Introduces VITAL 1150

FlightSafety International introduced its new VITAL 1150 Image Generation visual system, an enhancement to it VITAL 1100. VITAL 1150 can render normal rates of 120 Hz with up to 8K resolution. This provides accurate representations of real-world visual environments. Its ability to process and display scenes at these extraordinary high speeds and resolutions results in the sharpest visual quality throughout the entire flight envelope encountered during training. Also added are new features for advanced information assurance that support current and future cyber-security requirements. VITAL 1150 incorporates advanced rendering techniques for enhanced weather scenarios including new cloud simulations using specialized elliptical shading that improve the 3-D visual effects for added realism. The VITAL 1150 is also designed for use with FlightSafety's immersive Mixed Reality system, as well as Unmanned Systems and Night Vision Goggle training.

FlightSafety International
www.flightsafety.com

2. Kissimmee Gateway Airport Achieves "National" Classification for GA

The City of Kissimmee announced that Kissimmee Gateway Airport achieved "National" Classification for General Aviation airports from the Federal Aviation Administration (FAA). The FAA released its 2019 report to Congress which updated the categories of airports in the National Plan of Integrated Airport Systems (NPIAS). In the report, Kissimmee Gateway Airport received an upgrade to the highest classification, National, up from the Regional designation. The upgrade occurred mainly because of the number of jet and multi-engine aircraft based at the airport as well as steadily increasing activity levels, and its proximity to Orlando International Airport. Kissimmee Gateway is designated as a reliever airport for Orlando International, accommodating corporate jets and other aircraft seeking an airport closer to the southwest section of the greater Orlando area.

Kissimmee Gateway Airport
www.kissimmeeairport.com

3. Thule Subterra PowerShuttle Plus

An electronics travel case designed to protect and organize everything from headsets to small cables. The PowerShuttle Plus will fit a Bose A20 or a Lightspeed Zulu 3 snug.
Some advantages of the case:

- Protect large headphones along with your full kit of cables, adapters and other electronics in dedicated storage compartments;
- Keep all of your travel essentials efficiently organized and within reach from your airline seat pocket;
- Charge your phone while keeping it accessible in the exterior pocket with cord pass-through;
- Built to last and protect belongings with durable materials, padding and YKK zippers.

Price: $29.95
Sporty's Pilot Shop
www.sporty.com

4. Bombardier Service Opens in China

Bombardier announced significant enhancements to its customer support capabilities for business aircraft customers in China on the eve of ABACE. Bombardier's centrally located Service Centre in Tianjin has received Authorized Service Centre status from engine manufacturers Rolls-Royce, GE and Honeywell.Bombardier is also announced a new line maintenance services at its Tianjin Service Centre. This new team offers AOG mobile repair as well as unscheduled and scheduled maintenance services on various Challenger and

Global aircraft registered with the following regulatory bodies: EASA, FAA, Canada, Bermuda, Cayman Islands, Aruba, Qatar, Isle of Man, San Marino and Guernsey.

Bombardier's Tianjin Service Centre has obtained approvals from a growing number of aviation authorities since opening two years ago and can now offer a full scope of scheduled and unscheduled maintenance services for Global, Challenger and Learjet aircraft registered in China, Hong Kong, Macau, Cayman Islands and Bermuda. Certification is in progress for further expanded capabilities under FAA and EASA. Bombardier also has two regional support offices in Hong Kong and Beijing and two regional parts depots in Hong Kong and Tianjin.

Bombardier
Monteral, Canada
www.aero.bombardier.com

5. First TBM 910 Goes to European Customer

Daher announced the sale of a TBM 910 very fast turboprop aircraft 2019 version to a European customer who took delivery after Germany's AERO Friedrichshafen general aviation show.

In a new step aligned with Daher's TBM e-copilot strategy of reducing pilot workload and supporting safe flight operations, the TBM 910 has an automatic icing detection system that provides automated protection while keeping the pilot fully in the loop. When icing or ice accretion is detected by an externally-mounted sensor — and if the pilot does not take action — the automatic icing detection system will activate deicing devices such as the airframe, windshield, propeller and the engine's particle separator. An amber CAS (Crew Alerting System) message is displayed by the avionics, advising the pilot to clear the automatic activation and revert to the manual control mode. As the entry-level member in Daher's TBM product line, the TBM 910's Model Year 2019 definition also includes G1000 NXi avionics suite features that are incorporated in the high-end G3000 advanced flight deck of the TBM 930 and TBM 940 aircraft versions. They are: Surface Watch, which helps the pilot maintain enhanced situational awareness in the airport environment; Baro VNAV, allowing approaches with vertical guidance when Wide Area Augmentation System (WAAS) navigation is not available; and visual approach assistance for the TBM pilot in performing visual approaches on non-controlled airports with vertical guidance.

Daher
Louey, France
www.daher.com

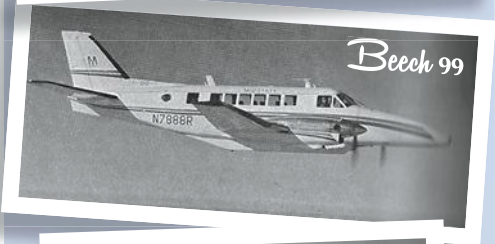
May 1969 News

Prediction: Number of full-time professional pilots in GA will rise from **33,400 in 1967 to 60,300 (flying 396 hr. average) in 1975,** and to **73,000 (flying 430 hr.) in 1980.***

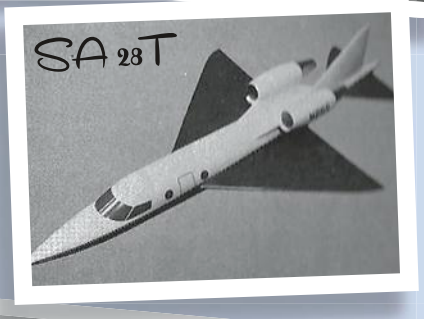
Edited by Jessica A. Salerno *jessica.salerno@informa.com*

Prediction: Turboprops and jets will grow the fastest — a whopping 631.0% is predicted — from 1,585 units in 1967 to 11,600 in 1980.*
R. Dixon Speas Associates study prepared for the Utility Airplane Council

Ted Smith Aerostar 601: Heralded as the fastest piston twin in general aviation, this Rajay-charged Aerostar rendition is the second limb on the Smith family tree.



Beech 99 with optional cargo pod that fastens to its underside. The pod will hold 800 lb. and has a volume of 38.5 cu. ft. Streamlining makes the added drag almost negligible.



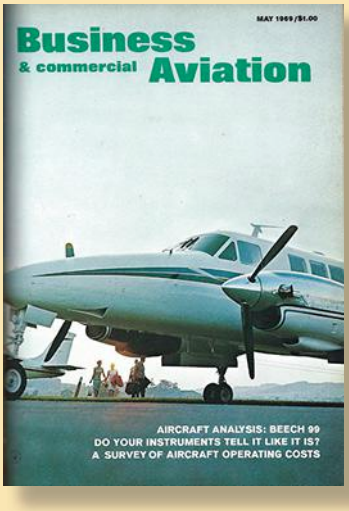
Delta Wing Bizjet has been proposed by Ed Swearingen who says his company has firm purchase agreement with AiResearch Aviation. Aircraft called the SA 28T will be powered by Garrett AiResearch TFE-723, 3,000-lb.-thrust high bypass turbofans.

Garrett-powered Jetstream is flying in England. It is one of two military prototypes. U.S. Air Force version will have gross weight of 14,500 lb. compared to civil version at 12,500 lb.

First production model of Flight Products' "Vertifon" flight simulator will go to FAA's Civil Aeromedical Institute at Oklahoma City. Pilots see movies and experiences motion designed to produce vertigo.

ATR rating applicants will have to demonstrate proficiency in non-precision (no-electronic glidepath) approaches. Requirement was added to test procedure in wake of seven fatal accidents involving VOR and ADF approaches. **BCA**

THE ARCHIVE



The Beech 99 Airliner, shown on the ramp at Spaatz Field, Reading, Pennsylvania, has thrust its long nose well into the scheduled commuter airline picture. Since its introduction in mid-1968, the 15-passenger 99 has reached a delivery total of 85 units to some 33 commuter airlines. A BCA Aircraft Analysis showing operating costs and breakeven seat-mile costs over typical third-level routes appears in this issue.

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