AUGUST 2019 $10.00 www.bcadigital.com

BCA

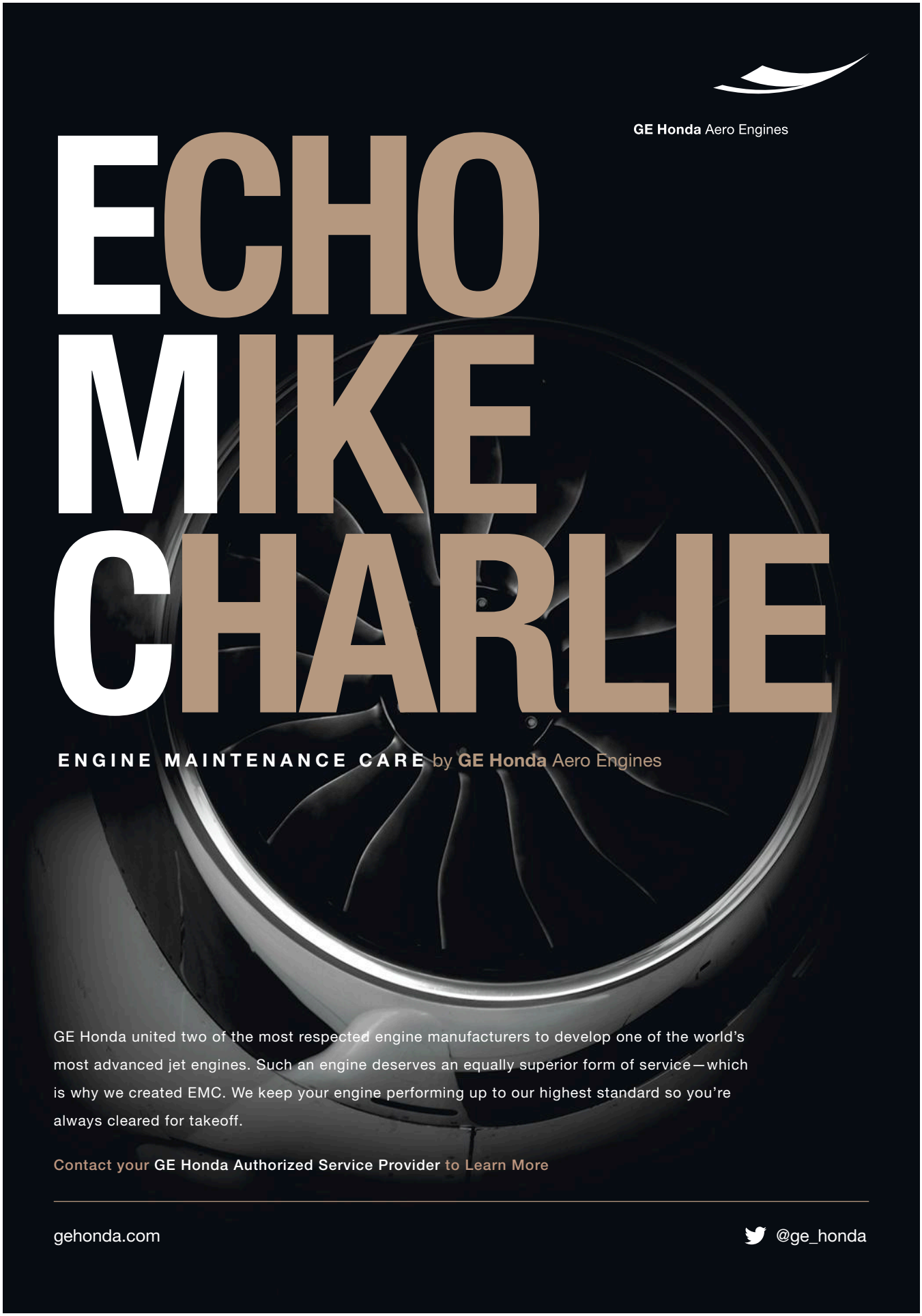
Business & Commercial Aviation

2019
Operations Planning Guide

A tool for planning flight department budgets for the coming year

ALSO IN THIS ISSUE

AVIATION WEEK NETWORK


GE Honda Aero Engines
ECHO
MIKE
CHARLIE
ENGINE MAINTENANCE CARE by GE Honda Aero Engines
GE Honda united two of the most respected engine manufacturers to develop one of the world's most advanced jet engines. Such an engine deserves an equally superior form of service—which is why we created EMC. We keep your engine performing up to our highest standard so you're always cleared for takeoff.
Contact your GE Honda Authorized Service Provider to Learn More
gehonda.com
@ge_honda

BCA
Business & Commercial Aviation

CONTENTS AUGUST 2019

2019 Operations Planning Guide

DIGITAL EXTRAS

Tap this icon in articles in the digital edition of BCA for exclusive features. If you have not signed up to receive your digital subscription, go to aviationweek.com/bcacustomers

For the latest developments, go to www.bcadigital.com

Selected articles from BCA and The Weekly of Business Aviation, as well as breaking news stories and daily news updates

COVER
Istock/Jet Liner Images

Features

9 Intelligence

Edited by William Garvey, Jessica A. Salerno and Molly McMillin

Gulfstream G600 Receives Type and Production Certificates From the FAA

Piaggio Aerospace Gets an Infusion of Money From Italian Government

ADS-B-Equipped Airplanes Are at 73% of the Fleet as of May

FAA Issues Waivers for Parachute-Equipped Drones

Honda Aircraft Delivered Two Elites to Hawaii Operator

Fast Five with Shelly Simi, President and CEO, National Association of State Aviation Officials

Departments

65 MARKETPLACE

Keep up with all the news and blogsfrom BCA editors "like" us on facebook facebook.com/avweekbca *and follow us on twitter* twitter.com/avweekbca

BCA
Business & Commercial Aviation

Editor-in-Chief	**William Garvey** — william.garvey@informa.com
Executive Editor	**Jessica A. Salerno** — jessica.salerno@informa.com
Senior Editor/Chief Pilot	**Fred George** — fred.george@informa.com
Safety Editor	**Richard N. Aarons** — bcasafety@gmail.com
International Operations/ Features Editor	**David Esler** — david.esler@comcast.net
News Editor	**Molly McMillin** — molly.mcmillin@informa.com
Art Direction	**Lisa Caputo** — lcaputo@aviationweek.com
Art Department	**Colin Throm** — colin.throm@aviationweek.com
Associate Producer	**Theresa Petruso** — theresa.petruso@aviationweek.com
Copy Editor	**Scot Greenan** — smpg124@att.net
Contributors	**James Albright**— james@code7700.com **Mal Gormley** — malgormley@gmail.com **Kent S. Jackson** — kjackson@jetlaw.com **Ross Detwiler** — rossdetwiler.com **Patrick Veillette, Ph.D.** — jumprsaway@aol.com **Ringston Media** — info@ringstonmedia.com
Editorial Offices	520 Folly Rd., Ste. 238, Charleston, S.C. (520) 638-8721 · (843) 718-2458

Publisher	**Frank Craven** — frank.craven@informa.com Phone: (913) 967-1729
Managing Director, Business Aviation Intelligence/ Data Services	**Anne McMahon** — anne.mcmahon@aviationweek.com Phone: (646) 291-6353
Director of Sales, Business Aviation	**Elizabeth Zlitni** — elizabeth.zlitni@informa.com Phone: (913) 967-1348
Advertising Production Coordinator	**Kara Walby** — kara.walby@informa.com Informa, 9800 Metcalf Ave., Overland Park, KS 66212 Phone: (913) 967-7476 · Fax: (913) 514-7303
SeniorAudience Development Manager	**Tyler Motsinger** — tyler.motsinger@informa.com Phone: (913) 967-1623
Head of Business Aviation Fleet Data	**Nigel Prevett** — nigel.prevett@aviationweek.com Phone: 407-314 7403
Head of Valuations, Business Aviation	**Chris Reynolds** — chris.reynolds@informa.com Phone: (913) 967-1956
Subscription Information	**BCA Customer Service:** (800) 525-5003; +1 (847) 9147 Email: bca@omeda.com **Manage Your Subscription:** aviationweek.com/bcasubscribers
Reprints	**Wright's Media** **Nick Iademarco** — informa@wrightsmedia.com Phone: (877) 652-5295 · Fax: (281) 419-5712

President, Aviation Week Network	**Gregory Hamilton**—hamilton@aviationweek.com
Managing Director—Civil Aviation	**Iain Blackhall** — iain.blackhall@aviationweek.com
Administrative Offices	605 3rd Ave., New York, N.Y. 10158

By Informa Markets

BCA - Business & Commercial Aviation (ISSN 0191-4642) is published monthly by Informa Markets, a trading division of Informa PLC, 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)

AMSTAT

A CAMP Systems Company

For Salesforce®

View AMSTAT Contacts & Fleet data from within Salesforce®

Link your Accounts, Contacts & Leads to live AMSTAT data

Add AMSTAT data directly into your Salesforce® solution.

Receive alerts of changes to linked data.

www.amstatcorp.com

Information That Moves You Forward

For additional information, please contact:
Chris Skurat at 732-530-6400 ext. 145 or chris@amstatcorp.com

BCA

Advertising Sales

Publisher

Frank Craven – frank.craven@informa.com
(202) 517-1061

Director of Sales

Elizabeth Zlitni – elizabeth.zlitni@informa.com
(913) 967-1348

North America Advertising Sales

Pacific Region

Miguel Ornelas – miguel.ornelas@aviationweek.com
(661) 480-7000

Midwest Region

Rob Howlett – rob.howlett@aviationweek.com
(949) 481-4519

Jodi Espinoza – jespinoza@acukwik.com
(913) 967-1651

Eastern Region

Cheryl Mahon — cheryl.mahon@aviationweek.com
(949) 481-4519

Florida, Georgia, South Carolina

Beth Eddy – betheddy@aviationexhibits.com
(561) 279-4646

Canada

David Seaberg – david.seaberg@vicbrownmedia.com
(416) 787-0914

Strategic Account Managers

Tom Davis – tom.davis@aviationweek.com
(469) 854-6717

Matt Holdreith – matt.holdreith@informa.com
(646) 719-0767

FBO Advertising Sales

Jodi Espinoza – jespinoza@acukwik.com
(913) 967-1651

Sara Hellon – sara.hellon@informa.com
(913) 967-1833

Jennifer Shafer-Doyle – jennifer.shafer@informa.com
(913) 967-1833

Worldwide Advertising Sales

Francine Brasseur – francine.brasseur@informa.com
+(617) 649-0411

Michele Markarian – michele.markarian@informa.com
(617) 649-0420

Europe

Robert Springthorpe – robert.springthorpe@aviationweek.co.uk
+44 (0) 207 017 7627

Andrea Prudente – andrea.prudente@aviationweek.com
+44 207 152 4524

Israel

Tamir Eshel – invision@netvision.net.il
+972 (9) 891-1792


You may not know their names.
But if you've flown in the last
hundred years, you know their work.
We're proud of the 50,000
dedicated employees of GE Aviation.
They've transformed the world
by transforming flight.
CHRISTINA AKERS
Test Technician, Passport™ Turbofan
GE Aviation
CELEBRATING 100 YEARS OF LIFTING PEOPLE UP
AND BRINGING THEM HOME SAFELY.

William Garvey
Editor-in-Chief
william.garvey@informa.com

And the Award Goes to . . .

A **result**, not the **purpose**

NO. 6 RUE GALILÉE IS A PLEASANT, 10-MIN. STROLL SOUTH from the Arc de Triomphe along the Avenue Kléber. The elegant edifice there is home to the 121-year-old Aéro-Club de France and on the eve of this year's Paris Air Show it was alive with conversation, laughter, clinking glasses and anticipation.

You see, the club serves as the biennial venue for the Aerospace Media Dinner that is convened to celebrate the previous 12 months' best from the industry's print and electronic media. This year's gathering took place on June 16, and it proved to be a satisfying night for the Aviation Week Network (AWN), of which *BCA* is a member.

First, *Inside MRO,* a sister publication focused on aircraft maintenance matters, took the prize for "Electric Propulsion Primer," an article examining the evolution of aeronautical electric power and which the judges deemed the year's Best Propulsion submission.

The Best International Publication honor was awarded to *Aviation Week & Space Technology,* our senior sibling, and quite rightly long one of the most respected news and technical aerospace journals extant.

And when the category of Best Business Aviation submission was projected on the screen, the selection announced from the many submitted was "Seeing Red Over 'Gray,'" published in the January 2019 issue of *Business & Commercial Aviation.*

AEROSPACE MEDIA DINNER

David Esler with Heidi Fedak, manager of corporate communications at Gulfstream Aerospace, which sponsored the award.

All of us AWN members involved in that surprising hat trick were delighted, appreciative and humbled, of course, and the three trophies were proudly displayed in the Aviation Week chalet throughout the show days that followed.

But *BCA*'s particular thanks go to the person who laboriously researched and wrote the illuminating feature on illegal charters and the dangers and abuses they represent — International Operations/Features Editor David Esler.

A former U.S. Army officer and a Commercial pilot with Instrument and Multiengine Ratings, over the years David initially instructed budding aviation students and thereafter traveled throughout the world thoughtfully reporting on business and general aviation activities, its participants, their technology and the things that concerned them. In the doing, he has been accorded numerous acknowledgements for his work, the Paris honors in June simply being the most recent.

That his subject was both relevant and weighty was underscored in recent comments to *BCA* by Gary Dempsey, president of the National Air Transportation Association. He said illegal, aka "gray," charters are "the hottest topic at every one of our gatherings. It's ongoing and widespread." And those who unwittingly or knowingly pursue them, "We regard . . . as careless, clueless or criminal."

This latest recognition of a *BCA* editor sparked my curiosity about our honors history. I carefully studied the list and discovered that of the 53 awards *BCA* editors and contributors received for editorial excellence in the past 20 years, David's work accounted for a full dozen of them. Mind you, he's not alone among *BCA* team members in earning multiple accolades. For example, Fred George, Pat Veillette and yours truly have been honored nine, four and five times, respectively, during that period.

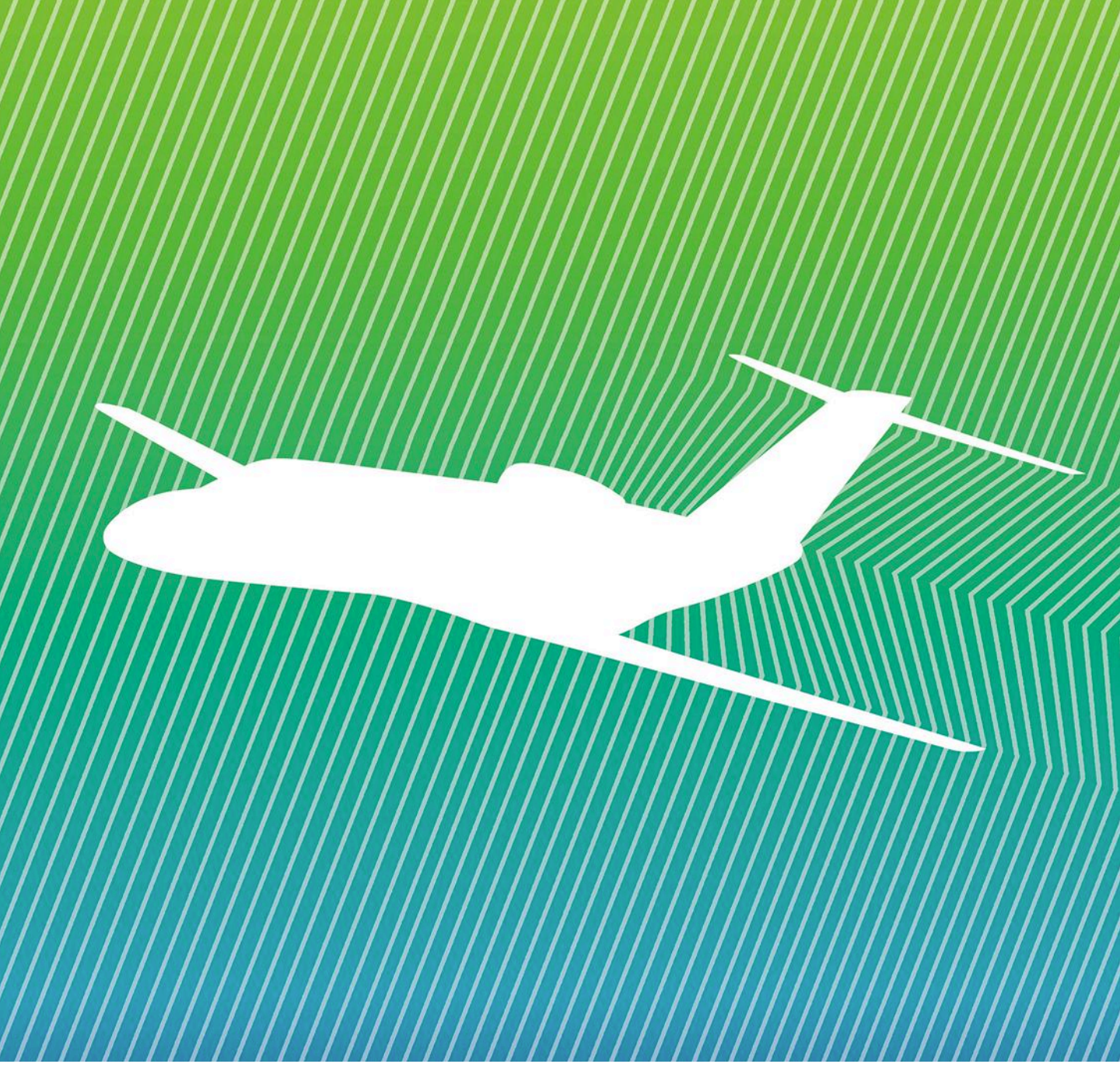
But more significantly, 20 different *BCA* editorial team members have received outside recognition for their good work during the past score of years and there were many other former — and some still current — colleagues honored prior to that. After all, *BCA* editors have been on this editorial crusade to help ensure operational safety, efficiency and service delivery for 60+ years; it was our predecessors who set the standard — a high bar we're always striving to clear.

And in addition to undertaking their regular research and writing assignments, *BCA*'s editorial team members regularly lead and participate in industry panels, make safety presentations, serve on committees, teach aviation in college, create videos and podcasts, feed websites and serve as professional pilots, instructors and trained investigators. Those efforts help keep us current on industry issues, trends and vulnerabilities, and help enrich our editorial delivery.

The point of all that is not to boast — the applause quiets and glory fades pretty quickly — but rather to assure you, our readers, that we're on the job, take our responsibility to you with utmost seriousness, and strive to deliver the highest quality and useful information month after month, year after year. We take nothing for granted and do nothing by rote. We know we need to earn your trust with every issue.

To those in judgment who bestow these media honors, know that your actions help stimulate the best in aviation and space journalism. And to all honorees within our walls and without, hearty congratulations. You've earned it. Take a bow.

Now, *merci beaucoup et adieu* to the City of Lights. It's time to get back to work. **BCA**



NBAA|BACE®

OCTOBER 22–24, 2019 • LAS VEGAS, NV

Join over 23,000 industry professionals for the most important three days of business aviation, with 1,000 exhibitors, 2 static displays of aircraft – one inside the exhibit hall and the other outside at Henderson Executive Airport, and more than 50 education opportunities. Save the date and visit the NBAA-BACE website to learn more.

www.nbaa.org/2019

INTELLIGENCE

EDITED BY **WILLIAM GARVEY, JESSICA A. SALERNO AND MOLLY MCMILLIN**
william.garvey@informa.com
jessica.salerno@informa.com
molly.mcmillin@informa.com

NEWS / ANALYSIS / TRENDS / ISSUES

IN LATE JUNE, GULFSTREAM'S G600 RECEIVED ITS type and production certificates from the FAA, clearing the way for first deliveries to begin this year. "Getting both authorizations on the same day is evidence of the maturity of our G600 production processes and speaks to the safety and reliability of the aircraft's design," said Gulfstream President Mark Burns, who went on to note that the FAA award came less than a year after similar dual certifications were bestowed simultaneously upon the all-new G500. The G600 performance specifications include a 6,500-nm range at Mach 0.85 cruise, or 5,500 nm at Mach 0.90. The new model features a Symmetry Flight Deck, including active control sidesticks ad 10 touch screens. The aircraft can be configured with three living areas in the passenger cabin, plus a crew rest area forward.

AS OF MAY, THE NUMBER OF TURBINE-POWERED U.S. BUSINESS aircraft equipped with ADS-B rose to 73% of the fleet, or 13,174 aircraft, according to a report by FlightAware. Another 4,784 of the 17,958 aircraft in the fleet had not been equipped to meet the FAA's Jan. 1, 2020, ADS-B mandate. Those figures represented a nearly 50% rise from a year earlier when only 51% of the registered U.S. fleet had been equipped. Aircraft with the highest equipage rates include the Cirrus Vision SF50 with 99% compliance, Honda Aircraft's HA-420 HondaJet at 95%, the Dassault Falcon 7X at 94%, Embraer Legacy 600/650 at 91% and Gulfstream's G650 at 90%. Aircraft with the lowest equipage rates include the Gulfstream III with 39%, Learjet 55 at 43%, Cessna Citation III at 49%, Piaggio P180 Avanti at 49% and the Learjet 31 at 50%.

IT LOOKS LIKE THE ITALIAN GOVERNMENT HOPES A MONEY transfusion from its federal coffers will help bring ailing Piaggio Aerospace back to financial health, or at least extend its life until someone comes along with a permanent remedy. To that end, the government recently committed to place $795.3 million (€700 million) of orders with the airframer, which hopes to resume operations, having entered extraordinary receivership at the end of last year. The upcoming contracts, announced by the company on June 21, include maintenance for military engines worth around $227 million (€200 million), the production of nine new Avanti Evo turboprops and the upgrade of 19 other aircraft for the Italian armed forces and other national agencies worth $295 million (€260 million), and approvals to complete the development and produce at least one P.1HH Hammerhead medium-altitude, long-endurance unmanned air system (UAS), valued at $180 million (€160 million). After the United Arab Emirates government canceled its order for Hammerhead UAVs and investor Mubadala withdrew its support last November, Piaggio crashed into receivership. Rome believes the company could play a critical role in Italy's future involvement in a pan-European long endurance UAS, currently under development.

Jet-A and Avgas Per-Gallon Fuel Prices

July 2019

Jet-A

Region	High	Low	Average
Eastern	$8.77	$4.50	$6.23
New England	$7.78	$3.88	$5.20
Great Lakes	$8.15	$3.24	$5.52
Central	$7.53	$3.37	$4.96
Southern	$8.24	$4.35	$6.01
Southwest	$6.90	$3.20	$5.25
NW Mountain	$7.93	$3.55	$5.32
Western Pacific	$8.65	$3.75	$5.90
Nationwide	**$7.99**	**$3.73**	**$5.55**

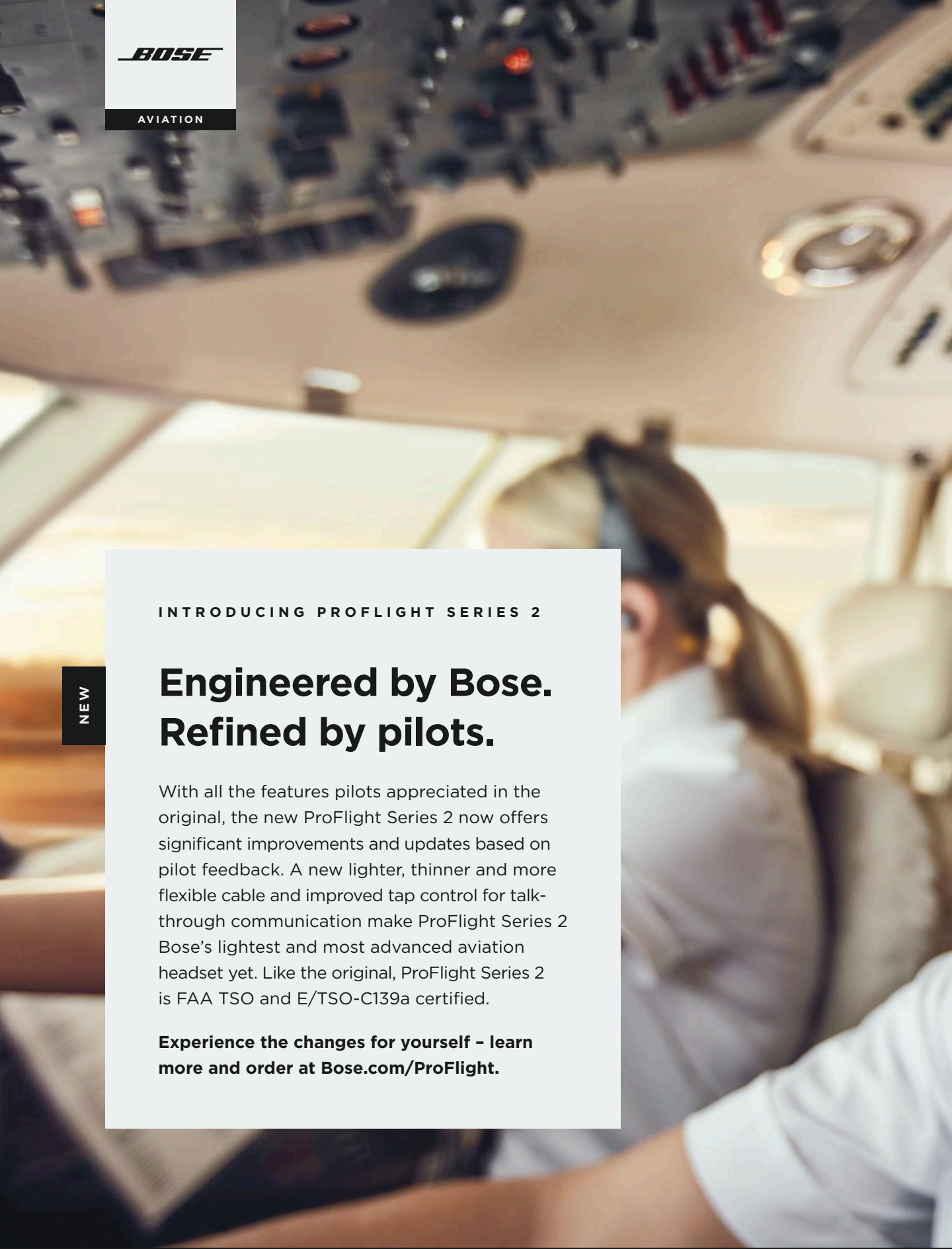
Avgas

Region	High	Low	Average
Eastern	$8.45	$5.00	$6.56
New England	$7.45	$5.00	$5.94
Great Lakes	$8.59	$4.59	$6.07
Central	$7.59	$4.51	$5.51
Southern	$8.50	$4.30	$6.29
Southwest	$7.19	$4.10	$5.65
NW Mountain	$8.46	$4.65	$5.79
Western Pacific	$8.52	$4.99	$6.33
Nationwide	**$8.09**	**$4.64**	**$6.02**

The tables above show results of a fuel price survey of U.S. fuel suppliers performed in July 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 operational information, go to **www.bcadigital.com**



INTRODUCING PROFLIGHT SERIES 2

NEW

Engineered by Bose. Refined by pilots.

With all the features pilots appreciated in the original, the new ProFlight Series 2 now offers significant improvements and updates based on pilot feedback. A new lighter, thinner and more flexible cable and improved tap control for talk-through communication make ProFlight Series 2 Bose's lightest and most advanced aviation headset yet. Like the original, ProFlight Series 2 is FAA TSO and E/TSO-C139a certified.

Experience the changes for yourself – learn more and order at Bose.com/ProFlight.

Connect with us @BoseAviation

Viking Air Sells Six CL-515 Water Bombers to Indonesia

In June, Canada's Viking Air Ltd., a subsidiary of Longview Aviation Capital, announced the sale of six new CL-515 water bombers along with a CL-415 upgraded from a piston-powered CL-215 to Indonesia's Ministry of Defense. Longview acquired the amphibious aircraft program from Bombardier in 2016. At the time of the announcement, the company's board of directors had yet to approve production launch. In addition, Longview has acquired rights to the entire line of de Havilland Aircraft from Bombardier.

Textron Delivers 300th Citation CJ4

Textron Aviation delivered its 300th Cessna Citation CJ4 in June to McNeilus Steel, based in Dodge Center, Minnesota. McNeilus Steel, a family owned metals distribution business, employs more than 450 people across locations in Minnesota, North Dakota and Wisconsin. McNeilus is upgrading to full ownership of a CJ4, from fractional ownership of a Citation CJ1+ since 2016. Introduced in 2010, the CJ4 boasts an IFR range of 1,926 nm with a maximum cruise speed of 451 kt.

HONDA AIRCRAFT DELIVERED THE FIRST TWO HONDAJET ELITES to Hawaii on June 27. The airframer said it was the first light jet to enter service in the Aloha State. Wing Spirit, a new commercial outfit, will operate the pair on inter-island charters. It is also considering using HondaJets as air ambulances and for aviation education opportunities throughout the state's islands. **The air ambulances would be outfitted with custom medevac configurations, marking the first time this design has been implemented in the program's history.** "When creating the HondaJet, my goal was to design a technologically advanced aircraft that would improve the lives of customers around the world," said Honda Aircraft Co. President and CEO Michimasa Fujino. "Wing Spirit using HondaJets for lifesaving transportation and as a method of convenient transit between islands is true recognition that the aircraft is achieving that goal." Honda says it has delivered more than 125 HondaJets to date.

ELECTRIC MOTOR DEVELOPER MAGNIX HAS TEAMED UP with certification specialist AeroTEC to convert the Cessna 208B Caravan to electric propulsion. Flight testing of the popular, unpressurized single-engine utility aircraft, its Pratt & Whitney Canada PT6 turboprop swapped out for a 750-hp Magni500 electric motor, is to begin by year's end. MagniX has already announced agreements with Canada's Harbour Air to convert the de Havilland Canada DHC-2 Beaver seaplane to battery-electric propulsion, and with Israeli startup Eviation to power its Alice nine-seat electric regional aircraft. These programs are also planned to begin flight tests this year. **The Caravan is a key target for companies developing electric propulsion, as the nine-seat aircraft is widely used by smaller operators, with more than 3,000 in use worldwide.** "AeroTEC is responsible for the Magni500-powered 208B's modification design, integration and flight test," says Lee Human, president and founder of the Seattle-based engineering company. He said the goal is to take the conversion through FAA certification and make electric aircraft widely available. Aircraft modifications are underway at the AeroTEC Flight Test Center in Moses Lake, Washington. MagniX previously said the aircraft will only have a range of about 100 nm on current battery technology, but pointed out that many Caravans operate only over short ranges carrying packages or people. A startup fully funded by a single investor, MagniX is targeting what it calls "middle mile" transportation — the conveyance of passengers and cargo over distances up to 1,000 mi.

TURKISH AEROSPACE (TUSAS) CARRIED OUT THE FIRST FLIGHT of the first complete prototype of its T625 Gokbey utility helicopter on June 29. Prototype P1 took to the air for 45 min. at the company's Akinci airbase facility outside Ankara. Powered by a pair of Rolls-Royce/Honeywell LHTEC T800 engines, the 6-metric-ton T625 has been designed as a dual role platform primarily to serve as a replacement for the numerous Bell UH-1 Huey helicopters still serving with the Turkish Army and air force. As many as 100-150 aircraft are envisaged for this role alone. TUSAS also sees interest from the Turkish Police and Coast Guard. The Turkish government is also mulling the use of the aircraft as an air ambulance to support the country's health services. The second and third prototypes are to follow soon and will support commercial certification activity. TUSAS wants to certify the helicopter to European Aviation Safety Agency specifications. Internationally, the type will face stiff competition from incumbent platforms, such as Leonardo's AW139 and Bell's Model 412, but the company has high hopes of being able to offer it overseas. It plans to begin production of the T625 by the end of 2021.

CAN
CORPORATE ANGEL NETWORK
CORPORATE ANGEL AWARD
Pfizer

THANK YOU, PFIZER, FOR GIVING CANCER PATIENTS A LIFT

Closing The Gap To Treatment By Flying Patients Closer To Their Cure.

Congratulations to Pfizer and its flight department, the latest recipient of the Corporate Angel Award presented by Corporate Angel Network (CAN), Phillips 66® Aviation, Safe Flight Instrument Corporation and *Business & Commercial Aviation Magazine*.

Pfizer, like more than 500 other major corporations, is a participant in CAN, a national public charity that arranges free passage for cancer patients using empty seats on corporate jets. Since joining CAN in 2009, Pfizer has transported men, women and children to recognized cancer treatment centers across the country.

Corporate Angel Network, Phillips 66 Aviation, Safe Flight Instrument Corporation and *Business & Commercial Aviation* are proud to honor Pfizer for giving cancer patients a lift in both body and spirit

BECOME A CORPORATE ANGEL: CALL US AT 866-328-1313 OR GO TO CORPANGELNETWORK.ORG.

BCA

SAFE FLIGHT
INSTRUMENT CORPORATION

PHILLIPS 66

U.S. Air Force May Purchase Five Global 6000s

The U.S. Air Force wants to purchase up to five new Bombardier Global 6000s, designated as E-11s, with deliveries of one per year, according to a Sources Sought Synopsis document requesting information. The aircraft would be equipped with the Battlefield Airborne Communications Node to increase communication coverage for deployed ground troops. Funds for the aircraft are not yet available.

Garmin Co-Founder Gary Burrell: 1937-2019

Gary Burrell, co-founder of Garmin International and maker of global positioning systems, died June 12 at the age of 81. He had retired from

his Olathe, Kansas, electronics firm in 2002 but served as Garmin co-chairman until 2004. In 1989, Burrell and co-founder Min Kao launched the company — which combined their given names — with the goal of creating products powered by then-emerging global positioning system, or GPS, technology. Garmin grew from an office with two folding chairs and a card table to more than 13,000 employees in 60 offices around the world, including about 4,000 in the Kansas City area.

GAME COMPOSITES, FOUNDED BY WALMART HEIR Steuart Walton, has received FAA type and production certificates for its GB1 Gamebird, a two-place composite aerobatic and training aircraft. The Bentonville, Arkansas manufacturer reported orders on hand for 19 of the clean-sheet aircraft and initially plans to produce about one per month but production could double by year's end. Walton is a Georgetown-educated attorney, a pilot like his grandfather and Walmart founder Sam Walton, and is on the Walmart board of directors. Game Composites is headed by Philipp Steinbach, a partner in the enterprise, CEO and chief designer. "From our humble beginnings in a rented shack in Europe six years ago, I am proud of what we have achieved as a team and the appreciation we receive from our customers, as well as the regulators involved in this program," Steinbach said. The $400,000 aircraft is produced at Bentonville Municipal Airport/Louise Thaden Field (KVBT), a focal point for general aviation activity in Arkansas. The company said the GB1 has a roll rate of 400 deg./sec., a maximum load factor of +/- 10 G, a 200+ kt. cruise speed and 1,000+ nm range. According to Game Composites, a flight from Phoenix to Bentonville took slightly more than 5 hr. and several flights from Bentonville to Denver took less than 3 hr.

WITH THE AEROSPACE INDUSTRY ACCELERATING TOWARD an electric future, Rolls-Royce recently announced its plan to acquire Siemen's electric and hybrid electric aerospace propulsion unit. Based in Germany and Hungary, Siemens' eAircraft business has been crafting all-electric and hybrid electric propulsion systems for aircraft. Under the acquisition, the company's 180-member electric propulsion design team will be integrated into Rolls-Royce's recently formed electrification unit. Rolls-Royce, which only released details of its electric propulsion plans earlier this year, views the acquisition as a chance to quickly augment its own developments in the sector, and penetrate new markets ranging from electric vertical takeoff and landing vehicles to regional airliners and beyond.

H55, A TECHNOLOGY SPINOFF FROM THE SOLAR IMPULSE round-the-world solar-powered aircraft team, has flown a two-seat electric aircraft aimed at the pilot training market. The Bristell Energic, manufactured by BRM Aero, made its first flight on June 21 from Sion, Switzerland. For H55, which was founded by senior members of the Solar Impulse team including its CEO and pilot Andre Borschberg, flying the Energic is a step toward the development of certified propulsion systems for electric vertical-takeoff-and-landing (eVTOL) aircraft and air taxis. The Energic is based on an ultralight aircraft designed by Milan Bristell, founder and CEO of BRM Aero, which is based in the Czech Republic. The developer says the battery-powered Energic has an endurance of 1.5 hr., plus reserves, in a typical training program. **"The emergence of civil aviation in large markets such as China and India requires pilot training with a real flight trainer with a maximum takeoff weight equal to or above 750 kg [1,650 lb.]," said Bristell.** "The market is impatient for an electric airplane and our goal at Bristell is to be able to respond to this with a flight trainer that is clean, quiet and affordable to operate." H55 was founded to develop complete electric propulsion systems, from energy storage to pilot controls, for aircraft to be certified under European CS-23 regulations. The company has funding from the Swiss federal government, the canton of Valais' Ark foundation for innovation and NanoDimension, a venture capital fund based in Switzerland and Silicon Valley.

FlightSafety is Here For YOU

Your Success

Relax. Our instructors work to ensure YOU have an exceptional training experience with a positive outcome.

Your Proficiency

Be the very best. We are committed to helping YOU achieve and maintain the highest level of skills and safety.

Your Satisfaction

Count on us. We all have the same goal: providing YOU with the highest-quality training and outstanding service.

BUILT OVER TIME
TRUST
EARNED EVERY DAY

Train with FlightSafety and benefit from our unequaled experience, team of master instructors and safety-focused programs using state-of-the-art simulation technology. Trust that we'll always go above and beyond for you and your flight department and deliver the value you deserve and expect. It's all about you.

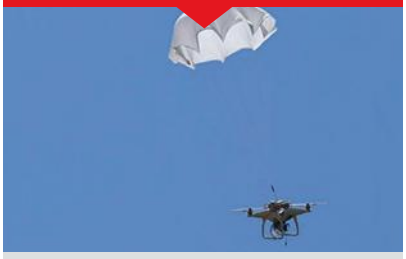
FlightSafety international

flightsafety.com • 314.785.7815

Bombardier Delivers 300th Challenger 350

Bombardier Aerospace has delivered its 300th Challenger 350 super-midsize business jet, the company said. The delivery comes five years after its entry-into-service. The company did not disclose the customer. Bombardier delivered 60 Challenger 350 aircraft in 2018 and nine in the first quarter of 2019. The aircraft has captured 58% of the super-midsize segment, the company said.

FAA Issues Waivers for Parachute-Equipped Drones



The FAA recently issued multiple waivers allowing operators to fly parachute-equipped drones over people — flights normally prohibited because of the risk of injuring bystanders. All the waivers involved DJI aircraft fitted with the ParaZero SafeAir parachute system. It uses independent sensors to monitor the drone's key flight parameters and detect anomalies to the flight profile. When it detects a critical failure, it cuts power to stop its rotors, activates the parachute and triggers an audio warning system to alert anyone below.

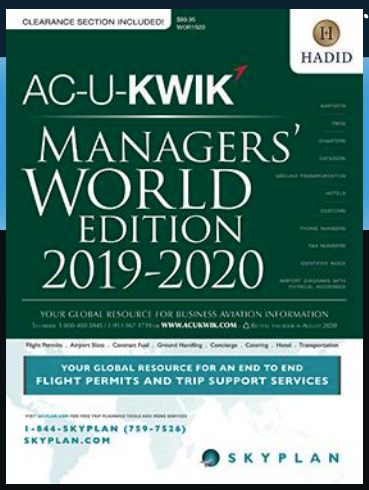
DUNCAN AVIATION HAS ANNOUNCED THAT ITS MAINTENANCE, repair and overhaul (MRO) facility in Provo, Utah, has received Stage I accreditation from the International Standard for Business Aircraft Handling (IS-BAH). The Provo facility is only the second MRO in the U.S. to have earned this accreditation; the first was the full-service Duncan Aviation facility in Lincoln, Nebraska. **"Duncan Aviation in Provo is one of the very few large MROs to achieve IS-BAH accreditation. It's challenging to achieve this level of quality for an FBO that is only a few months old,"** says Provo FBO Manager Bob Cornett. "We have a tremendous group here that has faced hurdles every day since we opened in January. In spite of the many challenges, the team stepped up and agreed that it was tremendously important to take on the extra work necessary to secure this accreditation." IS-BAH, developed by the International Business Aviation Council (IBAC) and the National Air Transportation Association (NATA), is a set of global industry best practices for business aviation ground handlers that features a safety management system (SMS) as its core. This international accreditation certifies that the Duncan Aviation Safety Management System followed by the facility in Provo has been recognized and certified as meeting all international standards to promote and provide safe environments for customers and workers.

THE NATIONAL AIR TRANSPORTATION ASSOCIATION (NATA) and the University of Maryland have signed a research **agreement to review the causes, hazards and costs of accidental discharges of foam fire suppression systems in aircraft hangars.** The project will also address high-expansion and low-expansion foam systems, in addition to determining the rationale for the requirement of foam systems included in the National Fire Protection Association (NFPA) 409 for aircraft hangars. "There is significant uncertainty surrounding the benefits versus potential hazards related to hangar foam fire suppression systems," NATA President and CEO Gary Dempsey stated. "NATA members have repeatedly voiced concern that the cost of installing these foam systems dramatically increases the expense of new hangars, while providing limited risk mitigation due to the low incidence of hangar fires." Feedback from the industry indicates the risk of accidental discharge of these systems is high and such discharges include significant costs related to clean-up, aircraft damage and possible environmental damage. NATA's proposal and industry comments are due Nov. 14.

AMPAIRE, A STARTUP HYBRID-ELECTRIC AIRCRAFT DEVELOPER, recently announced a 50-aircraft launch order plus 50 options from Personal Airline Exchange (PAX), another U.S. startup that plans to offer per-seat, on-demand charter service. The aircraft involved is Ampaire's 337 Electric EEL, a six-seat Cessna 337 Skymaster converted to hybrid-electric propulsion. The testbed EEL made its first flight on May 23 and Ampaire is aiming for supplemental type certification of the conversion in 2021. The Skymaster has a push-pull engine configuration and the Ampaire mod replaces the rear piston engine with an electric motor, to be powered by batteries in an under-fuselage pannier. The resulting EEL is to have a useful range of 200 mi., and Ampaire is anticipating fuel savings of more than 50% from parallel-hybrid propulsion, according to CEO Kevin Noertker.

AC-U-KWIK

Your Global Resource for Vital Business Aviation Information



2019-2020 Managers' World Edition
NOW AVAILABLE to order!

Plan. Schedule. Dispatch.

Order yours at Acukwik.com/products

AVIATION WEEK NETWORK

Conveniently access business aviation's most accurate and reliable data in one source

INTERVIEW BY **WILLIAM GARVEY**

Shelly Simi

President and CEO, National Association of State Aviation Officials, Washington, D.C.

Appointed to her current position at NASAO in January 2019, Simi's fascination with aviation began in childhood watching crop dusters flying low over the cotton fields of her native Mississippi. She was also keen on the steady stream of FedEx "purple planes" descending into Memphis International 65 mi. north. Moved by her interest, her dad arranged a local plane ride in a Cessna 182 which "gave me a view of the world I'd never seen before." By the time she landed, she was hooked. She later entered the Commercial Aviation Bachelor's program at Delta State University in Cleveland, Mississippi, where she began her flight training. Upon graduating, she worked fulltime as a flight ops/fuel coordinator at the same place she had interned: FedEx. Hoping to expand into public relations, she got hired by the General Aviation Manufacturers Association in D.C., where she honed her communications skills for 15 years. She went on to similar roles at Adam Aircraft, Jeppesen and Aurora Flight Sciences until being approached by NASAO. She is a founding board member of Women in Aviation, International; was president of the Aero Club of Washington; and past trustee of the University Aviation Association.

Questions for Shelly Simi

1 **What exactly is NASAO's role?**

Simi: NASAO serves as the voice of the states. Our State Directors are focused on all things that effect flying in and out of their airports, and we partner with the FAA to identify those aviation needs and prioritizing investments. NASAO is the only aviation organization that holds the full public interest. Others represent unions, pilots, business aviation and such; we represent all aspects. The majority of our focus is on business and general aviation airports to help assure access for aircraft operators, maintain runways of all sizes and deliver a safe and efficient air transportation system, among other things.

2 **What are the association's concerns?**

Simi: Of course, continued long-term funding! Also, a top area we're turning our attention to is the pilot shortage and decline in maintenance technicians. We need to look at ways to get more people into the pipeline so aviation workforce development is critical. We support programs that connect government officials, educators and employers to meet the specific demands of a given area. These need to be affordable, accessible and aligned with the technologies that will drive interest plus be a motivational tool. While we're excited and support the rapid growth of commercial and recreational UAS use, safety is the top concern regarding the integration of drones into the NAS. NASAO has an active voice on the Drone Advisory Committee and our states are working with regulatory authorities and the FAA on drone operations, at least at low altitudes. This could include different regulations in different states, but we all have the same goal of achieving the full potential of UAS. If we work together to implement the technology that will ultimately save time and increase access, then it's a win-win.

3 **Infrastructure has been getting a lot of attention in Washington. Are airports beneficiaries?**

Simi: We were very pleased that Congress passed a long-term FAA bill with $1 billion per year allocated for airport infrastructure projects. This funding can bring much needed improvements which can help create an economic revival for GA. Federal funding of the Airport Improvement Program (AIP) has remained static at $3.35 billion for many years. With construction and material costs continuing to increase, that amount has not been adequate, so we're working hard to promote further airport infrastructure investment and funding certainty so AIP funding can be raised to $4 billion per year.

4 **Would raising the Passenger Facility Charge (PFC) help general aviation airports?**

Simi: Yes, and here's why. AIP funding alone is not always sufficient to meet the financial needs of the small and rural airports. Only 20% of those funds are allocated to GA airports. PFCs provide a state and local funding source that can be directly allocated to projects that improve air safety, increase competition, and/or reduce congestion or noise impacts on communities. All great things and projects which could not be fully funded using the airport's AIP formula funds or AIP discretionary grants alone.

5 **You've had a really successful career in aviation. How do we get more women interested?**

Simi: Women in Aviation, International started as an idea 30 years ago and now has over 14,000 members – 4,000 attend our annual convention. We feel we'd had an impact. And the key to its success is mentoring, providing a welcoming and stable foundation for women in or interested in aviation. It's a kind of fraternity, or better yet, sorority that comes together to promote what we all love. That first plane ride of mine was piloted by a woman; I was surprised and delighted. Seeing her in that role changed the course of my life and that's what we hope to do. **BCA**

OPEN UP THE BOARDROOM

Work efficiently without limits.

Connect in real time with the secure,

high-performance, low-latency network.

The Most Compelling User Experience ▪ smartskynetworks.com/ATG ▪ 800.660.9982

SMARTSKY NETWORKS®

Taking and Keeping Control

Two incidents **in which control of the airplane** became critical

BY **ROSS DETWILER** rossdetwiler.com

ATSB (2)

VH-FVR under tow following completion of post-occurrence maintenance. The angle of the horizontal stabilizer relative to the angle of the wings indicates substantial structural deformation.

Editor's Note: This month we're adding a new player to the C&C bench, but he's no BCA rookie. A U.S. Air Force Academy graduate, Ross Detwiler distinguished himself as a fighter and instructor pilot, and following his active duty military service — he continued flying heavy transports (C-5) for the Air Guard — he spent decades helping lead major corporate flight departments involved in domestic and global operations. He's also been a BCA contributor for many years.

Maintaining effective flight control of an airborne airplane is probably the most critical consideration in aviation. Even if power is lost, potential outcomes are far more satisfactory if the pilot is able to "keep the blue side up." This month we look at two situations in which flight control of an airplane became a critical issue. The first situation involved a wrongly installed aileron control system on a fly-by-wire (FBW) regional jet. In the second, the design of a cable, push-rod and bell crank system was key.

First, the RJ

On Nov. 11, 2018, the crew of Air Astana Flight 1388, an Embraer ERJ-190LR, diverted to Beja Airport (LPBJ), Portugal, suffering control issues after departure from Lisbon's Alverca Air Base (LPAR). The aircraft had arrived at Lisbon approximately five weeks earlier for contracted maintenance. The flight in question was the first post-maintenance flight for the airplane. The crew intended to ferry the machine to the operator's home base at Almaty, Kazakhstan, with a refueling stop in Minsk, Belarus. The captain, copilot, jump seat pilot and three technicians taxied out and took off in the early afternoon.

Upper tail plane of VH-FVR showing damage to horizontal and vertical stabilizers that was evident when the damage was identified five days and 13 flights after the inflight upset/pitch disconnect and associated maintenance.

The weather in the area, although not solid IFR, consisted of towering cumulus in all quadrants. They noted immediately after departing into meteorological conditions that the aircraft was not responding to their control inputs. Attempting to maintain control, their initial inputs led to further and further divergences from their intended flight path.

The crew was unable to achieve stability in any axis and remained unable to determine the cause of their problem. They tried but could not engage the

autopilot. The more they attempted to steady the aircraft, the worse the out-of-control situation became.

They continued unsuccessfully to battle for control, but they were only able — with considerable effort — to minimize the oscillatory movements. Gaining this control resulted in high structural loads on the airplane during some of the maneuvers. Attempts to gain control in more than one axis at a time did not work.

After 6 min. of flight, the crew declared an emergency and requested a return to Alverca. All the while, they were trying to diagnose the cause of the abnormal roll of the aircraft. The airplane warning systems were not indicating any problem at all. In fact, the only warnings received were for excessive flight attitudes.

They requested a climb to FL 100, again stating they had "flight control problems."

The situation did not improve. The aircraft and, indeed, the people aboard were sustaining intense G forces and, at times, complete loss of control for moments at a time.

Considering the increasing criticality of the situation, the crew made several requests for headings that would enable them to reach the Atlantic Ocean to perform a ditching. Listening to the tapes, it is apparent that the crew was at a point of maximum stress. The flight graphs show the crew continually unable to obtain or maintain suggested headings for ditching.

The pilots sought help from all involved. The jump-seat pilot and the technicians on board were informed and enlisted in a team effort to solve the problem. The aileron control on this airplane is not what we'd call "pure" FBW, but it does have computer inputs to the system under "Normal" operation. Despite the fact that they had no warnings, they knew enough of their aircraft systems to consider going to direct laws on the flight control system. If there was trouble with the flight control computer, at least this would get that computer out of the control loop as it pertained to the ailerons.

However, the computer was not malfunctioning. Rather, it was functioning according to the way it had been programed. The problem was that it had not been programed to operate with the aileron controls hooked up incorrectly, so it was not helping. Getting it out of the control loop left only the pilot trying to make inputs to regain control.

The situation improved considerably, the crew was able to realize that the

The Lessons That Result

Aircraft accidents and incidents are useful in one, and only one, aspect. That is to help us learn. An aircraft incident that results in no loss of life is a gimme that allows the same contemplation with none of the sadness that accompanies a catastrophe. So I picked two such incidents, both raising questions about flight control systems, for my first shot at this.

Three major areas of concern come to mind reading these incidents.

Preflights, Especially When Post-maintenance Related

In the first incident, I'd have to, at least initially, give the crew a "What were you thinking?" regarding their failure to conduct a thorough flight control check after maintenance. It may turn out they were operating on a checklist that required someone else do the flight control check. That is a fact not in view here. So let's consider post-maintenance preflights.

I flew Phantom F-4 maintenance test flights both in Thailand and at McDill AFB in Tampa, Florida. Maintenance hogans are under the same kind of pressures to get equipment back to the line that pilots can experience to get a trip done. Nevertheless, before I taxied out on any post-maintenance flight, I always completed a thorough flight control preflight. As the stick was moved, each responding flight control was checked and its position hand signaled to the pilot. Same procedure for the speed brakes, flaps, leading edge devices and the bleed air boundary layer control system — all were checked and signaled operational.

This attention to detail can pay off. I remember a friend doing a maintenance test flight on an F-100 in 1968. He told us about it at the bar that night. Through hand signals to the crew chief, he signaled that he was going to move the stick to the left. He recounted "stick left, left aileron up" and with the stick still left, he swung his head over to the other side of the canopy-up cockpit . . . "right aileron . . . up."

"Time for a break here, Normy."

Maintenance has a job to do and that is "get the meter on that plane running ASAP." We have to consider that when doing post-maintenance flights. How serious is the work that's been done? Look at the second airplane in question. In that case "the work" was only an inspection after the incident and yet the way in which that maintenance was accomplished resulted in a second incident, a broken plane gone flying. The tail of that plane was on crooked! Seriously? How does maintenance miss that one on a structural overstress check? How on earth did the pilots, who have to get in it, miss that 13 times? The answer is human logic, communication, motivation and action. That's why we talk about this stuff.

Knowing How Your Flight Control System Works Is Vital

Modern, fly-by-wire flight control systems put a computer between the pilot input and the flight control surfaces. In so-called "normal laws" these systems send every stick movement through a computer. That computer analyzes a number of other inputs and then gives that pilot input "further consideration." All this is done in an instant.

Computer reasoning: "Yes, he wants a hard turn, but at this speed, umff, that's the hardest he gets," or, "He wants the nose up farther, but it's just below the stall angle of attack, so he can pull back on the stick all he wants, I'm not going to give him more pitch."

The systems also have a degraded level of performance called "direct laws." In that mode, the computer is taken out of the equation and the flight controls move in direct communication with the stick, just like a "regular" airplane. **BCA**

problem, whatever it may be, was originating in the aileron system. Reaching this conclusion, they reduced all aileron control inputs.

Having gained some control of the situation, the crew flew east, searching for better weather conditions, and became better able to fly suggested headings and altitudes, issued by ATC, to reach a VFR recovery location.

When the pilots were able to keep altitude and heading, and had sufficient visual references, the aircraft was joined by a pair of F-16 fighters from the Portuguese Air Force that were scrambled from the Monte Real Air Base. They assisted in guiding the aircraft to Beja Air Base, which had been selected in the meantime as the best emergency landing option.

After two non-stabilized approaches, the aircraft managed to land safely on Runway 19L at the third approach. The intended runway was 19R, but due to drift, they finally managed to land on the left runway.

All on board were physically and emotionally shaken, one of the passengers sustaining a leg injury. The pilot was so mentally fatigued that he had to let the first officer (F/O) make the landing on the third attempt.

Next, the Mechanically Linked

On Feb. 20, 2014, a Virgin Australia Regional Airlines (VARA), ATR 72, registered VH-FVR, departed Canberra, Australia, on a regularly scheduled flight to Sydney. During descent, with the autopilot in vertical speed mode, the F/O as pilot flying (PF) was manually adjusting engine power to maintain the airspeed around the target of 235 kt.

While passing through about 8,500 ft., the aircraft encountered a significant wind shear that resulted in a rapidly decreasing tailwind. This led to a rapid increase in airspeed, with the airspeed trend vector (displaying predicted speed on the primary flight display) likely indicating well above the turboprop's maximum operating speed (VMO) of 250 kt. The F/O reduced engine power and made nose-up control inputs in an attempt to slow the aircraft.

At the same instant, and in response to the unexpectedly high airspeed trend indication and their proximity to Vmo, the captain, who was the pilot monitoring (PM) perceived a need to take over control of the aircraft and made nose-up pitch control inputs. He was, according to company policy, supposed to make

Accidents in Brief

Compiled by Jessica A. Salerno

Selected accidents and incidents in June and July 2019. NTSB information is preliminary.

July 6— About 1330 CDT, a Grob G103 glider (N106NS) crashed during an off-field landing near Brandon, Mississippi. The pilot and sole occupant were killed and the glider was heavily damaged. The glider was registered to the Central Mississippi Soaring Society, LLC, and operated by a private individual. VFR prevailed and no flight plan was filed for the Part 91 flight. The flight originated from the Woodbridge airport (6MS1) about 1315 and was en route to the Harrell Field airport (MS08).According to the tow pilot, the purpose was to move two gliders from 6MS1 where the gliders are hangared, to MS08, where the flights are typically conducted. He towed the first glider to 2,000 ft. AGL southeast of 6MS1, where the glider released from the tow plane. The tow pilot then returned to 6MS1 for the second glider. The glider pilot previously stated to the tow pilot that he would release at 3,000 ft. AGL. The tow pilot added that the second tow was slow due to the glider's weight, high temperature, and high-density altitude at the time. About 2,100 ft. AGL, the glider released from the tow plane. The tow pilot stated that this was in same area that the first glider released. He didn't see or hear from the glider pilot again.

The pilot in the first glider reported that he heard the accident pilot on the radio, stating that, "he was getting low, and would probably have to land out."

The wreckage was located in a fenced field about two-and-half miles southeast of 6MS1, and about 6 mi. southwest of MS08.

July 5 — About 1358 CDT, a Beech A36 airplane (N1809S) was substantially damaged during a forced landing following an inflight loss of engine power near Chebanse, Illinois. The pilot sustained serious injuries, one passenger sustained minor injuries, and one passenger was killed. The airplane was registered to and operated by private individuals as a Part 91 personal flight. It was VFR and no flight plan was filed. The flight originated from Smyrna Airport (MQY), Smyrna, Tennessee, about 1135 and was destined for Bolingbrook's Clow International Airport (1C5), Bolingbrook, Illinois.

The pilot reported a loss of engine power during cruise flight about 3,000 ft. MSL. His attempts to restore engine power were not successful and he executed a forced landing to a wheat field. The airplane came to rest upright on a southeast heading. The impact/debris path was approximately 75 ft. long. Ground depressions consistent with impact from the main landing gear wheels were located about 50 ft. from the airplane. The fuselage nose structure was partially separated forward of the firewall. The engine remained attached to the nose structure and the propeller remained attached to the engine. The fuselage and both wings were damaged consistent with impact forces.

July 1 — About 2045 EDT, an experimental amateur built Rans S12 airplane (N1094K) impacted a runway on a private airstrip near Orleans, Indiana. The pilot, who was the sole occupant, was fatally injured. The airplane sustained heavy damage during the impact and subsequent ground fire. The Rans S12 was owned and operated by the pilot as a Part 91 personal flight. VFR prevailed in the area about the time of the accident, and the flight was not operated on a flight plan. The local flight originated from the Paoli Municipal Airport, near Paoli, Indiana, at an unknown time.

According to initial information given to the FAA, the pilot had performed two or Three landings before the accident flight. Popsicles were brought out to the pilot between flights. A camera was located near the airstrip. Review of a video

an announcement that he had assumed control. This procedure was not immediately accomplished. Therefore, the F/O was unaware that the captain was taking control. The captain's input resulted in a pitching maneuver that exceeded the design load factor of the regional airplane.

Additionally, about 1 sec. after the captain initiated the nose-up inputs, the F/O, then unaware of their cause, reversed the control input on his side. The differential forces in the left (captain's) and right (F/O's) pitch control systems reached the threshold to activate the pitch uncoupling mechanism, disconnecting the left and right pitch control systems from each other. According to the ATR flight manual, this uncoupling occurs only in the pitch axis controls.

The captain completed the takeover by announcing he had control about 5-6 sec. after taking hold of the controls. Nevertheless, before the takeover was completed, the pitch system disconnect led to one side of the airplane putting in a strong up command (captain), and the other putting in a strong down command (F/O). As a result of this uncoupling, the high airspeed and asymmetric elevator deflections that occurred, aerodynamic loads exceeded the strength of the horizontal stabilizer and resulted in significant damage to that surface.

At the start of the pitching maneuver, the senior cabin crewmember was unrestrained in the rear of the cabin as she waited for a passenger to return to their seat. When the aircraft pitched back down, the cabin crewmember was thrown from her seat and suffered a broken leg.

The flight crew continued the flight using just one side of the disconnected pitch control systems and landed without further incident at Sydney.

Based on the crew report of an in-flight pitch disconnect associated with moderate turbulence, and data recorded by the aircraft's onboard maintenance systems, the airline maintenance watch arranged for the contracted approved maintenance organization to carry out the applicable maintenance. However, the licensed aircraft maintenance engineers involved in the inspection after flight in turbulence and/or exceeding VMO did not carry out the specified general visual inspection of the stabilizers, probably because of a breakdown in the coordination and certification of the inspection tasks between the engineers. The damaged horizontal stabilizer was not detected and the aircraft was released to service.

During the next five days the aircraft was operated on 13 flights and was

showed it captured a segment of the accident flight. The airplane can be seen spiraling downward, impacting the runway, and a subsequent ground fire occurs.

According to initial information, the pilot had received flight training and had received a flight instructor's endorsement in the pilot's logbook on September 26, 2018, indicating a "solo check" in the pilot's airplane.

▶ June 30 — About 0911 CDT, a Beech BE-300 (N534FF) collided with a hangar and terrain after takeoff from Addison Airport (KADS), Addison, Texas. The airline transport pilot, the commercial-rated copilot, and eight passengers weer killed in the accident. A post-impact fire ensued and the airplane was destroyed. The airplane was registered to EE Operations LLC and operated under Part 91. VFR prevailed and an IFR flight plan had been filed. The cross-country flight was originating at the time of the accident and was en route to Albert Whitted Airport (KSPG), St. Petersburg, Florida.

According to information provided by EE Operations and Flyte Aero (an aviation services provider), the flight crew, and passengers arrived at the airport to prepare for the personal flight, about an hour and a half prior to the accident. The airplane fuel tanks were "topped off" and luggage was loaded in the aft baggage compartment of the airplane. According to ATC data, the pilot contacted ground control stating he was ready to taxi and about 0905 was provided taxi instructions to Runway 15. About 0910 the pilot was given departure instructions to turn left heading 050 and was cleared for takeoff from Runway 15.

The takeoff and departure of the airplane was captured by radar and multiple security cameras and was observed by several witnesses located in various locations at the airport. One witness stated that as the airplane went down the runway, it seemed more quiet than normal and sounded like it did not have sufficient power to takeoff. After the airplane lifted off, witnesses observed the airplane drift to the left, and then roll to the left before colliding with the hangar. Several security cameras captured the drift to the left immediately after takeoff and then a roll to the left. One camera showed the airplane roll completely inverted before it collided with the hangar.

▶ June 28 — About 1715 CDT a Beechcraft BE-58 (N4614S) crashed during an approach to the Hiawatha Municipal Airport (K87), Hiawatha, Kansas. The pilot was fatally injured, and the airplane was destroyed. The airplane was registered to and operated by Mako Certificate LLC, as a Part 91 cross-country fight. The flight departed the Augusta Municipal Airport (3AU), Augusta, KS, at 1623 en route to K87. The pilot was not in contact with ATC during the flight; however, a preliminary review of radar information revealed the pilot's flight from 3AU, northeast, towards K87.

The airplane wreckage was located in an open corn field about 1 mi. north of K87. The airplane came to rest upright, on a 171 deg. heading, with a post-crash fire consuming most of the cabin and inboard sections of both wings. The wreckage was confined to one area, and all major components were accounted for on-site.

▶ June 28 — About 1607 Alaska daylight time (AKDT), a float-equipped, Maule M-6-235 (N56512) sustained heavy damage following a loss of control and impact with steep, mountainous, tree-covered terrain about 7 mi. northwest of Moose Pass, Alaska. The airplane was being operated VFR by the pilot under Part 91, when the accident occurred. The commercial pilot and two passengers were killed, and one pilot-rated passenger seated in the right front seat received serious injuries. Marginal visual conditions prevailed, and no flight plan had been filed. The flight departed an unknown location near Seward, Alaska, about 1529 destined for Lake Hood, Anchorage, Alaska.

At the time of the accident, the pilot was using a Garmin GPSMAP 496 GPS receiver, capable of storing route-of-flight

subject to routine walk around visual inspections by the flight crew and engineers. No one identified any anomalies until the flight crew observed some damage after a suspected bird strike. The aircraft was grounded and subjected to extensive maintenance that included replacement of the horizontal and vertical stabilizers.

The Findings

In part of its preliminary report regarding the Air Astana ERJ-190LR incident, the GPIAAF, Portugal's transport accident investigation agency, noted that the hydraulically powered power control units (PCUs) move the ailerons and that these PCUs are controlled through a cable system. However, the investigators determined the cable system had been installed incorrectly during maintenance.

It further noted that the installation of a Service Bulletin had made it difficult to understand the maintenance instructions. The message "FLT CTRL NO DISPATCH" resulted in 11 days of troubleshooting, but did not identify the ailerons' cables reversal "nor was this correlated" to the message.

Also, the crew failed to identify the reversal in their flight control checks.

And because of the significant structural damage inflicted on the airframe in the flight, the agency changed the event's classification from a serious incident to an accident, following ICAO recommendations.

For its part, the Australian Transport Safety Bureau (ATSB) identified a number of operational factors that contributed to the inflight upset and pitch disconnect of the VARA ATR-42. Among them:

- During the descent, when the sterile flight deck policy was applicable, the flight crew engaged in non-pertinent conversation. This distracted the crew and probably reduced their ability to monitor and respond to fluctuations of airspeed.
- The magnitude of the captain's nose-up control input was probably greater than he intended, due to his response

Accidents in Brief

data. The National Transportation Safety Board investigator-in-charge reviewed the archived GPS data logs for June 28, 2019, revealing that about 1602 the airplane crossed Moose Pass at a GPS altitude of about 2,000 ft. The airplane continued northwest along the Sterling Highway at various GPS altitudes between 1,700 ft. and 2,400 ft. According to the Alaska Rescue Coordination Center (AKRCC), a 406 MHz emergency locator transmitter (ELT) signal was received at 1614, and rescue personnel from the Air National Guard's 210th Air Rescue Squadron, Anchorage, began a search for the source of the 406 ELT. An Air National Guard HH-60G helicopter crew discovered the accident site, and the sole survivor was subsequently evacuated. The airplane impacted in a near vertical attitude in an area of alder brush and tundra-covered terrain, at an elevation of about 1,546 ft. MSL. A detailed wreckage examination is pending following recovery of the airplane.

▶ June 28 — About 0041 CDT, an Agusta Spa A109S helicopter (N11NM) crashed while landing at Brainerd Lakes Regional Airport (BRD), Brainerd Lakes, Minnesota. The pilot and flight nurse were fatally injured, the flight paramedic was seriously injured, and the helicopter sustained heavy damage. The helicopter was registered to and operated by North Memorial Healthcare under Part 135. It was IFR at BRD for the flight, which departed from North Memorial Heliport (MY77), Robbinsdale, Minnesota, about 2348. The helicopter was returning to BRD after delivering a patient to MY77. Following descent from a cruise altitude of 6,000 ft. MSL, the pilot flew the ILS Runway 23 approach at BRD. According to the flight paramedic, who was seated in the left forward seat, the runway surface and lights were visible below a thin fog layer during the approach to landing. He noticed a few clouds to the side of the helicopter and recalled the pilot remarking that the weather conditions were foggy, and they would need to go-around. He subsequently noticed the helicopter spin to the right and impact the ground. The helicopter impacted a grassy area to the left of Runway 23 and came to rest on a heading of 074 deg. The main fuselage and tail boom exhibited crushing consistent with a high velocity vertical descent. The helicopter was upright and nearly intact, with no movement from the initial impact point. There was no evidence of a post-crash fire.

An Appareo Vision 1000 cockpit image recording device, engine data collection units, data acquisition unit, Outerlink satellite communications unit, and HeliTAWS unit were recovered from the wreckage and transported to the NTSB in Washington, D.C. for examination and download. The wreckage was recovered for post-accident examination.

▶ June 27 — About 2232 EDT, a Beech E-55 (N664AR) was destroyed when it crashed into a residence and terrain in Hope Mills, North Carolina, during approach to Fayetteville Regional Airport (FAY), Fayetteville, North Carolina. The private pilot and one person in the residence were killed, and a second person in the residence was seriously injured. The personal flight was conducted under Part 91. Night VFR prevailed, and no flight plan was filed for the local flight that departed FAY about 2229.

According to preliminary information from the FAA, the flight remained in the airport traffic pattern after takeoff to perform a landing on Runway 4. While on the right base leg of the traffic pattern, the pilot reported control issues with the airplane and no further communications were received from the accident flight. The wreckage was subsequently located about 2 mi. southwest of the approach end of Runway 4.

The pilot's brother was not a certificated pilot, but flew often with the pilot. According to the pilot's brother, his most recent flight with the pilot was on June 21, 2019. They flew uneventfully from FAY to Claxton-Evans County Airport (CWV), Claxton, Georgia and returned. While at CWV, they completely fueled the airplane. During the roundtrip flights, the pilot utilized the autopilot often and there were no anomalies. Additionally, the pilot

to a high stress level, but increased the probability that the aircraft's limit load factor would be exceeded.

▶ Shortly after the captain initiated the nose-up control inputs, the first officer reversed his control input. The differential forces in the left and right pitch control systems were sufficiently large to inadvertently activate the pitch uncoupling mechanism, disconnecting the left and right pitch control systems.

▶ Given the high airspeed, the asymmetric elevator deflections that occurred immediately following the pitch disconnect event resulted in aerodynamic loads on the tailplane that exceeded its strength and damaged the horizontal stabilizer.

Inspection and Continued Operation

Further to establishing that the damage went undetected because the aircraft tail was not inspected in accordance with the turbulence/Vmo exceedance job instruction card, the ATSB identified further, maintenance-related, factors that increased risk:

▶ ATR (the aircraft manufacturer) did not provide a maintenance inspection to specifically assess the effect of an inflight pitch disconnect. As a result, if an inflight pitch disconnect occurred, the aircraft may not be inspected at a level commensurate with the criticality of the event. And, as a legacy of there being no inspection specific to an inflight pitch disconnect, there is potential for other ATR aircraft to have sustained an inflight pitch disconnect in the past and be operating with undetected horizontal stabilizer damage.

▶ Although the approved maintenance organization specified fatigue management procedures, the licensed aircraft maintenance technicians who were involved in the inspection after flight in turbulence and/or exceeding Vmo operated outside the normal hours of work. As such, they were at risk of fatigue on the day of the inspection and/or the day following. **BCA**

did not report any anomalies or warnings during those flights.

A friend of the pilot reported that he flew with the pilot on June 24, 2019, from FAY to Smith Reynold Airport (INT), Winston Salem, North Carolina. The purpose of the flight was to transport the friend and his copilot to reposition a business jet. The friend and his copilot returned in the business jet to FAY, and arrived prior to the accident pilot, who returned solo uneventfully. The friend added that the accident airplane departed with FAY with 120 gal. of fuel and he estimated that 60 gal. remained for the accident flight. During startup at FAY for the flight to INT, the attitude and heading reference system (AHRS) fail amber caution light illuminated in the cockpit at engine startup and remained illuminated for 12 to 15 minutes, which included the initial portion of the flight. The pilot remarked during engine runup that the light usually extinguished by then.

They discussed continuing the flight under visual flight rules because the autopilot would not engage, which would require the accident pilot manually fly the airplane. The friend added that during the time the caution light was illuminated, he did not observe any anomalies with the electronic flight information system (EFIS) display. To the friend's knowledge, the autopilot would not engage with the caution light illuminated and would not remain engaged if the caution light illuminated. After the caution light extinguished, the pilot engaged the autopilot for the remaining trip to INT. The friend spoke to the pilot after they both returned to FAY. The pilot reported that the light remained extinguished and he utilized the autopilot on the return flight to FAY; however, after landing at FAY, he turned off the avionics and then back on, the light illuminated for 3 minutes before he shut down the airplane and planned to take the airplane to an avionics maintenance facility. The pilot also commented that he planned to perform three night landings to maintain his night currency.

A debris path was observed beginning with freshly cut treetops, descending about a 35-deg. angle and extending approximately 50 ft. on a magnetic heading of 270 deg. to the back of a residence. Sections of the right wing, left horizontal stabilizer, and the right engine came to rest inside the residence and the main wreckage came to rest in the front yard of the residence, upright and oriented about a magnetic heading of 180 deg.

The landing gear was in the retracted position. The flaps were in the retracted position. Measurement aileron trim actuator corresponded to a full down tab on the left aileron.

The pilot held a private pilot certificate with ratings for airplane single-engine land, airplane single-engine sea, airplane multiengine land and instrument airplane. His most recent FAA third-class medical certificate was issued on September 13, 2017. At that time, he reported a total flight experience of 480 hours.

The six-seat, low-wing, retractable tricycle-gear airplane, was manufactured in 1979. It was powered by two Continental IO-520, 285-hp engines equipped with constant-speed, two-blade Hartzell propellers. According maintenance logbooks, the airplane's most recent annual inspection was completed on November 1, 2018. At that time, the airplane had accumulated 2,178.8 hr.. The left engine had accumulated 517.3 total hours; of which, 54.1 hr. were since major overhaul. The right engine had accumulated 986.55 hr.; of which, 94.8 hr. were since top overhaul.

The airplane was equipped with an Aspen Avionics EFD 1000 EFIS, which utilized an AHRS. During an interview, a maintenance technician reported that the accident airplane was at their facility due to an AHRS fail light illumination in the cockpit. The pilot visited the facility about 1800 on the evening of the accident, to check the status of the repair. The pilot was informed that the repair had not been completed as the facility needed to contact the EFIS manufacturer for more information.

The recorded weather at FAY at 2253 was: wind from 200 deg. at 4 kt.; visibility 10 mi.; clear sky; temperature 26C; dew point 20C, altimeter 30.18 in.

An autopilot programming unit and an engine monitor were retained for data download. Additionally, three autopilot servos were retained for examination. **BCA**

Stick and Rudder vs.

U.S. AIR FORCE

Practicing without a purpose is useless

U.S. Air Force Boeing 747 (E-4B) hand-flown during air refueling behind a KC-135 tanker.

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

"Can this airplane land itself?" That's a frequent question from the flying public when first viewing a high-tech cockpit. These days the question has morphed into "can this airplane fly without a pilot?" Even in its most recent incarnation, the question boils down to that of autoland.

The only aircraft I've ever flown with autoland capability was a U.S. Air Force E-4B, a Boeing 747-200. The autopilot was a masterpiece for its time and the only thing it wasn't allowed to do that we pilots could do, was fly behind a tanker, hook up, and gulp down 40,000 gal. of jet fuel. Believe it or not, that's easier than it sounds.

The aircraft could also land itself; that's harder than you might imagine. Somedays it would kiss the runway in the touchdown zone, on speed, with nothing for me to do but pull the reverse levers and take a bow on behalf of the electrons while the passengers applauded. The very next autoland could be planted on brick one and make me consider calling my dentist to check the integrity of my fillings. But even that experience was nothing compared to an autoland on a Ceiling and Visibility Unlimited (CAVU) day at a busy airport when the ILS critical area was unprotected.

One day at Will Rogers World Airport, Oklahoma City (KOKC) I was in the flare at 30 ft. when another airplane taxied by the localizer antenna. Just as the throttles came to idle and the nose rotated gently upward, the airplane rolled its 200-ft. wings so quickly all I could do was "pickle" everything off and go around. These thrills happened often enough to encourage a healthy paranoia about anything in an airplane controlled by a computer. Back then, in the 1980s and before, we learned to place a greater trust on our stick and rudder skills than those ones and zeros behind the magical curtain. But these days, most of us have come to accept the autopilot as just another member of the cockpit crew.

The idea that we have become too reliant on automation and have let our basic piloting skills atrophy isn't new. Every few years there is a noteworthy crash, some hand-wringing and a call for pilots to take a little more stick time. This has been around for almost as long as I have been flying. But I don't think more stick time will answer the problem. What we need is better stick time, hand-flying the airplane when it is safe to do so and then do so in a way that helps us improve.

Becoming too reliant on the automation is an easy trap to fall into. I have to admit I am as guilty as the next pilot, even back in the days when the only automation involved was a flight director. My first flight director was in the Northrup T-38 and I remember once watching in fascination as the needles seemed to align themselves, as if there was an autopilot. (There wasn't.) Then I realized my eyes and hands were simply reacting to the crossbars of the flight director and I hadn't looked at the raw data since the course and glideslope were captured. That was in 1979.

Digital Dependence

Whenever I hear of an airplane that has crashed because its pilots gave up control to the electrons, I think of that day in the T-38. The tendency is natural, your brain seeks the easy way out and would rather be a passenger when the autopilot seems to be doing a flawless job. This, of course, is a recipe for disaster. But you can prevent that disaster by mentally flying the airplane even when the electrons are handling the stick and rudder. That way, when the electrons mess up, you will be fully prepared to take over.

A Misplaced Trust

The first autopilot came soon after the birth of powered flight when Lawrence Sperry mounted a "gyroscopic stabilizer apparatus" in a Curtiss C-2 biplane. He hit upon the idea when studying the gyroscopic effect of spinning wheels that tended to keep motorcycles upright. His design included a wind-driven generator to spin several gyroscopes up to 7,000 revolutions per minute. These gyroscopes were then mechanically linked to a control mechanism. One gyro, for example, would keep the ailerons positioned to keep the wings level. The autopilot, at its inception, was a mechanical device.

By the 1940s, autopilots had evolved into electronic devices capable of much more than keeping the wings and nose approximately level. The Minneapolis-Honeywell C-1, for example, was coupled with the famous Norden bombsight on the Boeing B-17 Flying Fortress, the Consolidated B-24 Liberator and the Boeing B-29 Superfortress.

Sperry autopilot installed on a Curtis biplane. (Glenn H. Curtiss Museum)

My first autopilot was in the KC-135A tanker, which had hardly progressed from the days of World War II. The device's primary purpose in life was to hold an altitude smoothly to maintain a stable platform for receivers during air refueling. While it could maintain a heading, it did everything else poorly. We never trusted it to maintain a course and the idea of coupling it to an ILS was unthinkable. I flew that airplane down to minimums many times, but each approach was hand-flown. (Because it had to be.)

SANJAY ACHARAYA

An early autopilot control panel, the Minneapolis-Honeywell C-1.

Fast forward to today: I am now flying a Gulfstream G450 where practically everything is digital, run by computers that think in terms of ones and zeros. The binary wizardry is capable of threading the needle on a Required Navigation Performance (RNP) approach flying a radius around a fix down to a lateral accuracy as tight as RNP 0.1, just over 600 ft. When presented with an approach to minimums in this airplane, the only time I don't couple the autopilot is during simulator recurrent training. I have become so trusting of the ones and zeros that the largest threat during many of my approaches is the tendency of my brain to disengage and become a passenger along for the ride. I am not alone in this.

Case Study: Singapore Airlines Flight 327

On Nov. 3, 2011, the crew of Singapore Airlines Flight 327 had every reason to be confident about their Boeing 777 flying from Manchester International Airport, U.K. (EGCC) to München-Franz Josef Strauss Airport, Germany (EDDM). They were flying a state-of-the-art airplane for a company with an enviable safety record. The weather in Munich was above Category I ILS minimums: 2,000 meters visibility (1.25 mi.) with a cloud base of 300 ft. Their company Standard Operating Procedures (SOPs) recommended that the captain fly the approach with the autopilot coupled. The crew did precisely that. In fact, the only mistake the crew had made up until the landing flare was that they never told the airport tower that the approach was coupled.

Pilots who fly exclusively in the U.S. can be forgiven for thinking there still was no problem. The U.S. Aeronautical Information Manual says when the visibility is less than 2 mi. or the ceiling is less than 800 ft., the ILS critical area will be protected. But that is far more restrictive than the International

GERMAN FEDERAL BUREAU OF AIRCRAFT ACCIDENT INVESTIGATION

Singapore Airlines Flight 327, aircraft position after stop.

Civil Aviation Organization's criteria of 550 meters (1,805 ft.) visibility and 60 meters (200 ft.)ceiling. The ILS critical area was not protected during Flight 327's approach.

Just prior to the Boeing 777's landing, tower cleared a British Aerospace BAe 146 Avro RJ85 to take off from an intersection. The Avro was still climbing and had not yet passed the runway's departure end when the Boeing neared the runway's touchdown zone. The Avro interrupted the localizer signal, causing the 777 to roll just prior to touchdown. At the moment the Boeing's captain pressed his Takeoff/Go Around (TO/GA) button, the aircraft's left main gear contacted the runway, signaling weight on wheels. This signal disabled the TO/GA function, confusing the pilots as the aircraft continued to track left of centerline. As the aircraft approached the left side of the runway, both pilots pressed right rudder to correct, but it was too late. The aircraft departed the left side, kicking up a cloud of dirt. Their correction finally pushed the airplane back to the right, but too far right and the aircraft departed the right side of the runway, where it came to a rest.

The pilots did a commendable job minimizing the lateral deviations as well as they did. Nobody was injured and the damage to the airplane was minimal. The pilots, the airline and the investigators were left wondering how such a thing could have happened to such a well-run airline flying such a capable airplane. The German investigators placed the blame on the operator, saying they "allowed the decision for an autoland landing without having to consider the required conditions on the ground."

Looking at the Singapore Airlines' SOP the criticism is probably well-founded. But I think we as pilots should learn a lesson here that our automation only behaves well when the conditions on and off the airplane are as the designers predicted. We know that much of aviation is unpredictable and it is up to us, the human pilots, to monitor the automatic pilots and take over before things go beyond design predictions. We have to keep our brains engaged even when the automation is doing the actual flying.

But when it comes time to take over, we have to instinctively know what to do. You can attribute the cause of many recent crashes to pilots suddenly hand-flying their aircraft without a firm grasp about what stick and rudder inputs were needed before things became uncontrollable. In 1988, an Air France crew flew their Airbus A320 on a "low pass" in front of an airshow crowd, not realizing their aircraft committed itself to landing and withheld go-around thrust until it was too late. In 2009, a Turkish Airlines crew was slam-dunked into Amsterdam-Schiphol International Airport, Netherlands (EHAM); they failed to realize a faulty radio altimeter had convinced their autothrottles it was time to retard to idle at almost 2,000 ft. In 2013, an Asiana Airlines crew got their Boeing 777 so far behind the power curve on approach to San Francisco International Airport (KSFO) that getting back to the glidepath became impossible. The list of pilots-turned-passengers goes on and on.

Solution: More Stick Time?

The FAA wants you to hand-fly more often — really. In 2017, the agency issued Safety Alert for Operators (SAFO) 17007, Manual Flight Operations Proficiency. This SAFO says an "air carrier's line operations policy should permit and encourage manual flight operations," as defined by "managing the flight path through manual control of pitch, bank, yaw and/or thrust." But there is a cautionary note: "When deciding to fly manually, crews should apply basic threat and error management principles and take into account the various factors affecting operational workload."

So, it is up to you, the pilot, to apply good judgment. And if you break anything (or anyone), well that's you not applying good judgment. We need to think about this: Good judgment isn't issued with your pilot certificate.

In much of my Air Force upbringing, the automation philosophy was to couple as soon as possible after takeoff and remain coupled until you couldn't. The idea was to free up your brain to think strategically as the electrons waged the tactical war. So, there I was, just a few years after retiring a military uniform for that of a civilian charter pilot when . . .

Our Gulfstream had done a great job intercepting the localizer and once the glideslope had centered, we started down. We were in the clouds and expected to remain so until about 700 ft. above the town of Lalysos, just a few miles west of the Rhodes, Greece, airport. Seven hundred feet is practically Visual Flight Rules (VFR) in our world, so nobody was

worried about the approach. I was in the right seat and had only one item left on the checklist, the final notch of flaps. We had intercepted the glideslope at 2,500 ft. on the ILS to Runway 25.

At about 2,000 ft. the captain — who was also the company chief pilot — said, "Do you mind if I increase my proficiency?" Before I could answer he clicked off the autopilot and promptly got us above the glideslope needle that was, moments ago, centered. "A dot high and going higher," I said. We popped out of the weather a dot and a half high and too fast to extend our last notch of flaps. "Well I might be too high," he said, "but at least I'm too fast." The runway was over 10,000 ft. long and he managed to save the landing, if not the approach.

That was one of my first times sitting in the right seat with that captain and I was, to say the least, surprised. I have messed up my share of approaches over the years, but I've never been so cavalier about it. Unfortunately, he repeated this trick often.

The worst incident was when we were flying into a very short runway and the weather was just a hundred feet above minimums. When the weather is that crummy and you have a good autopilot, like we did in this airplane, you let the airplane fly while you watch it like a hawk. That's what I do.

"Do you mind if I increase my proficiency?" he asked once more. The needles were centered, we were at 1,600 ft. MSL and our decision altitude was 400 ft. MSL, just 200 ft. above the runway.

"I would rather you didn't," I said. But it was too late; he clicked off the autopilot.

"Going high," I said. "A dot high," I repeated. "You need to correct," I said. He did not. I repeated myself. He started to increase his vertical descent rate.

At decision altitude I spotted the runway, what was left of it.

He pushed the nose over hard and we found ourselves on the pavement in an instant. He planted the airplane halfway down the runway, but this particular Gulfstream had great brakes and we managed to roll out with less drama.

"Let's never do that again," I said.

The captain simply laughed.

I've replayed that approach in my head many times over the years since, wondering what I could have done differently. The right answer, I realize now, would have been to call for the go around the minute he deviated from our stable approach criteria. But, for the purpose of why we are here now, the takeaway is that all of this captain's stick time was for naught. Over the years I've never seen a pilot take more stick time in an automated airplane than he did. And yet his stick and rudder skills were poor. How can we fix this?

Better Solution: Purposeful Practice

Most proponents of "We need more stick time!" will preach that "practice makes perfect!" But that maxim is demonstrably false. So, then they tell you "perfect practice makes perfect!" But that is unachievable. (How can you practice perfectly to become perfect, if you aren't already perfect?) There are two problems with grabbing some stick time whenever the time permits. First, it can be an unwarranted risk when modern simulators are available. But even without the added risk, practice without outside critique is just about useless. If the other pilot isn't empowered to debrief your performance, you will have practiced without learning.

The 2016 book, Peak: Secrets From the New Science of Expertise, explores the idea of practice that facilitates expertise. Its author, psychologist Anders Ericsson, was also the author of the often-misquoted study that proposes it takes 10,000 hr. of practice to become an expert at anything. (It doesn't.) Dr. Ericsson says what it takes is practice with a purpose.

"We all follow pretty much the same pattern with any skill we learn, from baking a pie to writing a descriptive paragraph. We start off with a general idea of what we want to do, get some instruction from a teacher or a coach or a book or a website, practice until we reach an acceptable level, and then let it become automatic. And there's nothing wrong with that. For much of what we do in life, it's perfectly fine to reach a middling level of performance and just leave it like that."

That pretty much describes how many of us approach flight training. But as professional aviators, a "middling level of performance" should not be good enough. We all know pilots who have 20 or 30 years of experience who are not as sharp as others with just four or five. This is true of just about any profession, such as medical doctors or schoolteachers. Even the act of driving a car as basic transportation can reveal large gaps in skill levels between those who take the skill seriously and those for whom it is just another chore. Ericsson's study shows there is more to practice than repetition.

According to the study, "Research has shown that, generally speaking, once a person reaches that level of 'acceptable' performance and automaticity, the additional years of 'practice' don't lead to improvement. If anything, the doctor or the teacher or the driver who's been at it for 20 years is likely to be a bit worse than the one who's been doing it for only five, and the reason is that these automated abilities gradually deteriorate in the absence of deliberate efforts to improve."

Ericsson calls the efforts many of us employ to get better at something "naive practice." It is doing something repeatedly expecting the repetition alone will improve one's performance. He offers instead what he calls "purposeful practice."

- ▶ Purposeful practice has well-defined, specific goals.
- ▶ Purposeful practice is all about putting a bunch of baby steps together to reach a longer-term goal.
- ▶ Purposeful practice is focused.
- ▶ Purposeful practice involves feedback.
- ▶ Purposeful practice involves getting out of one's comfort zone.

The idea of "purposeful practice" is just what we need to improve our stick and rudder skills in an age of ones and zeros. So, let's do that.

When Is 'Practice' in the Aircraft Appropriate?

This is a decision you have to make based on your operation, your risk tolerance, the capabilities of your aircraft and the experience levels of everyone involved. In my current operation, we do not fly a lot so I would say we are not as proficient as I would like. We will not accept unnecessary risk, but then who really does? Our G450 is highly capable, but the automation does not include autoland or autobrakes. All of our pilots are highly experienced. I am the pilot in charge so here are the decisions I've made.

I think "practice" in the airplane is invaluable but that we should avail ourselves to every possible safety advantage at

our disposal. I think that any instrument approach shot in less than VFR conditions should be coupled when flying an airplane that can do that precisely. So, hand-flying once in Visual Meteorological Conditions (VMC) is OK, but there are ground rules involved. I also believe VFR skills need to be sharpened as well, but there are times when this is not appropriate. For example, if you are flying into a congested airport, or to one with which you are not familiar, perhaps practice isn't such a good idea.

Setting the Ground Rules

Here again, your rules of practice should be tailored to your operation, aircraft and people. Here are the ones we employ.

- When the weather is below basic VFR minimums, instrument approaches are coupled until in VMC. Yes, we can hand-fly our aircraft to minimums and are required to do so in the simulator. But letting the automation do it doubles the number of humans doing the monitoring.
- When the Pilot Flying (PF) is hand-flying the airplane, the Pilot Monitoring (PM) assumes safety/instructor pilot responsibilities.
- No aircraft systems are disabled at any time for the purpose of "training."
- Stable approach criteria are always followed.
- No pilot will exceed any of the aircraft's limitations.

Empowering the 'Safety/Instructor Pilot'

One of the biggest problems with the way most of us exercise our hand-flying skills is that we do so in an incomplete manner. We are exercising our skills while self-critiquing silently. The other pilot is expected to keep quiet before, during and after the practice. We assume this pilot is nothing more than a "safety pilot," as is the normal situation, and will only speak up if something becomes unsafe. This deprives the PF of the most important element of practice: assessment by another pilot.

This problem becomes especially noticeable if the PF has a supervisory role or if the PM is in any way intimidated by the PF. The best way to overcome this situation is with an effective pre-brief that lets the PM know that he or she will be fulfilling two roles in the practice to come. First, they are to speak up if things become unsafe or unstable. Second, they are to observe the PF's performance and are expected to provide a critique in an effort to help the PF improve.

When the weather is good, we often brief, "this will be a visual approach backed up by the ILS" or something to that effect. This might be the perfect time to brief, "This will be an ILS that I will fly 'heads down' on the needles with you as my safety/instructor pilot. Standard callouts apply as if we were IMC. Do not allow me to deviate more than half a dot on the localizer or glidepath at any point. If I do so below 2,000 ft., announce that fact and I will go 'heads up' and take over visually. I might be a bit rusty, so I am counting on you to keep us safe and help me with my proficiency."

A CAVU day might also be the perfect time to practice visual approaches without reference to the electrons. Having a good sight picture of a proper glidepath and lateral alignment is something we can lose after years of flying the needles. Here again, a good pre-brief is important. Let the safety/instructor pilot know that you intend to fly the visual approach without the ILS or other instrument approach guidance in view but that he or she should have them available. For example: "I will be flying this approach visually and will not look at the ILS as a backup but am counting on you to keep an eye on me and the instruments to make sure I don't violate our stable approach criteria. Please speak up if it appears I am getting close to doing so."

The Critique: Maximizing Purposeful Practice

Once the aircraft is on the ground and put away, ask the safety/instructor pilot for a full debrief. Encourage the pilot to be frank and react positively to anything said. For example: "Everything looked great until we got below about 1,500 ft. and the winds shifted. We started to go below glidepath to about a dot when you noticed and pulled it back. But then our speed decreased almost 10 kt. That's when I said something about the approach becoming unstable."

And the response? "That was a good call. I need to do a better job of keeping my eyes moving, even when things are looking good. Thanks!"

As professional aviators we tend to adopt the "professional courtesy" of other professions that basically believe: "Thou shall not criticize another professional." But improvement is impossible without honest critique and you owe it to yourself to ask for just that. You also owe it to your fellow pilot to provide it.

Finally, you also need to keep track of your performances, good and bad. This kind of trend monitoring can help you realize what you need to work on for your next simulator event and can also help you diagnose problems in the future. Here is a personal example.

About 15 years ago, while flying a Challenger 604, I got into a series of poor landings that I was unable to figure out. I tended to flare too early, but now and then I flared too late. (Ouch!) The other pilots kept quiet and if I ever said anything, they would say "We all have good and bad streaks." But I eventually figured out the problem. You see, every airplane I had ever flown before the Challenger had a 4- or 5-deg. nose-up attitude on approach; the nose-low attitude of the Challenger required a larger shift in my eyes from the aim point to the end of the runway during the flare. But I figured it out after a bit of a struggle. Two years later, I needed to relearn my lesson. But my written "grade book" made it easier the second time.

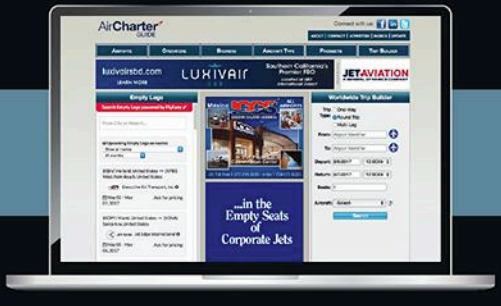
Analog, Digital or Both?

There appear to be two kinds of pilots in accident reports that involve a stick and rudder problem: those who prefer to hand-fly and those who do not. Ignoring the automation during a night flight into a busy airport is a recipe for disaster. Just think of the recent near-calamity of Air Canada Flight 759 at San Francisco International Airport. But not having the skills to fly the same approach without automation can be deadly. Think of Asiana Flight 214 for another KSFO example.

We owe it to ourselves to keep proficient, and practicing in the airplane is invaluable. But there is a right and wrong time to do that. And, more importantly, there is a right and wrong way to practice. **BCA**

AirCharter GUIDE

65th Edition
Now Available
to Order!



Know Your Options

So many destinations.
So many aircraft.
One source: aircharterguide.com.

AVIATION WEEK NETWORK

Drones 101 Part 2

Duke Energy's flight department used its drones to **help restore power in Puerto Rico**

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

In a dramatic example of how drones can assist in disaster recovery, Charlotte, North Carolina-based Duke Energy sent more than 200 volunteer workers to Puerto Rico to assist in restoring power to the island after Hurricane Maria struck in 2017. Its secret "weapon?" Five drones operated by two of its FAR Part 107-certified pilots.

The Category 5 hurricane devastated Dominica, the U.S. Virgin Islands and Puerto Rico. It is regarded as the worst natural disaster on record to affect those islands and was also the deadliest Atlantic hurricane since Jeanne in 2004.

BCA contacted Jacob Velky, Duke Energy's manager of aerial services, to learn more about his company's experience with drones in Maria's aftermath as well its application of its unmanned aerial systems (UASes) in the course of normal operations.

Duke Energy owns 58,200 megawatts of base-load and peak generation in the U.S. that it distributes to 7.6 million customers in six states. Its service territory covers 104,000 sq. mi. with some 32,000 mi. of distribution lines. The company has approximately 29,000 employees.

Duke's Aviation Services department currently operates three Bombardier Challenger CL-300 business jets for personnel transportation as well as an AgustaWestland 139 and a Bell 407GX helicopter. And, notably, its fleet includes 55 UAS aircraft of various makes and models for routine power-line inspection, wildlife surveys, indoor inspections of powerplants and boilers, and to examine solar panels, inspect towering equipment, track construction, access remote areas — and render assistance when disaster strikes.

In Puerto Rico, the company's UASes and pilots were employed at first for documentation — to paint a visual picture of the damage, plus all the resources being deployed. This required an extensive search for broken utility poles and downed power lines buried under thick vegetation, which was often the case in the island's mountainous terrain. The second role was to help repair crews string new lines and reconnect lines to existing or new power poles.

Velky, a 2009 Wake Forest University graduate with a B.S. degree in aeronautical science, began his tenure in Duke Energy's flight department as a summer intern in 2009. He went on to become a copilot on the company's aircraft full time in January 2010 flying its Hawker 800XP and Falcon 2000LX until fall 2012. At that point he assumed various roles in Duke Energy's Supply Chain organization but returned to Aviation Services in early 2017 to lead the UAS team.

A cross-functional team was launched in late 2014, comprising participants from the company's Emerging Tech, Legal, Aviation Services, Supply Chain and Risk groups. The members focused on learning about UAS technology and its capabilities as well as obtaining the required approvals needed to fly the equipment commercially.

The FAA granted Duke Energy its first approvals in 2015, which were then used to test over a dozen use cases for power-line inspections, volumetrics, solar panel inspection and other tasks. In August 2016, the FAA's new FAR Part 107 UAS regulations paved a path for the company to get the technology into the hands of more employees.

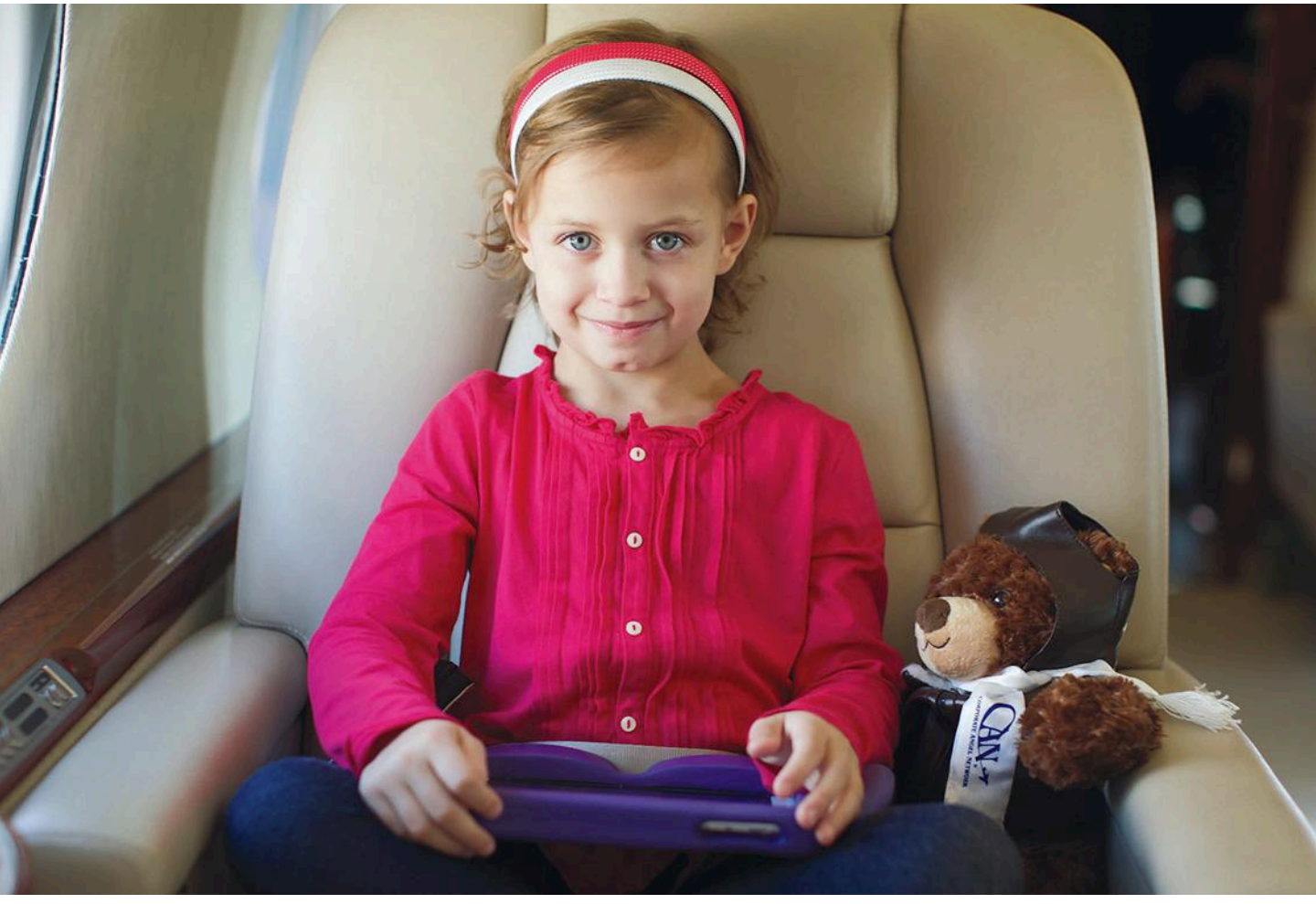
The first class of employees, trained in the second half of 2016, was primarily fixed on thermal inspection of Duke Energy's solar assets. Once dedicated personnel were hired into Aviation Services in 2017, widespread adoption and use of UAS aircraft began. The technology is now employed by every major line of business in the company, including transmission and distribution (power lines), generation (powerplants, solar, hydro), economic development and corporate communications.

DUKE ENERGY (2)

Duke Energy's Jacob Velky and Bryan Williams in Puerto Rico restoring power with help from a fleet of drones.

The company's UAS fleet comprises an assortment of makes and models, which Velky declined to identify, instead saying that they're constantly evaluating new models to determine their best features and applications.

Bringing Cancer Patients Closer to Their Cure



Cancer Patients Fly Free in Empty Seats on Business Jets

- Corporate Angel Network arranges free flights to treatment for cancer patients by using empty seats on business jets.
- Since 1981, Corporate Angel Network, a not-for-profit organization, has worked with more than 500 corporations including half the *Fortune* 100, to fly close to 60,000 cancer patients to specialized treatment and currently transports 250 patients each month.
- The process is simple. Call or visit our website for more information.

Close to 60,000 flights and counting!

Corporate Angel Network

(866) 328-1313 WWW.CORPANGELNETWORK.ORG
TWITTER: @CORPANGELNET INSTAGRAM: @CORPORATEANGELNETWORK

UAS Pilot Training

The Association for Unmanned Vehicle Systems International, a trade organization, predicts that the global drone market will be $140 billion in 10 years. That means there's a significant need for people to master the art and science of safely operating drones. A couple of dozen universities and community colleges offer UAS degree programs, as well as other familiar training organizations offering online training programs.

Stay alert to quickly morphing FAR Part 107 regulations. The FAA is expected to issue recurrent training requirements for some kinds of operations (possibly online) and focus on subjects like weather, aircraft loading, physiological effects of drugs and alcohol, etc. While some autonomous UAS aircraft could eventually obviate the need for human pilots, that's getting ahead of the story.

Meanwhile, here is a representative list of drone pilot training resources:

DARTdrones Wings Program
Offers hands-on flight training and online training programs and customized enterprise programs.
www.dartdrones.com

Embry-Riddle Aeronautical University
ERAU is one of just a few universities in the country to offer a bachelor's degree in unmanned aircraft systems, as well as self-guided online and Eagle Vision programs, seminars and workshops, and tailored programs.
www.proed.erau.edu/programs/small-unmanned-aircraft-systems

FlightSafety International
FlightSafety has expanded its offerings to provide comprehensive Unmanned Systems Training through a series of Remote Pilot ground and flight training courses.
www.flightsafety.com/business-commercial/unmanned-systems-training/

King Schools
Courses include preparation for the initial FAA Part 107 Knowledge Test, recurrent Knowledge Test and training for operating legally in controlled airspace.
www.kingschools.com/ground-school/drone-pilot/

National Press Photographers Association
The NPPA's drone training program is offered in partnership with The University of Georgia Grady College of Journalism and Mass Communication and The Drone Journalism Lab at the University of Nebraska.
www.NPPA.org

University of North Dakota
UND offers bachelor's, master's and certification programs for unmanned aerial and unmanned aircraft engineering and operations, in addition to programs tailored to students' needs.
www.UND.edu

Others
Other providers offer an assortment of drone training programs, mostly limited to online prep courses for the Part 107 Knowledge Test for a Remote Pilot Certificate, but some will come to your facility. **BCA**

"The industry is evolving very quickly," he said. "I keep an eye on new drone technology. Our challenge isn't takeoffs and landings as much as it is increasing flight time, and determining which drones are a good match for a variety of operational environments."

The ones the company employed in the Puerto Rico disaster recovery were large aircraft with six-rotors each of 4 to 5 ft. in diameter. They were used to "re-conduct" fallen lines by lifting lightweight lines to personnel working at the top of the power-line towers, who could then haul up heavier lines connected to the new lines.

"We worked in primitive conditions," Velky noted. "This was done in hot, rugged jungle terrain, with trees down everywhere. We couldn't do this without our drones. They were great force-multipliers."

Significantly, Duke Energy's Aviation Services department recently passed an International Standard for Business Aircraft Operations (IS-BAO) Stage Three in-depth audit and rating of its safety management system (SMS) of the flight department. And at Velky's insistence, the audit included the company's UAS operations — an industry first.

He said, "We're proud of our aviation safety culture and excited about the technology's ability to reduce risks that our employees encounter every day, such as working at heights, around energized equipment and in confined spaces."

Velky emphasized the importance of exchanging information and working with other business flight departments operating UASes, particularly in post-disaster operations.

In conducting research for this story, it became clear that a growing number of businesses are establishing their own in-house UAS operations rather than paying for third-party service providers. A common misunderstanding with new commercial drone flyers are the UAS registration requirements. Unlike flying under the model aircraft rule where a single registration can be used for multiple aircraft, commercial drones require individual registrations.

Asked about his sources for UAS-savvy talent, Velky said, "Some of my recent hires are coming out of colleges and universities with drone programs," adding, "It's exciting to see college programs start to get into this with college degrees focused on unmanned

systems [and] the salaries being offered are a very nice place to start."

Today, UAS training at Duke Energy is largely done in-house with some third-party assistance. Explained Velky, "We have some personnel who were trained elsewhere, but we're also training people with no aviation experience at all. The trainees learn many of the concepts [airplane] pilots must know — airspace regulations, reading METARs, and so forth — to prepare them to take the FAR Part 107 written exam." There is no FAA practical exam — that is a flight test —- for would-be commercial UAS operators, but Velky thinks that will come eventually, due to the rapid advances in the technology and in airspace management systems.

Asked if there were any program setbacks, Velky responded, "With any new technology there are always setbacks and challenges. We have adopted an operational excellence model, which consists of four main components: Plan, Do, Check and Adjust. Just like flying an airplane, we plan every mission before we go into the field, and just like flying an airplane, there is no such thing as a perfect flight or a perfect mission.

"As such we make sure to take time to review each mission, what went according to the plan, what didn't go according to plan and attempt to learn as much as we can," he said, "to ensure the next time we perform that mission we don't make the same mistakes."

Then asked if he had any advice for other flight departments considering operating a UAS, he said, "Don't miss the opportunity to be part of this technological evolution."

He continued that, "Through embracing this technology, Aviation Services at Duke Energy has broadened and deepened the value proposition of our aviation department, which has given us a strategic seat at the table to help influence how others across the company can perform tasks safer and more efficiently.

"At the same time," he concluded, "it is important not to discount the past. As an aviation community, we have learned many great lessons and developed rock-solid safety management systems. Failing to leverage the wealth of expertise and knowledge in the manned aviation community when building out an unmanned systems program would be a huge miss and ultimately a risk to the entire aviation community." **BCA**

Drone Organizations

Tech phenomena quickly develop user and provider organizations and companies, and the UAS evolution is no exception. What follows are some of the more prominent groups that may be useful resources, especially for those seeking to network with other operators.

Aircraft Owners and Pilots Association
The AO PA's drone-flying members will have a leg up on the competition and new discounts to look forward to thanks to a new partnership with North Carolina-based PrecisionHawk and its subsidiary Droners.io, an online commercial drone pilot employment service.
www.AOPA.org

Association of Commercial Unmanned Aircraft Systems
A non-profit trade association advocating for the commercial use of small unmanned aircraft systems. A related website, Skyborn (dronepilots.org) is an online commercial UAS pilot employment service.
www.acuas.org

Association of Professional Drone Pilots
Provides consulting, training, certification, compliance paperwork, public relations and drone sales.
www.prodronepilots.org

Association for Unmanned Vehicle Systems International
The AUVSI is a nonprofit organization dedicated to the advancement of unmanned systems and robotics. It represents UAS corporations and professionals from more than 60 countries involved in industry, government and academia. AUVSI members work in the defense, civil and commercial markets. The AUVSI's events calendar is full of drone-focused events and webinars.
www.AUVSI.org

Australian Certified UAV Operators
Offers its users a variety of services and publications.
www.acuo.org.au

Commercial Drone Alliance
Provides members with advocacy and information.
www.commercialdronealliance.org

General Aviation Manufacturers Association
A few years ago, GAMA expanded its membership ranks to include non-voting "associates" that are developing, manufacturing or advocating electric or hybrid propulsion aircraft, technologies, systems, policies and standards primarily intended for general aviation.
www.gama.aero

NBAA
The NBAA offers its users a variety of services, advocacy and publications.
www.nbaa.org/aircraft-operations/uas

UAV Systems Association
The UAVSA supplies its members information, tools and resources to engage and inform the community, and help UAS businesses realize their full potential.
www.uavsa.org **BCA**

Sitting Satisfaction

A new age of seat design is here

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

There was a time, albeit a while ago, when VIP seating on a business aircraft was hardly luxurious. The seats typically could be likened to a stack of leather-covered boxes whose recline mechanism often as not didn't function properly. Indeed, despite the aircraft's impression of luxury, some of the seats within were regularly described as uncomfortable.

But times have changed, and with them, business aircraft seating has evolved, driven by multiple factors, but nothing so much as customer demand. In response, aircraft manufacturers are taking a greater in-house role in the design, development and production of the executive seats that go into their jets and turboprops.Among the leaders in this arena is Embraer Executive Jets. The Brazilian airframer went so far as to complete the acquisition of Aero Seating Technologies of Irwindale, California, in 2015, rebranding it Embraer Aero Seating Technologies (EAST), a wholly owned Embraer subsidiary.

BOMBARDIER

The Nuage seat from Bombardier, with patented tilt-link design, is featured on the OEM's Global 5500, 6500 and 7500 business jets.

The intent, according to Embraer, was to provide seating that featured "high-quality, ergonomic comfort and lightweight construction, with innovative designs and features for the ultimate cabin experience."

Just a year later, Embraer opened a 50,000-sq.-ft. EAST facility in Titusville, Florida. Today, EAST produces seats for virtually the entire Embraer Executive Jets aircraft line, from the Phenom 100EV light jet to the recently certified super-midsize Praetor 600.

"Embraer recognizes the distinct importance of the aircraft seat; the ultimate customer touch point," said Embraer's then-President and CEO Paulo Cesar de Souza e Silva.

In 2017, Rockwell Collins acquired B/E Aerospace, including its seating division. Just a year later, United Technologies Corp. (UTC) completed its acquisition of Rockwell Collins, with its subsequent restructuring and rebranding as Collins Aerospace.

"As our company has continued to grow, we've found ongoing opportunities to package our offerings as a single solution so customers don't have to work at finding multiple entry points," said Mark Zimmerman, regional sales manager for business aviation sales. "We are working to bring them a full cabin portfolio as a one-stop shop."

At Textron Aviation, the passenger seat is arguably the single most important appointment of our aircraft," said Chris Pinkerton, director of interior development. "Seating is literally the interface between the customer and the aircraft.

"For this reason, Textron Aviation is involved in all phases of the seat development and production. From concept to construction, to upholstery and installation, we have determined that it is in the best interest of our customers to be active in all phases."

There have been similar moves across the industry. Business jet interiors specialists Lufthansa Technik and Iacobucci, the Italian cabin interior products specialist, joined forces this past spring, reaching an agreement on the integration of Lufthansa's "chair" business jet seating line into Iacobucci's cabin seating portfolio.

According to Lufthansa Technik, following optimization of the mechanical design, Iacobucci is ready to build and distribute the seats to both business aviation and commercial customers worldwide, and work has already begun for a VIP launch.

The German company first introduced its chair line in 2014, describing it as the synthesis of German engineering and manufacturing with a French design created by Pierrejean Vision studio in Paris. The combination results in "offering VIP aircraft owners and their designers a virtually unlimited range of possibilities for adapting cabin seating to the real needs and tastes of passengers."

For its part, Iacobucci opened its HF Aerospace Seat Division in 2013, "expanding its product portfolio in order to have a full premium cabin product range for its business jet consumers and for OEMs."

"The first seats featured upholstery leathers from Perrone Aerospace [and] the choice of foam was based on ergonomic standards, to allow a more practical and comfortable use to those who sit," according to Iacobucci. And "the seats were designed to achieve the highest comfort possible, offering all passengers a full, lie-flat recline."

How Do Ergonomics Fit In?

Simply defined as the study of people in their environment, ergonomics' goal is to eliminate discomfort and risk of injury.

More in depth, according to the International Ergonomics Association in Zurich, "Ergonomics is the scientific

discipline concerned with the understanding of the interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance."

Ergonomics and workplace safety specialist Dorman Consulting of Victoria, Australia, notes that ergonomists use the data and techniques of a number of disciplines to achieve the best design, among them:

▶ Anthropometry — Body sizes, shapes, populations and variations.

▶ Biomechanics — Muscles, levers, forces and strength.

▶ Environmental physics — Noise, light, heat, cold, radiation, system vibration, hearing, vision and sensations.

Business jet manufacturers that are bringing more of seat design, development and production in-house have taken the science of ergonomics to a new level when creating seats for newer generations of aircraft.

During the research and development phase for its new G500 and G600, Gulfstream Aerospace did extensive human factors testing and enlisted interior and industrial designers to create seats with excellent ergonomics, as well as aesthetics.

"As we developed ultra-long-range aircraft like the G650, G650ER, G500 and G600, we wanted to ensure our seats are configured well for both sitting and sleeping," explained Tom O'Hara, director of design innovation at the Savannah, Georgia, manufacturer. "One of the ways we have achieved this is by constructing the layers of the seat in a way that promotes comfort and dissipates heat.

"Gulfstream's seats were designed to make customers as comfortable in their aircraft as they are at home," O'Hara continued. "Good ergonomics improve blood flow and oxygen rejuvenation." And to that end, he added, "We do extensive long-range seat testing at our state-of-the-art integration test facility to monitor the body's condition in a seat and learn how it responds in specific environments."

At Textron Aviation, its designers paid special attention to the ergonomics of the environment with regard to seating, said Pinkerton. "Our modern aircraft provide unprecedented customer experiences [including] the quality of the materials, cabin sound levels, access to natural light and especially the comfort of the passenger seat during all phases of the flight."

TEXTRON

Builders today see comfort and optimized functions — tilt, swivel, tracking — as main drivers for customers considering a business jet purchase

Textron has also taken the science of ergonomics in a unique direction. "Pressure mapping, for example, plays a pivotal role in understanding the basic levels of comfort," explained Pinkerton.

The company is also developing new technologies for future seats that will enhance the experience with regard to ergonomics. "There are countless standards and guidelines for reference, which provide a really good starting point, but we have spent years fine-tuning the posture of the occupant to maximize comfort," Pinkerton added.

Textron's goal is a modern aircraft in which everything is considered for an "unprecedented customer experience," including the quality of the materials, cabin sound levels, access to natural light and the comfort of the passenger seat during all phases of flight. "Takeoff and landing are just as important as cruise, whether working or sleeping," said Pinkerton.

Collins has also placed a renewed emphasis on ergonomics. "We apply the science of ergonomics from the very beginning of the seat design process," said Ian Webb, vice president of sales and marketing.

"We see comfort and spatial optimization as main drivers when a customer is looking at a business jet seat," Webb pointed out. "To that end, we have revolutionized our seat architecture and high-end seat cushion materials to cradle passengers during all segments of flight, and specifically reduce pressure points in various positions."

Longer Flights Dictate Changes in Seating

In recent years, large-cabin, ultra-long-range business jets have become the fastest growing industry segment. And with nonstop flights in excess of 10 hr. becoming commonplace, cabin seating has taken on a new importance.

TEXTRON (3)

The rise of such models of aircraft, introduced and sustained by the G650 and G650ER, increased the importance of easily berthable seats that really feel like beds, according to O'Hara. "As a result, we developed specific trim styles that can lie flatter with less bolstering to sleep like a mattress. In addition, we created seats that deflect a build-up of pressure and heat, which greatly enhances comfort.

"Gulfstream has invested significant research and development into innovative solutions to keep customers cool while they sit and sleep in our seats over long flights," he said.

The longer the flight, the more important it is to have a seat that can properly support passengers, explained Pieter Likoray, Bombardier's senior vice president of worldwide sales and marketing. "While conceiving the Global 7500 aircraft," he said, "we knew that the cabin experience was just as important as range and speed, and the new Nuage was part of the conversation from the start."

"On a long flight," he continued, "the seat allows for fluid movement and different positions. The result is a home-like environment that allows passengers to arrive at their destination feeling refreshed — something customers value and appreciate in an aircraft that can fly for so many hours."

On such longer flights, explained Robert Connolly, senior director of contracts and specifications for Dassault Falcon Jet, "seats must have multiple uses — sleeping, working, eating, reading, watching movies, meetings; so, we work with the customer to determine the primary use and then make adjustments to the foam buildup to meet their needs."

Seating in the modern business jet seeks to fill the need for many functions in addition to comfort: working, dining, resting, napping. And the side-facing divan is typically designed to convert to a comfortable bed for overnight flights.

More than ever, overall aesthetics have become a part of seat design. In terms of upholstery, Dassault has designed the latest Falcon business jet seats with highly customized quilting, incorporating an accent color thread in a light ivory leather, as well as hand-embroidered designs that include hand beading in each headrest.

"There was also a project in which all the seats were metallic silver [foil

Flat Beds for Legacy Jets

Even as a new generation of business jet seats promises a more comfortable trip on long, nonstop intercontinental flights, there remain thousands of legacy aircraft still in service in which the seats, whose comfort was acceptable for shorter excursions, were definitely not designed not for lay-flat sleeping.

But there are solutions offered by a number of companies in the form of custom-made mattress packages designed to convert cabin seats into comfortable sleeping platforms within minutes.

These packages are typically compact, lightweight (in the 30-40 lb. range), and include the mattress, fitted and flat sheets, and a customized carry-on storage bag; some of them are a bit more luxurious than others. Pricing ranges from $2,500 to slightly more than $8,000 per mattress package, depending on the manufacturer, placement in the cabin and individual styling.

Mattress packages from JetPedic include not only sheets but mattress pad protectors and duvets. And according to the Costa Mesa, California, company, mattress types include micro-pocket coil, latex, gel memory foam and standard foam. Bedding features high-thread-count Egyptian cotton sheets and blankets, plus toppers and bed covers. A complete line of Italian couture labels include Hamburg House, Home Treasures and Peacock Alley — available with custom embroidery and monogramming, "to make your sleeping experience personal."

In-Flight Bedding Solutions Inc. (formerly Custom Comfort Solutions Inflight Bedding) products come with memory-foam contour pillows and matching pillowcases in a choice of standard or king, synthetic or down-filled. The Tyler, Texas, firm also offers "complete customization of all bedding, including embroidery to match any style of aircraft interior."

According to owner Jeff Bone, the latest improvement from the 13-year-old business is a new, lightweight memory foam that creates a firmer foundation. And like all In-Flight bedding materials, it includes fire-blocking. In addition to club mattresses, In-Flight Bedding also offers custom mattresses for divans and dual-divans.

JetBed has a different approach to the creation of bedding to supplement business jet seating. The centerpiece of the San Diego company's solution is a custom-made inflatable air mattress.

There are various systems designed to fit specific aircraft models, contoured to the aircraft's sidewall configuration, seat width, seat height and club spacing. And the comfort level can be adjusted by adding to or reducing the air pressure. According to the company, the JetBed is "light, compact, easy to use and, above all, comfortable."

It takes less than a minute to inflate the mattress between club seats, and approximately the same amount of time to deflate and tuck it back into the carry-on bag, claims JetBed. The bag contains the entire JetBed package, including a battery-powered pump.

According to the company, "Our patented designs allow the user to sleep in the type of comfort expected from their bed at home or in a fine hotel." **BCA**

effect] leather on the front and black leather on the back," said Connolly. "It was very unique."

Comfort over the long haul is also a goal of Switzerland-based Yasava Solutions, and the company has embraced the concept of ergonomics in a way that takes business jet seating beyond the usual.

"By using cutting-edge engineering, advanced ergonomics and socio-cultural parameters," explained founder and CEO Christopher Mbanefo, "we create your interior space that not only represents you but becomes your haven suspended in time between heaven and earth."

"As 21st century humans, we cannot continue flying using outdated design principles," said Mbanefo. "The dynamics of culture and society must be reflected in our design solutions, resulting in a quantum step forward in life quality, while simultaneously respecting the planetary needs for balance.

Part of those solutions is the AïanaWave executive seat that is standard in Yasava's Astral design series cabin. According to Mbanefo, the seat features precision smart mechanics, using gravity as a source of energy, negating the need for complex electrical actuation systems. And he added, "Advanced ergonomics results in a seat that provides superior comfort, based on aero-medical research into long-endurance space travel, and represents the future of VVIP seating for long-endurance flights."

New Seats Meet New Technology

Collins views a new seat as an opportunity to drive the business aviation community forward. "We are very skilled in designing and developing solutions that will be certified on time and on cost, which is definitely one of our main discriminators," said Zimmerman. "A new seat is a tight collaboration between Collins and its customers."

Collins' next-generation Evolution seat was on display this May at the European Business Aviation Convention and Exhibition (EBACE) in Geneva and it "seamlessly combines the commercial first-class seating with executive aircraft seating," said Zimmerman. "It provides greater room inside the cabin due to a unique recline design that allows close-to-the-bulkhead installation."

The seat has a compact pedestal base that allows designers to achieve the appearance of a "floating" seat. It operates on a proprietary triple roller system for a smooth transition between seat positions with minimal effort and also has an extended leg rest.

A one-touch control allows immediate seat adjustments to the proper takeoff and landing positions, as well as a deep recline position to reduce pressure points during flight. A patented

Business jet seats today are designed with the total cabin aesthetics in mind, from colors to materials to stitching.

headrest with tilt provides head and neck support for reading or working and fits flush into the backrest when the seat is in the full-flat position. Articulating armrests can be lowered to create a wider sleeping surface.

"Once a seat has been certified dynamically, we have parameters that will guide the number of changes that can be incorporated," explained Zimmerman. "For example, we have a maximum certified weight, occupant center of gravity and occupant heat path data that must be respected."

When a customer desires changes, Collins' certification department will analyze the requests and provide options/feedback to try to meet with the customer's request while respecting the certification package.

According to PAC Seating Systems, "comfort has been an existing demand for the past five to 10 years, in particular since the Boeing Business Jet became popular in 2000," explained Director Andrew Perl. He noted that one of the key attributes of the PAC VIP single seat is that its upholstery can be of any density of foam, including any combination of densities with regard to the occupant load area.

And now available as an option on all leg rests, whether manual or motorized, is the auto-extending foot rest. "With the auto-extended foot rest," said Perl, "a tall person's feet are no longer hanging off the end of the leg rest."

Another trend is the growing popularity of the Palm City, Florida, company's POD sleeper seats, "a great way to accommodate more passengers in greater sleeping comfort, compared with a single seat," he observed. The PAC POD is fully motorized, offers infinite positions, and has such features as position memory; large, one-piece counter-balanced meal trays; reading lights; privacy dividers (manual and motorized); and provisions for a variety of inflight entertainment options. PAC has certified single, double and triple versions of its POD sleeper seat and has provided them for all types of narrow-body and widebody private jets, including Airbus Corporate Jets and Boeing Business Jets variants.

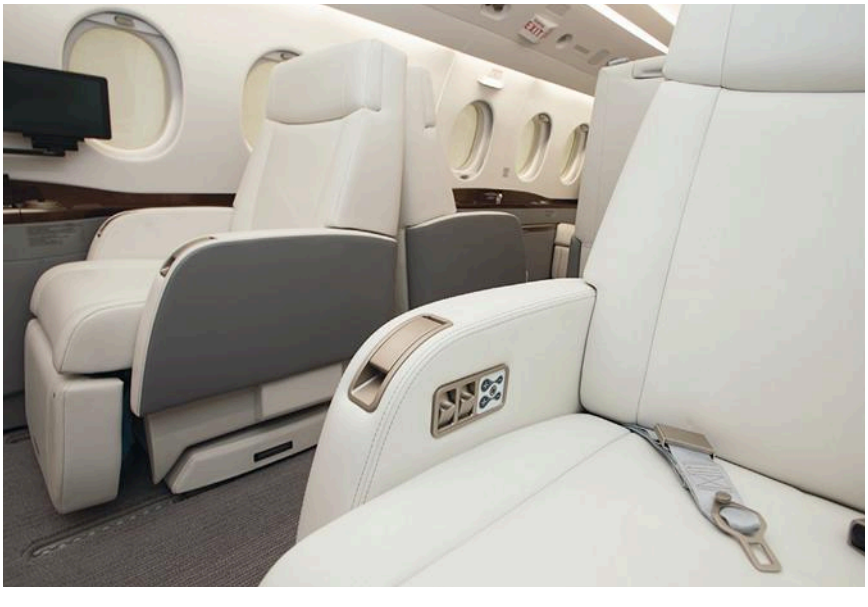
In 2017 and 2018, PAC received 25 new FAA seating certifications, of which almost all were for dynamically tested 16-G designs, but Perl adds that such a high-G certification "is no excuse for hard or thin seat and back cushions; it's an indication of poor design and lack of experience." PAC now provides a standard composite back shell with every seat, emphasized Perl, who added that patented design shortens upholstery time by about 20%. It can also be removed (with the back cushion attached) in about 10 min., providing easy maintenance access to shoulder belt inertia reels and seat back-mounted lumbar systems.

More than half the seats produced by PAC are motorized. "The system is quiet, reliable and easily customized," said Perl. "Features include recline, leg and foot rests, four-way lumbar support and release of track and swivel locks."

Meanwhile, at this year's EBACE, Bombardier Business Jets unveiled the prototype of its new Nuage Chaise, to be featured on the latest of its Global family of large-cabin business jets.

In fact, the Nuage seating collection was honored on May 24 at the Ninth Annual International Yacht & Aviation

With non-stop flights that often stretch well beyond 10 hr., the first consideration today in creating a business jet seat is comfort.



DASSAULT AVIATION

Awards competition with the first-place trophy in the Seating Design category.

The patented Nuage Chaise was conceived, designed and configured for exceptional comfort on longer flights. Philippe Erhel, the Montreal manufacturer's Design Lab supervisor, described it as "the first meaningful change in the operation and design of a business aircraft seat in 30 years." And he added, "Bombardier completely re-engineered the inner structure and architecture to fundamentally alter the way the seat moves and supports the passenger."

At the heart of the Nuage Chaise are three features Bombardier says are key:

▶A deep recline featuring a patented tilt-link system that pivots the seat backward at the knees as it reclines, keeping the body fully supported with no added pressure on the legs.

▶A unique floating base that houses a novel fluid-movement system, making for effortless tracking, and a swivel axis that maintains an intuitively centered point of rotation in any position.

▶A singular tilting headrest based on ergonomics provides for essential neck support, helping maintain "an effortless line of sight when watching television or reading in a reclined position."

When in full-flat mode, the length of the Nuage Chaise is 85.5 in., longer than a standard commercially available bed.

"The very identity of the Global 7500 aircraft — a business jet designed to fly longer distances than ever before possible — created the need for a seat that could provide superior ergonomic support on such flights," explained Erhel. "So, we designed a seat that, somewhat paradoxically, is built around motion."

The body needs movement and needs to shift positions, and the Nuage Chaise puts many options into the hands of passengers. While the seat has some electrically operated controls, the design team made it a point to give passengers tactile control to achieve the most comfortable positions. Most movements, therefore, are not powered electronically, but respond intuitively to the passenger's position, orientation and weight distribution. The idea was to create a chair that would provide passengers with the flexibility and support to easily alternate between various positions.

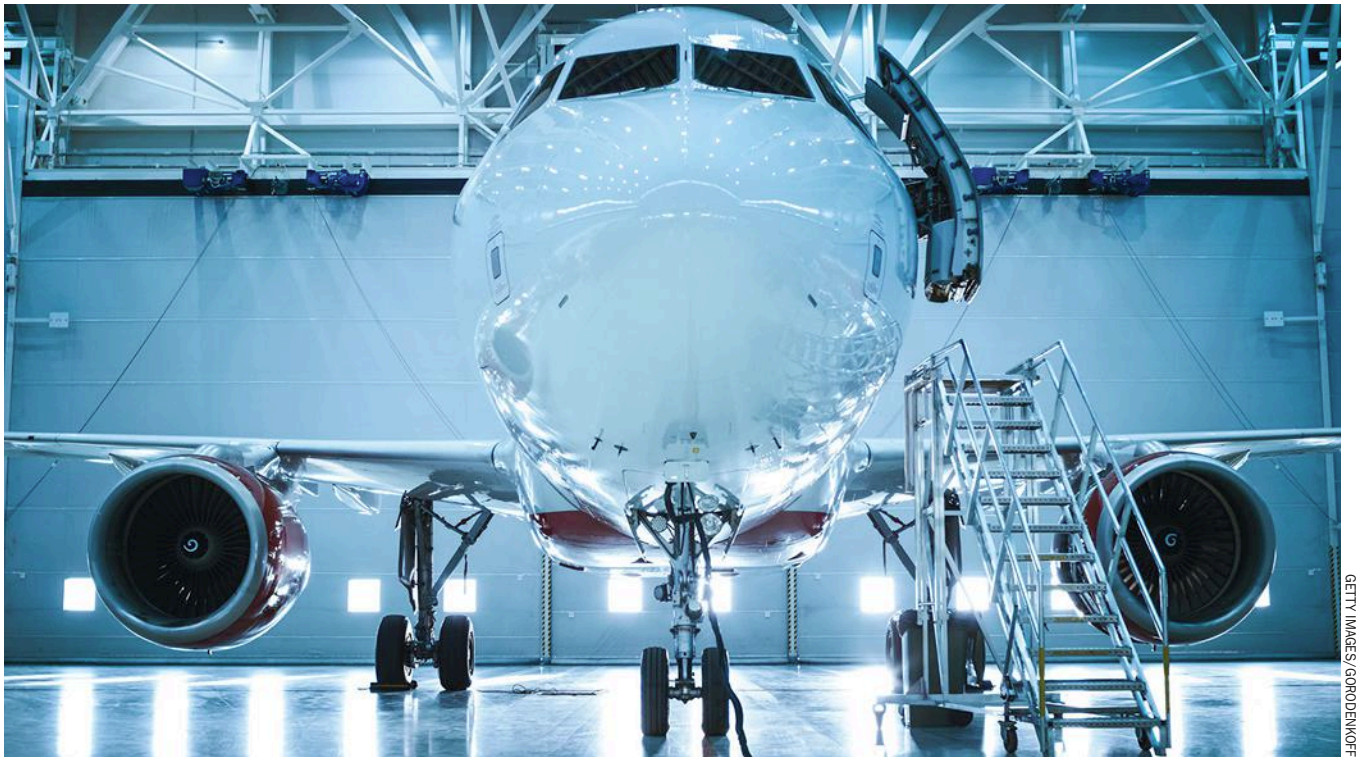
"My participation in the design of the Nuage program is a career highlight so far," said Erhel, "The period from conception to certification lasted about eight years, and the result is something of which we are extremely proud — a seat that raises the bar across the industry," he concluded.

Raising the bar in terms of business jet seating technology, materials and comfort is something continuing to occur across the industry.

Describing seating in the cabin environment, Yasava's Mbanefo explained that it is a matter of seeking a balance between the individual and the space. "The space so defined creates harmony, supporting the authenticity of the individual, and results in lightness of the mind, soul and body.

"Our objective is to realize these principles," he continued, "by creating the ultimate space for you to achieve the most luxurious and timeless flight experience in your aircraft." **BCA**

How to Use the Operations Planning Guide



GETTY IMAGES/GORODENKOFF

BY **PAUL LAFATA** plafata@airpowersgi.com

This year's Guide covers turbine-powered, in-production aircraft. For out-of-production aircraft data contact AirPower Software Group Inc. Aircraft operating costs are presented in a format that separates information into six areas: Direct Costs, Fixed Costs, Variable Costs, Annual Cockpit Subscription Services Costs, Annual Cabin Services Costs and Annual Trip Support Costs.

Aircraft Category

Aircraft are grouped into six categories reflecting similarity of aircraft size, mission and operations. Category 1 aircraft are turboprops weighing less than 12,500 lb. and very-light jets weighing less than 10,000 lb.; Category 2, multi-engine turboprops weighing 12,500 lb. or more and light jets weighing 10,000 to 19,999 lb.; Category 3, jets weighing 20,000 to 29,999 lb.; Category 4, jets weighing 30,000 to 40,999 lb.; Category 5, jets weighing 41,000 lb. and up; and Category 6, ultra-long-range jets with NBAA IFR ranges above 6,000 nm. Certain data are common to all aircraft in a category for purposes of calculating mission cost by listed range including airframe systems parts and labor, engine reserves, APU reserves, and propeller reserves for turboprop aircraft. Fixed costs, annual cockpit subscription services costs, annual cabin services costs and annual trip support costs figures are provided for reference only, and are not included in the Direct Operating Cost (DOC) figure for each of the mission ranges.

BCA Equipped Price

This number is taken from the June 2019 *Purchase Planning Handbook,* and reflects *BCA*-equipped, completed aircraft. The listed price is based on the latest model produced.

Direct Costs

Direct Costs are calculated based on the business aircraft missions shown in *BCA*'s June 2019 *Purchase Planning Handbook*. Three missions are shown for each aircraft: 300 nm, 600 nm and 1,000 nm. Ultra-long-range aircraft (Category 6) missions are 1,000 nm, 3,000 nm and 6,000 nm. The fuel expense for each mission is based on the fuel burn figure for the mission, provided by the OEM, and calculated under conditions shown in the June *Handbook*. Missions are calculated utilizing the manufacturer's recommended cruise setting; therefore, cruise settings may vary from aircraft to aircraft, *i.e.* max cruise versus long range. Where the aircraft cannot cover

the mission distance with an 800-lb. (four-passenger) payload, *BCA* shows a reduction in payload or a reduction in mission length at the editor's option.

Direct Costs include a bundling of mission fuel consumed from *BCA*'s *Purchase Planning Handbook,* maintenance labor, parts and reserve costs from the Variable Costs section of this Guide, apportioned to the actual flight time for the listed nautical mile mission length. Fuel price used is based on a nationwide average price of $5.19 per gallon for Jet-A at press time. The fuel consumption figure accounts for taxi, takeoff, climb, cruise, descent and landing for the applicable mission as appropriate for the aircraft category. (Note: Longer missions will lower average hourly fuel burns due to more time in cruise; conversely, shorter missions will increase average hourly fuel burn figures since proportionally more time is spent in the takeoff and climb phase rather than cruise.)

Fixed Costs (Annual)

This area of expense includes those costs that must be borne by a flight department irrespective of the level of aircraft utilization. The years 2017 and 2018 have been transitional, particularly for flight crew salaries. Airline demand for qualified pilots, retirements and geographical factors have resulted in substantial changes in compensation. Salary surveys published this year quickly become obsolete as qualified crew demand outstrips supply.

Salaries: Included are salaries for Flight Crew, Cabin Crew and Director of Maintenance where appropriate. We interviewed Sheryl Barden, CEO at Aviation Personnel International (API), for state of the industry insights with respect to aviation salaries. Retention strategies including bonuses, vesting stock options, work-life balance and general working conditions in flight departments, large or small, play key roles in mitigating personnel churn and attracting talent. The supply and demand equation for qualified staff remains out of balance, which drives total compensation according to Barden. Multiple-aircraft flight departments may or may not employ pilots as first officers, instead opting to qualify all pilots as captains. Directors of maintenance can have a direct impact on airframe resale value by ensuring a high degree of aircraft maintenance and repair status along and associated documentation, according to Barden. In summary, variation across the industry relative to total compensation is substantial. Therefore, benefits are not a calculated factor in salary estimates that would ordinarily cover health care, retirement, bonuses and other benefits typical for a corporate flight department. Salary figures are based on a nationwide average of quotes taken by ARGUS from aircraft operators.

Flight Crew Recurrent Training: Expenses shown are based on average transaction costs for representative aircraft models. Actual expenses can vary due to market capacity fluctuations, changes in training locations, and other factors such as training volume and length of commitment. Chris Weinberg, CEO of Avmkt.com, formerly Simhawk, notes the crew training landscape has changed significantly over the last 12 months with a number of acquisitions and new developments. FlightSafety International and Textron Aviation announced a joint venture to serve operators of the Cessna, Hawker and Beechcraft product lines. Simcom Aviation Training was acquired by Flexjet and Nextant parent company, Directional Aviation, which marked a major new entrant into the business aviation training space. Lastly, CAE purchased Bombardier's business aircraft training unit. Additionally, there has been continued expansion of in-aircraft or hybrid training options (flight training device with in-aircraft training) for non-type-rated turboprop aircraft as well as a number of owner-flown jets. Insurance underwriters continue to expand the number of approved training providers for these platform types, and many of the operators are seeking training options that are closer to their base location, or that require less time away from it.

Training costs remained effectively flat for current-production aircraft, according to Weinberg, with the exception of new programs that either have sole sourcing agreements or very limited capacity as aircraft deliveries ramp up. Actual pricing for out-of-production aircraft also remained flat or saw a small decrease due to excess capacity as attrition occurs with those fleets. Training expenses shown are based on average transaction costs for representative aircraft models on Avmkt's marketplace along with market research and survey results. Actual expenses can vary due to market capacity fluctuations, changes in training locations, and other factors such as training volume and length of commitment.

Cabin Crew Recurrent Training: These expenses were provided by telephone survey with a leading aviation training company.

Maintenance Training: This estimated cost is per-technician and includes initial maintenance training on an aircraft model. Data reflected here were compiled and analyzed by ARGUS.

Hull and Liability Insurance: This year we interviewed Tom Hauge at Wings Insurance. "My job as an insurance broker is akin to that of a salesman," he said. "I work to position the buyer in the best possible light to the underwriter. The level of thoroughness achieved through interviews with my clients can directly correlate to the quality of the quote." Come prepared to give your broker all the information needed to put you in front of an underwriter. Your broker will ask about your:

- Pilot experience (the more detail provided, the better).
- Planned utilization for the aircraft, including estimated annual flight hours, territory you plan to operate in and how you will use the aircraft for pleasure or business purposes.
- Detailed training plan (if you are transitioning into a higher performance aircraft or turbine transition, this area is particularly important to define).
- Your broker will also dig into your use case for the aircraft, including:
- Where you fly.
- How many times a year you utilize the aircraft.
- Expectations on liability coverages/any third-party passenger exposure.
- Where the aircraft is based and how it is secured when finished flying.
- And more.

Aviation insurance policies can vary widely. When you get down to the final step of selecting one insurance policy over another, choose the proper policy for broadness of coverage, liability limit needs, checkout or transition requirements and finally pricing. Other considerations include: Do you plan to dry lease time in the aircraft to a third party? Does the policy cover this use? Can dry leasing be added to the policy? What minimum experience requirements do your pilots need to have to be approved by the policy underwriting company? Do all your pilots currently hold these qualifications and experience, and if not, what will be required to have them approved by the insurance underwriting company?

These are just examples to consider. When you review your policy choices,

make sure all your missions/usage, pilots, etc. are covered. Without this knowledge, you could find yourself in an uncovered situation, responsible for a multitude of damages. With the right broker by your side, and the proper information, timing and knowledge about your policy, you can smoothly navigate the aviation insurance purchasing process and gain a policy that best fits your needs. Insurance estimates are based on the aircraft flown by professional, simulator-trained flight crews.

Hull Insurance per $100: This is the factor used as a multiplier to arrive at the total annual cost of hull insurance for a particular aircraft. It is derived from actual aviation insurers' quotes. Insurance quotes can vary greatly depending upon if the aircraft is covered under a fleet policy or a standalone policy. The first number reported is the estimated annual cost of hull insurance for a particular aircraft based on its *BCA*-equipped price as reported in the June 2019 *Purchase Planning Handbook*. The cost is computed by multiplying the cost per $100 of hull insurance factor by the *BCA*-equipped aircraft price. The figure includes war risk coverage, which constitutes on average $0.03 to $0.05 per $100 of hull insurance.

Liability Insurance per $M: This figure represents the total annual cost for liability insurance for an aircraft model. Aircraft in Category 1 are assumed to carry $25 million in liability insurance; Category 2 aircraft carry $100 million; and Categories 3 through 6 carry $200 million in liability insurance coverage. The annual cost is computed by multiplying the amount of liability coverage in millions by a per $M factor supplied to ARGUS by leading providers of this type of insurance coverage.

Hangar/Office: Expenses shown here are based on national average annual costs reported by flight departments in 2017 and escalated for 2019 based on the annual rate of expected inflation. The figures shown in each cost area are broken down by the six aircraft categories and will generally be the same for all aircraft of a particular category. This figure is an annual cost per aircraft and includes hangar and office rent as well as additional facilities costs such as utilities, ground upkeep, snow removal, janitorial service and insurance (other than aircraft insurance).

For more than one aircraft, it is valid to multiply the figure by the number of aircraft to arrive at a total flight department cost. Actual rental costs will vary widely from one geographical area to another.

Maintenance Software Programs: The figure shown for Maintenance Software Programs represents the average annual cost for a software program to track maintenance activities, intervals and expenses. This number represents an average cost as reported by various providers of maintenance software.

Variable Costs (Per Flight Hour)

These expenses are directly related to operation of the aircraft and are represented as an hourly cost figure. Included are Airframe Systems Parts and Labor Expense, and Engine, APU, Avionics and Propeller Reserves expenses as appropriate. For in-production aircraft it is assumed the aircraft is covered by the manufacturer's warranty. Figures shown are based on aircraft OEM direct estimates with warranty effect incorporated unless otherwise noted. For OEMs that did not participate this year, an inflation escalation was added to the most current available data.

Labor expense is computed by multiplying the Maintenance Labor Hours per Flight Hour ratio by the nationwide average service center hourly maintenance labor cost (Category 1: $105/hr.; Category 2: $105/hr.; Category 3: @110/hr.; Category 4: $115/hr.; Category 5: $120/hr.; Category 6: $120/hr.). Labor expenses for each Category noted here were used in the preparation of in-production aircraft maintenance labor costs per flight hour.

Airframe Systems Parts and Labor: This figure is a model-specific hourly expense with warranty taken into account. It should be noted that warranty periods and coverage vary from OEM to OEM and are not specifically defined in this description. Contact the OEM for policies related to new aircraft warranty and pre-owned aircraft within the warranty period for transfers related to the airframe, engines, APUs and avionics. The following descriptions define how maintenance man-hours and parts expense were calculated into mission costs:

Maintenance Labor Hours per Flight Hour: An aircraft manufacturer-supplied ratio of maintenance man-hours per flight hour. The number reflects an average for the first five years of operation while under warranty including scheduled maintenance and unscheduled maintenance events. Maintenance man-hours per flight hour are multiplied by the corresponding labor rate, by aircraft category and incorporated into the Airframe Systems Parts and Labor data.

Parts Expense: This hourly expense is derived from model-specific manufacturer's quotes and includes parts expenses for airframe systems. In-production aircraft parts expenses provided by the OEM have warranty taken into consideration. It should be noted that some warranty periods covered time frames less than five years but are not specifically called out in the

Guide. Airframe systems parts calculations assume unscheduled maintenance events would be covered by warranty, and does not include reserves for engine or APU overhauls, hot sections or long-range maintenance events, or propeller reserves. Those items are listed separately in the variable cost section. Avionics repair costs during the warranty period would also be covered by OEM warranty and therefore no reserve costs are shown for the Category 1-6 platforms. Regulatory mandates should be separately budgeted for when evaluating operating costs for each aircraft.

Engine Reserves and APU Reserves (where applicable): These expenses are based on OEM input for in-production aircraft where provided. Engine and APU OEMs and third-party service providers offer programs designed to fix or cover the operator's scheduled and unscheduled maintenance requirements on a per-hour, fee-paid basis. Engine and or APU loaners may be covered by these programs for unscheduled events resulting in significant out-of-service time for the aircraft. Consult policy terms and conditions or the service provider for specifics.

Avionics Reserves: For in-production aircraft, avionics reserves for Categories 1 through 6 are assumed not to be applicable due to OEM warranty coverage during the first five years of operation following entry into service. Additionally, upgrades to cover regulatory mandates are not factored in hourly operating costs.

Propeller Reserves (where applicable): These expenses are based on OEM input for in-production turboprop aircraft.

Annual Cockpit Subscription Services Costs

These are expenses directly related to cockpit navigation equipment database updates, safety services associated with Flight Planning, Cockpit Data Link and other services associated with flight operations. These services are typically purchased through the OEM in the case of FMS and GPS navigators or ground proximity system databases, and service providers for Data Link, Flight Planning, Charts and Maps, and digital Weather-related products. Information in this section is dependent on cockpit avionics configuration and pricing offered at the time of aircraft delivery, or as contracted with a cockpit services provider. Procurement of subscription services from a provider that offers training support on use of products as well as troubleshooting, system configurations on-wing and satellite communication link setup for service delivery where needed are highly desirable support elements. Typical subscription costs that vary depending on mission needs are reflected in this section. However, annual aircraft utilization and bundling of other services may reduce these expenses.

Navigation and EGPWS/TAWS Databases: Annual subscription prices are derived from OEM data sources or estimated where OEMs do not publish publicly available pricing, and therefore should be viewed as directionally correct for budgetary planning purposes. Navigation database prices do not include optional bundled or enhanced feature pricing unless specifically noted. For example, Navigation database, plus terrain, traffic or other charts and maps can be covered in a one-time renewal, or annual subscription price depending on the avionics manufacturer. The aircraft or database supplier should be consulted for price quotes. Expenses shown vary depending on cockpit avionics equipment configurations and are approximated averages for in-production aircraft.

Annual Cabin Services Costs

Cabin Services Costs assume the aircraft is optioned with appropriate equipment at time of delivery from the factory. AirPower Software provided budgetary planning numbers for Swift Broadband (SBB), Ka/Ku, SatTV, cockpit data link and Cabin/Iridium Phone services. Estimated Air-to-Ground service costs are derived from published pricing where available. Cabin services with the exception of Air to Ground and Cabin/Iridium Phone are applicable to aircraft Categories 4 through 6 due to suitable empennage and/or vertical stabilizer antenna/radome solutions and suitable space for installation. Not included in Cabin Services Costs are activation, on-wing field labor support, aircraft crew training expense or ongoing technical support associated with troubleshooting complex satellite communications equipment and networks. Many service providers offer a continuum of support services and should be contacted directly for information related to ongoing support and service activation.

Annual Trip Support Costs

Annual Trip Support expenses are similar for all aircraft in a particular category, reflecting comparable aircraft capabilities and mission utilization. Trip Support Costs include Catering Service, Flight Crew Travel, International Trip Support, Concierge, Ground Handling and Landing/Parking Fees. Fees reflected are annual numbers assigned to specific aircraft categories. For aircraft in Categories 5 and 6, 400 annual flight-hour utilization rates were used to arrive at budgetary planning estimates. For Categories 1 through 4, 250 annual flight-hour utilization rates were used. Mission durations vary substantially, which resulted in a change in the way these costs were calculated for the 2019 *Operations Planning Guide.*

Many operators elect to use a service provider in the case of Concierge and International Trip Support due to complexities associated with overflight and landing permitting and other logistical arrangement. International Trip Support and Concierge were not factored in for aircraft in Categories 1 through 4 unless otherwise noted, or the aircraft had sufficient NBAA IFR range sufficient to justify a budgetary planning estimate.

General

Abbreviations and annotations are used throughout the tables: "NA" means not available or not applicable to a particular aircraft model. As an example single-pilot-certified aircraft will not include a salary for the first officer. "NP" signifies that the specific performance is not possible and "OC" means On Condition.

Model Footnotes:

(1) Cirrus Aircraft offers the JetStream program, an all-inclusive operating cost per flight hour product that includes recurrent training, all scheduled and unscheduled maintenance, all subscriptions and more. Variable costs, which are normally included in JetStream, are broken out only for the purposes of calculating direct mission costs for each of the predefined ranges, and are based on the JetStream two-year/600-hr. program, and AirPower's estimates.

(2) Cessna Citation Longitude APU reserves are included in the engine reserve cost. These are pre-certification estimates based on data noted in the June 2019 *BCA Purchase Planning Handbook* and Textron operating cost inputs. **BCA**

Production Aircraft — Category 1 — Turboprops <12,500 lb. – Jets <10,000 lb.

	Manufacturer	Mahindra Aerospace	Piper Aircraft	Textron Aviation	Cirrus Aircraft
	Aircraft Model	Airvan 10	M500	Cessna Caravan	Vision G2**
	Category (1-6)	1	1	1	1
	BCA Equipped Price	$1,700,000	$2,209,999	$2,320,000	$2,380,000
DIRECT COSTS	300 nm	$794	$597	$910	$691
	600 nm	$2,050	$1,074	$1,780	$1,420
	1,000 nm	NP	$1,777	NP	$2,263
	3,000 nm	—	—	—	—
	6,000 nm	—	—	—	—
FIXED COSTS	Captain Salary	$84,150	$84,150	$84,150	$84,150
	First Officer Salary	SP*	SP*	SP*	SP*
	Cabin Crew Salary	NA	NA	NA	NA
	Director of Maintenance Salary	NA	NA	NA	NA
	Flight Crew Recurrent Training	$4,500	$4,500	$4,500	$14,000
	Cabin Crew Recurrent Training	NA	NA	NA	NA
	Maintenance Training	NA	NA	NA	NA
	Hull Insurance per $100	$10,710	$13,923	$14,616	$20,230
	Liability Insurance per $M	$5,500	$5,000	$5,500	$5,500
	Hangar/Office	$16,391	$16,391	$16,391	$16,391
	Maint. Software Programs	NA	NA	$1,523	NA
VARIABLE COSTS	Airframe Sys. Parts & Labor	$71	$98	$122	$137
	Engine Reserves	$100	$120	$119	$137
	APU Reserves	NA	NA	NA	NA
	Avionics Reserves	NA	NA	NA	NA
	Propeller Reserves	$4	$4	$4	NA
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	$924	$1,000	$1,000	$1,200
	EGPWS/TAWS Database	$150	Incl. in Nav Database	Incl. in Nav Database	Incl. in Nav Database
	Flight Planning	NA	NA	NA	NA
	Wx Services	NA	NA	NA	$1,200
	Charts & Maps	NA	NA	NA	$1,200
ANNUAL CABIN SERVICES COSTS	Swift Broadband	NA	NA	NA	NA
	Ka/Ku	NA	NA	NA	NA
	Air to Ground	NA	NA	NA	NA
	SatTV	NA	NA	NA	NA
	Cabin/Iridium Phone	NA	$2,000	$2,000	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	NA	$3,090	$3,090	$3,090
	Flight Crew Travel	NA	$2,030	$2,030	$2,030
	International Trip Support	NA	NA	NA	NA
	Concierge	NA	NA	NA	NA
	Ground Handling	$2,010	$2,030	$2,030	$2,030
	Landing/Parking Fees	$1,000	$1,000	$1,000	$1,000

*FAA certified for single-pilot operations
**See footnote in "How to Use the 2019 Operations Planning Guide"

Production Aircraft — Category 1 — Turboprops <12,500 lb. – Jets <10,000 lb.

	Manufacturer	Quest Aircraft	Textron Aviation	Nextant Aerospace	Vulcanair SpA
	Aircraft Model	Kodiak	Grand Caravan EX	G90XT	A-Viator
	Category (1-6)	1	1	1	1
	BCA Equipped Price	$2,454,800	$2,685,000	$2,750,000	$2,956,000
DIRECT COSTS	300 nm	$934	$995	$954	NA
	600 nm	$1,824	$1,948	$1,903	NA
	1,000 nm	$3,009	NP	$3,166	NP
	3,000 nm	—	—	—	—
	6,000 nm	—	—	—	—
FIXED COSTS	Captain Salary	$84,150	$84,150	$103,790	$99,595
	First Officer Salary	SP*	SP*	SP*	SP*
	Cabin Crew Salary	NA	NA	NA	NA
	Director of Maintenance Salary	NA	NA	NA	NA
	Flight Crew Recurrent Training	$4,500	$4,500	$8,000	$4,500
	Cabin Crew Recurrent Training	NA	NA	NA	NA
	Maintenance Training	NA	NA	NA	NA
	Hull Insurance per $100	$15,465	$18,795	$17,325	$18,623
	Liability Insurance per $M	$5,500	$4,625	$5,500	$5,500
	Hangar/Office	$16,391	$16,391	$16,391	$16,391
	Maint. Software Programs	NA	$1,523	NA	NA
VARIABLE COSTS	Airframe Sys. Parts & Labor	$107	$122	$214	NA
	Engine Reserves	$154	$120	$224	NA
	APU Reserves	NA	NA	NA	NA
	Avionics Reserves	NA	NA	NA	NA
	Propeller Reserves	$8	$4	$18	$18
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	$1,000	$1,000	$1,500	NA
	EGPWS/TAWS Database	Incl. in Nav Database	Incl. in Nav Database	NA	NA
	Flight Planning	NA	NA	NA	NA
	Wx Services	NA	NA	NA	NA
	Charts & Maps	NA	NA	NA	NA
ANNUAL CABIN SERVICES COSTS	Swift Broadband	NA	NA	NA	NA
	Ka/Ku	NA	NA	NA	NA
	Air To Ground	NA	NA	NA	NA
	SatTV	NA	NA	NA	NA
	Cabin/Iridium Phone	$2,000	$2,000	$2,000	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	$3,090	$3,090	$6,090	NA
	Flight Crew Travel	NA	$2,030	$4,060	NA
	International Trip Support	NA	NA	NA	NA
	Concierge	NA	NA	NA	NA
	Ground Handling	$2,030	$2,030	$2,030	NA
	Landing/Parking Fees	$1,000	$1,000	$4,060	NA

*FAA certified for single-pilot operations

Production Aircraft — Category 1 — Turboprops <12,500 lb. – Jets <10,000 lb.

	Manufacturer	Piper Aircraft	Epic Aircraft	Daher
	Aircraft Model	M600	Epic**	TBM 910
	Category (1-6)	1	1	1
	BCA Equipped Price	$3,189,000	$3,250,000	$4,069,964
DIRECT COSTS	300 nm	$636	NA	$571
	600 nm	$1,132	NA	$1,084
	1,000 nm	$1,898	NA	$1,751
	3,000 nm	—	—	—
	6,000 nm	—	—	—
FIXED COSTS	Captain Salary	$84,150	$84,150	$84,159
	First Officer Salary	SP*	SP*	SP*
	Cabin Crew Salary	NA	NA	NA
	Director of Maintenance Salary	NA	NA	NA
	Flight Crew Recurrent Training	$4,500	$4,500	$4,500
	Cabin Crew Recurrent Training	NA	NA	NA
	Maintenance Training	NA	NA	NA
	Hull Insurance per $100	$20,091	$22,750	$28,490
	Liability Insurance per $M	$5,000	$5,500	$5,500
	Hangar/Office	$16,391	$16,391	$16,391
	Maint. Software Programs	NA	NA	$6,710
VARIABLE COSTS	Airframe Sys. Parts & Labor	$98	NA	$81
	Engine Reserves	$120	NA	$144
	APU Reserves	NA	NA	NA
	Avionics Reserves	NA	NA	NA
	Propeller Reserves	$4	$9	$5
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	$1,200	NA	$1,300
	EGPWS/TAWS Database	Incl. in Nav Database	NA	Incl. in Nav Database
	Flight Planning	NA	NA	NA
	Wx Services	NA	NA	NA
	Charts & Maps	NA	NA	NA
ANNUAL CABIN SERVICES COSTS	Swift Broadband	NA	NA	NA
	Ka/Ku	NA	NA	NA
	Air to Ground	NA	NA	NA
	SatTV	NA	NA	NA
	Cabin/Iridium Phone	$2,000	NA	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	$3,090	NA	$3,090
	Flight Crew Travel	$2,030	NA	$2,030
	International Trip Support	NA	NA	NA
	Concierge	NA	NA	NA
	Ground Handling	$2,030	NA	$2,030
	Landing/Parking Fees	$1,000	NA	$1,000

*FAA certified for single-pilot operations
**OEM input not available

Production Aircraft — Category 1 — Turboprops <12,500 lb. – Jets <10,000 lb.

	Manufacturer	Textron Aviation	Daher	Pilatus
	Aircraft Model	Beechcraft King Air C90GTx	TBM 930	PC-12 NG
	Category (1-6)	1	1	1
	BCA Equipped Price	$4,200,000	$4,346,150	$4,988,000
DIRECT COSTS	300 nm	$1,134	$571	$787
	600 nm	$2,126	$1,084	$1,458
	1,000 nm	$3,353	$1,751	$2,346
	3,000 nm	—	—	—
	6,000 nm	—	—	—
FIXED COSTS	Captain Salary	$103,790	$84,159	$84,159
	First Officer Salary	SP*	SP*	SP*
	Cabin Crew Salary	NA	NA	NA
	Director of Maintenance Salary	NA	NA	NA
	Flight Crew Recurrent Training	$8,000	$4,500	$4,500
	Cabin Crew Recurrent Training	NA	NA	NA
	Maintenance Training	NA	NA	NA
	Hull Insurance per $100	$26,460	$30,423	$30,926
	Liability Insurance per $M	$3,875	$5,500	$5,500
	Hangar/Office	$16,391	$16,391	$16,391
	Maint. Software Programs	$5,781	NA	$2,581
VARIABLE COSTS	Airframe Sys. Parts & Labor	$204	$81	$172
	Engine Reserves	$238	$144	$134
	APU Reserves	NA	NA	NA
	Avionics Reserves	NA	NA	NA
	Propeller Reserves	$14	$5	$4
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	$12,000	$1,300	$13,790
	EGPWS/TAWS Database	$6,995	$350	Incl. in Nav Database
	Flight Planning	NA	NA	NA
	Wx Services	NA	NA	NA
	Charts & Maps	NA	NA	NA
ANNUAL CABIN SERVICES COSTS	Swift Broadband	NA	NA	NA
	Ka/Ku	NA	NA	NA
	Air to Ground	NA	NA	NA
	SatTV	NA	NA	NA
	Cabin/Iridium Phone	$2,000	$2,000	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	$6,090	$3,090	$3,090
	Flight Crew Travel	$4,060	$2,030	$2,030
	International Trip Support	NA	NA	NA
	Concierge	NA	NA	NA
	Ground Handling	$2,030	$2,030	$2,030
	Landing/Parking Fees	$4,060	$1,000	$1,000

*FAA certified for single-pilot operations

Production Aircraft — Category 1 — Turboprops <12,500 lb. – Jets <10,000 lb.

	Manufacturer	Viking Air	Textron Aviation	Piaggio
	Aircraft Model	400 Series*	Beechcraft King Air 250	Avanti Evo
	Category (1-6)	1	1	1
	BCA Equipped Price	$6,500,000	$6,610,000	$7,695,000
DIRECT COSTS	300 nm	NA	$1,178	$932
	600 nm	NA	$2,142	$1,670
	1,000 nm	NA	$3,329	$2,613
	3,000 nm	—	—	—
	6,000 nm	—	—	—
FIXED COSTS	Captain Salary	$99,595	$103,790	$103,790
	First Officer Salary	SP**	SP**	SP**
	Cabin Crew Salary	NA	NA	NA
	Director of Maintenance Salary	NA	NA	NA
	Flight Crew Recurrent Training	NA	$16,000	$16,000
	Cabin Crew Recurrent Training	NA	NA	NA
	Maintenance Training	NA	NA	NA
	Hull Insurance per $100	$26,000	$26,440	$42,323
	Liability Insurance per $M	$3,875	$3,875	$5,000
	Hangar/Office	$16,391	$16,391	$16,391
	Maint. Software Programs	NA	$5,781	NA
VARIABLE COSTS	Airframe Sys. Parts & Labor	NA	$204	$195
	Engine Reserves	NA	$261	$238
	APU Reserves	NA	NA	NA
	Avionics Reserves	NA	NA	NA
	Propeller Reserves	NA	$16	$19
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	NA	$12,000	$12,000
	EGPWS/TAWS Database	NA	$6,995	$6,995
	Flight Planning	NA	NA	NA
	Wx Services	NA	NA	NA
	Charts & Maps	NA	NA	NA
ANNUAL CABIN SERVICES COSTS	Swift Broadband	NA	NA	NA
	Ka/Ku	NA	NA	NA
	Air to Ground	NA	NA	NA
	SatTV	NA	NA	NA
	Cabin/Iridium Phone	NA	$2,000	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	NA	$6,208	$6,208
	Flight Crew Travel	NA	$4,005	$4,005
	International Trip Support	NA	NA	NA
	Concierge	NA	NA	NA
	Ground Handling	NA	$2,003	$2,003
	Landing/Parking Fees	NA	$4,060	$4,060

*OEM input not available
**FAA certified for single-pilot operations

Production Aircraft — Category 2 — Turboprops ≥12,500 lb. – Jets <20,000 lb.

	Manufacturer	Embraer	Nextant Aerospace	Textron Aviation	Honda Aircraft Co.
	Aircraft Model	Phenom 100 EV	Nextant 400 XTi	Cessna Citation M2	HondaJet Elite
	Category (1-6)	2	2	2	2
	BCA Equipped Price	$4,495,000	$4,650,000	$5,150,000	$5,280,000
DIRECT COSTS	300 nm	$999	$1,056	$1,046	$967
	600 nm	$1,781	$1,863	$1,853	$1,711
	1,000 nm	$2,851	$3,040	$2,882	$2,745
	3,000 nm	—	—	—	—
	6,000 nm	—	—	—	—
FIXED COSTS	Captain Salary	$112,409	$112,409	$112,409	$112,409
	First Officer Salary	SP*	SP*	SP*	SP*
	Cabin Crew Salary	NA	NA	NA	NA
	Director of Maintenance Salary	NA	NA	NA	NA
	Flight Crew Recurrent Training	$14,000	$14,000	$14,000	$14,000
	Cabin Crew Recurrent Training	NA	NA	NA	NA
	Maintenance Training	NA	NA	NA	NA
	Hull Insurance per $100	$11,238	$17,670	$12,875	$13,200
	Liability Insurance per $M	$16,500	$15,000	$16,500	$16,500
	Hangar/Office	$20,822	$20,822	$20,822	$20,822
	Maint. Software Programs	$3,355	NA	NA	NA
VARIABLE COSTS	Airframe Sys. Parts & Labor	$134	$241	$192	$202**
	Engine Reserves	$336	$318	$296	$300**
	APU Reserves	NA	NA	NA	NA
	Avionics Reserves	NA	NA	NA	NA
	Propeller Reserves	NA	NA	NA	NA
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	$1,400	$5,917	$1,810	$1,810
	EGPWS/TAWS Database	$550	$6,995	$350	$350
	Flight Planning	NA	NA	NA	NA
	Wx Services	NA	NA	NA	NA
	Charts & Maps	NA	NA	NA	NA
ANNUAL CABIN SERVICES COSTS	Swift Broadband	NA	NA	NA	NA
	Ka/Ku	NA	NA	NA	NA
	Air to Ground	NA	NA	NA	NA
	SatTV	NA	NA	NA	NA
	Cabin/Iridium Phone	$2,000	$2,000	$2,000	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	$8,566	$8,566	$8,566	$8,566
	Flight Crew Travel	$5,710	$5,710	$5,710	$5,710
	International Trip Support	NA	NA	NA	NA
	Concierge	NA	NA	NA	NA
	Ground Handling	$2,855	$2,855	$2,855	$2,855
	Landing/Parking Fees	$5,710	$5,710	$5,710	$5,710

*FAA certified for single-pilot operations
**AirPower estimate

Production Aircraft — Category 2 — Turboprops ≥12,500 lb. – Jets <20,000 lb.

	Manufacturer	Textron Aviation	Textron Aviation	Syberjet	Textron Aviation
	Aircraft Model	King Air 250 EP	King Air 350i	SJ30i	Cessna Citation CJ3+
	Category (1-6)	2	2	2	2
	BCA Equipped Price	$6,610,000	$7,755,000	$8,306,452	$8,705,000
DIRECT COSTS	300 nm	$1,178	$1,181	$991	$1,153
	600 nm	$2,142	$2,120	$1,659	$1,996
	1,000 nm	$3,329	$3,293	$2,586	$3,073
	3,000 nm	—	—	—	—
	6,000 nm	—	—	—	—
FIXED COSTS	Captain Salary	$112,409	$112,409	$112,409	$112,409
	First Officer Salary	SP*	SP*	$63,913	$63,913
	Cabin Crew Salary	NA	NA	NA	NA
	Director of Maintenance Salary	NA	NA	NA	NA
	Flight Crew Recurrent Training	$13,500	$13,500	$14,000	$14,000
	Cabin Crew Recurrent Training	NA	NA	NA	NA
	Maintenance Training	NA	NA	NA	NA
	Hull Insurance per $100	$25,118	$29,469	$20,766	$20,022
	Liability Insurance per $M	$15,000	$15,000	$16,500	$16,500
	Hangar/Office	$20,822	$20,822	$20,822	$20,822
	Maint. Software Programs	$5,964	$5,964	$1,755	$1,911
VARIABLE COSTS	Airframe Sys. Parts & Labor	$204	$204	$217	$169
	Engine Reserves	$261	$261	$231	$323
	APU Reserves	NA	NA	NA	NA
	Avionics Reserves	NA	NA	NA	NA
	Propeller Reserves	$16	$18	NA	NA
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	NA	$12,000	NA	$4,395
	EGPWS/TAWS Database	NA	$6,995	NA	$450
	Flight Planning	NA	NA	NA	NA
	Wx Services	NA	NA	NA	NA
	Charts & Maps	NA	NA	NA	NA
ANNUAL CABIN SERVICES COSTS	Swift Broadband	NA	NA	NA	NA
	Ka/Ku	NA	NA	NA	NA
	Air to Ground	NA	NA	NA	NA
	SatTV	NA	NA	NA	NA
	Cabin/Iridium Phone	$2,000	$2,000	$2,000	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	$6,008	$8,566	$8,566	$8,566
	Flight Crew Travel	$4,005	$5,710	$5,710	$5,710
	International Trip Support	NA	NA	NA	NA
	Concierge	NA	NA	NA	NA
	Ground Handling	$2,003	$2,855	$2,855	$2,855
	Landing/Parking Fees	$4,060	$5,710	$5,710	$5,710

*FAA certified for single-pilot operations

Production Aircraft — Category 2 — Turboprops ≥12,500 lb. – Jets <20,000 lb.

	Manufacturer	Textron Aviation	Embraer	Textron Aviation	Pilatus
	Aircraft Model	King Air 350iER	Phenom 300E	Cessna Citation CJ4	PC-24
	Category (1-6)	2	2	2	2
	BCA Equipped Price	$8,804,670	$9,450,000	$9,655,000	$10,070,950
DIRECT COSTS	300 nm	$1,234	$1,263	$1,241	$1,229
	600 nm	$2,205	$2,183	$2,200	$2,164
	1,000 nm	$3,429	$3,291	$3,369	$3,465
	3,000 nm	—	—	—	—
	6,000 nm	—	—	—	—
FIXED COSTS	Captain Salary	$112,409	$112,409	$112,409	$112,409
	First Officer Salary	$63,913	$63,913	$63,913	$63,913
	Cabin Crew Salary	NA	NA	NA	NA
	Director of Maintenance Salary	NA	NA	NA	NA
	Flight Crew Recurrent Training	$14,000	$14,000	$14,000	$14,000
	Cabin Crew Recurrent Training	NA	NA	NA	NA
	Maintenance Training	NA	NA	NA	NA
	Hull Insurance per $100	$32,093	$22,488	$24,138	$25,177
	Liability Insurance per $M	$15,000	$16,500	$16,500	$16,500
	Hangar/Office	$20,822	$20,822	$20,822	$20,822
	Maint. Software Programs	$5,964	$3,355	$1,755	NA
VARIABLE COSTS	Airframe Sys. Parts & Labor	$204	$157	$189	$244
	Engine Reserves	$261	$409	$332	$343
	APU Reserves	NA	NA	NA	NA
	Avionics Reserves	NA	NA	NA	NA
	Propeller Reserves	$18	NA	NA	NA
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	$12,000	$1,400	$12,000	$13,790
	EGPWS/TAWS Database	$6,995	$550	$7,000	Incl. in Nav Database
	Flight Planning	NA	NA	NA	NA
	Wx Services	NA	NA	NA	NA
	Charts & Maps	NA	NA	NA	NA
ANNUAL CABIN SERVICES COSTS	Swift Broadband	NA	NA	NA	NA
	Ka/Ku	NA	NA	NA	NA
	Air to Ground	NA	NA	NA	NA
	SatTV	NA	NA	NA	NA
	Cabin/Iridium Phone	$2,000	$2,000	$2,000	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	$8,566	$8,566	$8,566	$8,566
	Flight Crew Travel	$5,710	$5,710	$5,710	$5,710
	International Trip Support	NA	NA	NA	NA
	Concierge	NA	NA	NA	NA
	Ground Handling	$2,855	$2,855	$2,855	$2,855
	Landing/Parking Fees	$5,710	$5,710	$5,710	$5,710

Production Aircraft — Category 3 — Jets 20,000 lb. to 29,999 lb.

	Manufacturer	Bombardier	Textron Aviation	Bombardier
	Aircraft Model	Learjet 70*	Cessna Citation XLS+	Learjet 75*
	Category (1-6)	3	3	3
	BCA Equipped Price	$11,300,000	$13,700,000	$13,800,000
DIRECT COSTS	300 nm	$1,373	$1,526	$1,405
	600 nm	$2,411	$2,695	$2,458
	1,000 nm	$3,823	$4,273	$3,919
	3,000 nm	—	—	—
	6,000 nm	—	—	—
FIXED COSTS	Captain Salary	$146,120	$146,120	$146,120
	First Officer Salary	$80,157	$80,157	$80,157
	Cabin Crew Salary	NA	NA	NA
	Director of Maintenance Salary	$106,338	$106,338	$106,338
	Flight Crew Recurrent Training	$58,000	$58,000	$58,000
	Cabin Crew Recurrent Training	NA	NA	NA
	Maintenance Training	$10,356	$9,965	$10,356
	Hull Insurance per $100	$25,990	$27,948	$31,740
	Liability Insurance per $M	$26,600	$26,600	$26,600
	Hangar/Office	$36,062	$36,062	$36,062
	Maint. Software Programs	$1,736	$1,755	$1,736
VARIABLE COSTS	Airframe Sys. Parts & Labor	$107	$291	$107
	Engine Reserves	$616	$408	$616
	APU Reserves	NA	$39	$40
	Avionics Reserves	NA	NA	NA
	Propeller Reserves	NA	NA	NA
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	$38,500	$24,500	$38,500
	EGPWS/TAWS Database	$7,000	$7,000	$7,000
	Flight Planning	$3,500	$3,500	$3,500
	Wx Services	$1,400	$1,400	$1,400
	Charts & Maps	$2,450	$2,450	$2,450
ANNUAL CABIN SERVICES COSTS	Swift Broadband	NA	NA	NA
	Ka/Ku	NA	NA	NA
	Air to Ground	$22,740	$22,740	$22,740
	SatTV	NA	NA	NA
	Cabin/Iridium Phone	$2,000	$2,000	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	$24,258	$24,258	$24,258
	Flight Crew Travel	$16,172	$16,172	$16,172
	International Trip Support	NA	NA	NA
	Concierge	NA	NA	NA
	Ground Handling	$8,086	$8,086	$8,086
	Landing/Parking Fees	$16,172	$16,172	$16,172

*2018 data, escalated for inflation

Production Aircraft — Category 4 — Jets 30,000 lb. to 40,999 lb.

	Manufacturer	Embraer	Embraer	Textron Aviation
	Aircraft Model	Legacy 450	Praetor 500*	Cessna Citation Latitude
	Category (1-6)	4	4	4
	BCA Equipped Price	$16,570,000	$16,995,000	$17,457,000
DIRECT COSTS	300 nm	$1,345	NA	$1,853
	600 nm	$2,207	NA	$3,165
	1,000 nm	$3,344	NA	$5,000
	3,000 nm	—	—	—
	6,000 nm	—	—	—
FIXED COSTS	Captain Salary	$169,898	$169,898	$169,898
	First Officer Salary	$94,375	$94,375	$94,375
	Cabin Crew Salary	NA	NA	NA
	Director of Maintenance Salary	$127,306	$127,306	$127,306
	Flight Crew Recurrent Training	$58,000	$58,000	$58,000
	Cabin Crew Recurrent Training	NA	NA	$3,545
	Maintenance Training	$10,600	NA	$10,600
	Hull Insurance per $100	$29,826	NA	$31,423
	Liability Insurance per $M	$22,400	NA	$22,400
	Hangar/Office	$60,704	$60,704	$60,704
	Maint. Software Programs	NA	NA	$1,755
VARIABLE COSTS	Airframe Sys. Parts & Labor	$167	NA	$181
	Engine Reserves	OC	OC	$570
	APU Reserves	$33	NA	$39
	Avionics Reserves	NA	NA	NA
	Propeller Reserves	NA	NA	NA
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	$44,500	NA	$15,795
	EGPWS/TAWS Database	$7,000	NA	$1,050
	Flight Planning	$3,500	NA	$3,500
	Wx Services	$1,400	NA	$1,400
	Charts & Maps	$2,450	NA	$2,450
ANNUAL CABIN SERVICES COSTS	Swift Broadband	$68,000	NA	$68,000
	Ka/Ku	NA	NA	NA
	Air to Ground	NA	NA	$22,740
	SatTV	NA	NA	NA
	Cabin/Iridium Phone	$2,000	NA	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	$43,874	NA	$43,874
	Flight Crew Travel	$29,250	NA	$29,250
	International Trip Support	$21,937	NA	NA
	Concierge	$7,312	NA	NA
	Ground Handling	$14,625	NA	$14,625
	Landing/Parking Fees	$29,250	NA	$29,250

*Certification pending

Production Aircraft — Category 4 — Jets 30,000 lb. to 40,999 lb.

	Manufacturer	Textron Aviation	Embraer	Embraer
	Aircraft Model	Cessna Citation Sovereign+	Legacy 500	Praetor 600
	Category (1-6)	4	4	4
	BCA Equipped Price	$18,790,000	$19,995,000	$20,995,000
DIRECT COSTS	300 nm	$1,757	$1,356	$1,510
	600 nm	$2,991	$2,224	$2,566
	1,000 nm	$4,755	$3,404	$3,984
	3,000 nm	—	—	—
	6,000 nm	—	—	—
FIXED COSTS	Captain Salary	$169,898	$169,898	$169,898
	First Officer Salary	$94,375	$94,375	$94,375
	Cabin Crew Salary	NA	NA	NA
	Director of Maintenance Salary	$127,306	$127,306	$127,306
	Flight Crew Recurrent Training	$58,000	$58,000	$58,000
	Cabin Crew Recurrent Training	NA	NA	NA
	Maintenance Training	$10,600	$10,600	NA
	Hull Insurance per $100	$33,822	$35,991	NA
	Liability Insurance per $M	$22,400	$22,400	NA
	Hangar/Office	$60,704	$60,704	$60,704
	Maint. Software Programs	$1,755	NA	NA
VARIABLE COSTS	Airframe Sys. Parts & Labor	$182	$167	$176
	Engine Reserves	$566	OC	OC
	APU Reserves	$39	$45	$33
	Avionics Reserves	NA	NA	NA
	Propeller Reserves	NA	NA	NA
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	$15,795	$44,500	$44,500
	EGPWS/TAWS Database	$1,050	$7,000	$7,000
	Flight Planning	NA	$3,500	$3,500
	Wx Services	NA	$1,400	$1,400
	Charts & Maps	$2,450	$2,450	$2,450
ANNUAL CABIN SERVICES COSTS	Swift Broadband	$68,000	$68,000	$68,000
	Ka/Ku	NA	NA	NA
	Air to Ground	NA	NA	NA
	SatTV	NA	NA	NA
	Cabin/Iridium Phone	$2,000	$2,000	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	$43,874	$43,874	$43,874
	Flight Crew Travel	$29,250	$29,250	$29,250
	International Trip Support	NA	$21,937	$21,937
	Concierge	NA	$7,312	$7,312
	Ground Handling	$14,625	$14,625	$14,625
	Landing/Parking Fees	$29,250	$29,250	$29,250

Production Aircraft — Category 4 — Jets 30,000 lb. to 40,999 lb.

	Manufacturer	Gulfstream Aerospace	Bombardier	Textron Aviation
	Aircraft Model	G280	Challenger 350*	Cessna Citation Longitude
	Category (1-6)	4	4	4
	BCA Equipped Price	$24,500,000	$26,673,000	$26,995,000
DIRECT COSTS	300 nm	$1,992	$1,889	$1,826
	600 nm	$3,381	$3,209	$3,132
	1,000 nm	$5,250	$4,986	$4,915
	3,000 nm	—	—	—
	6,000 nm	—	—	—
FIXED COSTS	Captain Salary	$169,898	$169,898	$169,898
	First Officer Salary	$94,375	$94,375	$94,375
	Cabin Crew Salary	NA	$98,753	$98,753
	Director of Maintenance Salary	$127,306	$127,306	$127,306
	Flight Crew Recurrent Training	$58,000	$58,000	$58,000
	Cabin Crew Recurrent Training	NA	$3,545	NA
	Maintenance Training	$10,600	$12,237	$10,600
	Hull Insurance per $100	$31,850	$34,675	$35,094
	Liability Insurance per $M	$22,400	$23,400	$22,400
	Hangar/Office	$60,704	$60,704	$60,704
	Maint. Software Programs	$11,501	$8,142	NA
VARIABLE COSTS	Airframe Sys. Parts & Labor	$281	$132	$240
	Engine Reserves	$729	$676	$648
	APU Reserves	$45	$38	Incl. in Engine Reserves
	Avionics Reserves	NA	NA	NA
	Propeller Reserves	NA	NA	NA
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	$33,500	$48,500	$14,895
	EGPWS/TAWS Database	$7,000	$7,000	$1,365
	Flight Planning	$3,500	$3,500	$3,500
	Wx Services	$1,400	$1,400	$1,400
	Charts & Maps	$2,450	$2,450	$2,450
ANNUAL CABIN SERVICES COSTS	Swift Broadband	$68,000	$68,000	$68,000
	Ka/Ku	NA	NA	NA
	Air to Ground	NA	$22,740	NA
	SatTV	NA	NA	NA
	Cabin/Iridium Phone	$2,000	$2,000	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	$43,874	$43,874	NA
	Flight Crew Travel	$29,250	$29,250	NA
	International Trip Support	$21,937	$21,937	NA
	Concierge	$7,312	$7,312	NA
	Ground Handling	$14,625	$14,625	NA
	Landing/Parking Fees	$29,250	$29,250	NA

*2018 data, escalated for inflation

Production Aircraft — Category 5 — Jets ≥41,000 lb.

	Manufacturer	Embraer	Dassault	Bombardier	Dassault
	Aircraft Model	Legacy 650E	Falcon 2000S	Challenger 650*	Falcon 2000LXS
	Category (1-6)	5	5	5	5
	BCA Equipped Price	$25,900,000	$29,950,000	$32,350,000	$35,100,000
DIRECT COSTS	300 nm	$1,665	$1,878	$1,996	$1,878
	600 nm	$2,996	$3,199	$3,604	$3,199
	1,000 nm	$4,639	$4,984	$5,760	$4,984
	3,000 nm	—	—	—	—
	6,000 nm	—	—	—	—
FIXED COSTS	Captain Salary	$205,268	$205,268	$205,268	$205,268
	First Officer Salary	$125,779	$125,779	$125,779	$125,779
	Cabin Crew Salary	$98,753	$98,753	$98,753	$98,753
	Director of Maintenance Salary	$165,957	$165,957	$165,957	$165,957
	Flight Crew Recurrent Training	$94,589	$94,589	$94,589	$94,589
	Cabin Crew Recurrent Training	$3,545	$3,545	$3,545	$3,545
	Maintenance Training	$10,621	$10,037	$8,574	$11,301
	Hull Insurance per $100	$33,670	$38,935	$42,055	$45,630
	Liability Insurance per $M	$22,400	$22,400	$22,400	$22,400
	Hangar/Office	$103,196	$103,196	$103,196	$103,196
	Maint. Software Programs	$8,142	$8,362	$8,142	$8,362
VARIABLE COSTS	Airframe Sys. Parts & Labor	$317	$340	$150	$340
	Engine Reserves	OC	$525	$783	$525
	APU Reserves	$40	$24	$38	$24
	Avionics Reserves	NA	NA	NA	NA
	Propeller Reserves	NA	NA	NA	NA
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	$44,500	$44,500	$48,500	$44,500
	EGPWS/TAWS Database	$7,000	$7,000	$7,000	$7,000
	Flight Planning	$3,500	$3,500	$3,500	$3,500
	Wx Services	$1,400	$1,400	$1,400	$1,400
	Charts & Maps	$2,450	$2,450	$2,450	$2,450
ANNUAL CABIN SERVICES COSTS	Swift Broadband	NA	$78,000	NA	$78,000
	Ka/Ku	$125,000	NA	$125,000	NA
	Air to Ground	$22,740	$22,740	$22,740	$22,740
	SatTV	$11,652	$11,652	$11,652	$11,652
	Cabin/Iridium Phone	$2,000	$2,000	$2,000	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	$55,446	$55,446	$55,391	$55,446
	Flight Crew Travel	$36,964	$36,964	$36,927	$36,964
	International Trip Support	$27,723	$27,723	$27,695	$27,723
	Concierge	$9,241	$9,241	$9,232	$9,241
	Ground Handling	$18,482	$18,482	$18,464	$18,482
	Landing/Parking Fees	$36,964	$36,964	$36,927	$36,964

*2018 data, escalated for inflation

Production Aircraft — Category 5 — Jets ≥41,000 lb.

	Manufacturer	Dassault	Gulfstream Aerospace	Embraer
	Aircraft Model	Falcon 900LX	G500	Lineage 1000E
	Category (1-6)	5	5	5
	BCA Equipped Price	$44,800,000	$46,500,000	$49,900,000
DIRECT COSTS	300 nm	$2,047	$2,522	$3,063
	600 nm	$3,535	$4,055	$5,274
	1,000 nm	$5,569	$6,153	$8,214
	3,000 nm	—	—	—
	6,000 nm	—	—	—
FIXED COSTS	Captain Salary	$205,268	$205,268	$205,268
	First Officer Salary	$125,779	$125,779	$140,000
	Cabin Crew Salary	$98,753	$98,753	$120,000
	Director of Maintenance Salary	$165,957	$165,957	$165,957
	Flight Crew Recurrent Training	$94,589	$94,589	$94,589
	Cabin Crew Recurrent Training	$3,545	NA	$3,545
	Maintenance Training	$10,621	NA	$10,621
	Hull Insurance per $100	$58,240	$51,150	$64,870
	Liability Insurance per $M	$22,400	$22,400	$22,400
	Hangar/Office	$103,196	NA	$103,196
	Maint. Software Programs	$8,362	NA	$8,142
VARIABLE COSTS	Airframe Sys. Parts & Labor	$399	$492	$472
	Engine Reserves	$609	$889	OC
	APU Reserves	$27	$52	$40
	Avionics Reserves	NA	NA	NA
	Propeller Reserves	NA	NA	NA
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	$54,500	NA	$44,500
	EGPWS/TAWS Database	$7,000	NA	$7,000
	Flight Planning	$3,500	NA	$3,500
	Wx Services	$1,400	NA	$1,400
	Charts & Maps	$2,450	NA	$2,450
ANNUAL CABIN SERVICES COSTS	Swift Broadband	NA	NA	NA
	Ka/Ku	$125,000	$125,000	$175,000
	Air to Ground	$22,740	$22,740	$22,740
	SatTV	$11,652	$11,652	$11,652
	Cabin/Iridium Phone	$2,000	$2,000	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	$55,446	$55,446	$61,435
	Flight Crew Travel	$36,964	$36,964	$40,957
	International Trip Support	$27,723	$27,723	$30,718
	Concierge	$9,241	$9,241	$10,239
	Ground Handling	$18,482	$18,482	$20,478
	Landing/Parking Fees	$36,964	$36,964	$40,957

Production Aircraft — Category 5 — Jets ≥41,000 lb.

	Manufacturer	Bombardier	Dassault	Airbus
	Aircraft Model	Global 5000*	Falcon 7X	A320 Prestige
	Category (1-6)	5	5	5
	BCA Equipped Price	$50,441,000	$53,800,000	$115,000,000
DIRECT COSTS	300 nm	$3,265	$2,414	$3,758
	600 nm	$5,458	$4,036	$6,282
	1,000 nm	$8,459	$6,234	$9,770
	3,000 nm	—	—	—
	6,000 nm	—	—	—
FIXED COSTS	Captain Salary	$205,268	$205,268	$255,297
	First Officer Salary	$125,779	$131,077	$140,000
	Cabin Crew Salary	$98,753	$120,000	$120,000
	Director of Maintenance Salary	$165,957	$165,957	$199,148
	Flight Crew Recurrent Training	$94,589	$94,589	$120,000
	Cabin Crew Recurrent Training	$3,545	$3,545	$3,545
	Maintenance Training	$13,611	$20,260	$24,186
	Hull Insurance per $100	$65,573	$64,560	$149,500
	Liability Insurance per $M	$22,400	$22,400	$22,400
	Hangar/Office	$103,196	$103,196	$103,196
	Maint. Software Programs	$8,362	$8,362	NA
VARIABLE COSTS	Airframe Sys. Parts & Labor	$188	$278	$965
	Engine Reserves	$1,218	$747	OC
	APU Reserves	$50	$28	OC
	Avionics Reserves	NA	NA	NA
	Propeller Reserves	NA	NA	NA
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	$54,500	$54,500	$55,300
	EGPWS/TAWS Database	$7,000	$7,000	$7,000
	Flight Planning	$3,500	$3,500	$3,500
	Wx Services	$1,400	$1,400	$1,400
	Charts & Maps	$2,450	$2,450	$2,450
ANNUAL CABIN SERVICES COSTS	Swift Broadband	NA	NA	NA
	Ka/Ku	$125,000	$125,000	$175,000
	Air to Ground	$22,740	$22,740	NA
	SatTV	$11,652	$11,652	$11,652
	Cabin/Iridium Phone	$2,000	$2,000	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	$55,446	$55,446	$61,435
	Flight Crew Travel	$36,964	$36,964	$40,957
	International Trip Support	$27,723	$27,723	$30,718
	Concierge	$9,241	$9,241	$10,239
	Ground Handling	$18,482	$18,482	$20,478
	Landing/Parking Fees	$36,964	$36,964	$40,957

*2018 data, escalated for inflation

Production Aircraft — Category 6 — Ultra-Long-Range Jets

	Manufacturer	Gulfstream Aero.	Dassault	Gulfstream Aero.	Bombardier
	Aircraft Model	G600	Falcon 8X	G550	Global 6000*
	Category (1-6)	6	6	6	6
	BCA Equipped Price	$57,900,000	$59,300,000	$61,500,000	$62,310,000
DIRECT COSTS	300 nm	—	—	—	—
	600 nm	—	—	—	—
	1,000 nm	$6,807	$6,592	$7,938	$8,525
	3,000 nm	$21,986	$19,178	$22,328	$24,349
	6,000 nm	$45,677	$40,751	$46,345	$50,204
FIXED COSTS	Captain Salary	$233,045	$233,045	$233,045	$233,045
	First Officer Salary	$131,077	$131,077	$131,077	$131,077
	Cabin Crew Salary	$120,000	$120,000	$120,000	$120,000
	Director of Maintenance Salary	$199,948	$199,948	$199,948	$199,948
	Flight Crew Recurrent Training	NA	$98,000	$102,900	$102,900
	Cabin Crew Recurrent Training	NA	$3,545	$3,545	$3,545
	Maintenance Training	NA	$20,260	$12,880	$20,505
	Hull Insurance per $100	NA	$70,241	$67,650	$71,657
	Liability Insurance per $M	NA	$22,400	$22,400	$22,400
	Hangar/Office	NA	$109,266	$109,266	$109,266
	Maint. Software Programs	NA	$8,264	$9,395	NA
VARIABLE COSTS	Airframe Sys. Parts & Labor	$444	$251	$328	$187
	Engine Reserves	$979	$803	$1,163	$1,218
	APU Reserves	$52	$27	$52	$50
	Avionics Reserves	NA	NA	NA	NA
	Propeller Reserves	NA	NA	NA	NA
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	NA	$54,500	$55,800	$54,500
	EGPWS/TAWS Database	NA	$7,000	$7,000	$7,000
	Flight Planning	NA	$3,500	$3,500	$3,500
	Wx Services	NA	$1,400	$1,400	$1,400
	Charts & Maps	NA	$2,450	$2,450	$2,450
ANNUAL CABIN SERVICES COSTS	Swift Broadband	NA	NA	NA	NA
	Ka/Ku	NA	$125,000	$125,000	$125,000
	Air to Ground	NA	$22,740	$22,740	$22,740
	SatTV	NA	$11,652	$11,652	$11,652
	Cabin/Iridium Phone	NA	$2,000	$2,000	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	NA	$55,446	$61,435	$61,435
	Flight Crew Travel	NA	$36,964	$40,957	$40,957
	International Trip Support	NA	$27,723	$30,718	$30,718
	Concierge	NA	$9,241	$10,239	$10,239
	Ground Handling	NA	$18,482	$20,478	$20,478
	Landing/Parking Fees	NA	$36,964	$40,957	$40,957

*2018 data, escalated for inflation

Production Aircraft — Category 6 — Ultra-Long-Range Jets

	Manufacturer	Gulfstream Aerospace	Gulfstream Aerospace	Boeing
	Aircraft Model	G650	G650ER	BBJ MAX7
	Category (1-6)	6	6	6
	BCA Equipped Price	$69,500,000	$71,500,000	$91,200,000
DIRECT COSTS	300 nm	—	—	—
	600 nm	—	—	—
	1,000 nm	$8,165	$8,165	NA
	3,000 nm	$22,941	$22,941	NA
	6,000 nm	$47,314	$47,314	NA
FIXED COSTS	Captain Salary	$233,045	$233,045	NA
	First Officer Salary	$131,077	$131,077	NA
	Cabin Crew Salary	$120,000	$120,000	NA
	Director of Maintenance Salary	$199,948	$199,948	NA
	Flight Crew Recurrent Training	$102,900	$102,900	NA
	Cabin Crew Recurrent Training	$3,545	$3,545	NA
	Maintenance Training	$12,880	$12,880	NA
	Hull Insurance per $100	$90,350	$92,950	NA
	Liability Insurance per $M	$22,400	$22,400	NA
	Hangar/Office	$109,266	$109,266	NA
	Maint. Software Programs	$9,395	$9,395	NA
VARIABLE COSTS	Airframe Sys. Parts & Labor	$412	$412	NA
	Engine Reserves	$1,180	$1,180	NA
	APU Reserves	$52	$52	NA
	Avionics Reserves	NA	NA	NA
	Propeller Reserves	NA	NA	NA
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	$55,800	$55,800	NA
	EGPWS/TAWS Database	$7,000	$7,000	NA
	Flight Planning	$3,500	$3,500	NA
	Wx Services	$1,400	$1,400	NA
	Charts & Maps	$2,450	$2,450	NA
ANNUAL CABIN SERVICES COSTS	Swift Broadband	NA	NA	NA
	Ka/Ku	$125,000	$125,000	NA
	Air to Ground	$22,740	$22,740	NA
	SatTV	$11,652	$11,652	NA
	Cabin/Iridium Phone	$2,000	$2,000	NA
ANNUAL TRIP SUPPORT COSTS	Catering Service	$61,435	$61,435	NA
	Flight Crew Travel	$40,957	$40,957	NA
	International Trip Support	$30,718	$30,718	NA
	Concierge	$10,239	$10,239	NA
	Ground Handling	$20,478	$20,478	NA
	Landing/Parking Fees	$40,957	$40,957	NA

Production Aircraft — Category 6 — Ultra-Long-Range Jets

	Manufacturer	Boeing	Airbus	Boeing
	Aircraft Model	BBJ MAX8	ACJ319neo	BBJ MAX9
	Category (1-6)	6	6	6
	BCA Equipped Price	$99,000,000	$105,000,000	$107,900,000
DIRECT COSTS	300 nm	—	—	—
	600 nm	—	—	—
	1,000 nm	$11,592	$9,242	$9,132
	3,000 nm	$24,201	$26,656	$25,912
	6,000 nm	$51,161	$56,740	$54,930
FIXED COSTS	Captain Salary	$255,297	$255,297	$255,297
	First Officer Salary	$140,000	$140,000	$140,000
	Cabin Crew Salary	$120,000	$120,000	$120,000
	Director of Maintenance Salary	$199,948	$199,948	$199,948
	Flight Crew Recurrent Training	$120,000	$120,000	$120,000
	Cabin Crew Recurrent Training	$3,545	$3,545	$3,545
	Maintenance Training	$24,186	$24,186	$24,186
	Hull Insurance per $100	$132,561	$136,500	$144,478
	Liability Insurance per $M	$22,400	$22,400	$22,400
	Hangar/Office	$133,410	$133,410	$133,410
	Maint. Software Programs	$12,389	NA	$12,389
VARIABLE COSTS	Airframe Sys. Parts & Labor	$377	$928	$396
	Engine Reserves	OC	OC	OC
	APU Reserves	OC	OC	OC
	Avionics Reserves	NA	NA	NA
	Propeller Reserves	NA	NA	NA
ANNUAL COCKPIT SUBSCRIPTION SERVICES COSTS	Nav Database	$55,300	$55,300	$55,300
	EGPWS/TAWS Database	$7,000	$7,000	$7,000
	Flight Planning	$3,500	$3,500	$3,500
	Wx Services	$1,400	$1,400	$1,400
	Charts & Maps	$2,450	$2,450	$2,450
ANNUAL CABIN SERVICES COSTS	Swift Broadband	NA	NA	NA
	Ka/Ku	$175,000	$175,000	$175,000
	Air to Ground	$22,740	$22,740	$22,740
	SatTV	$11,652	$11,652	$11,652
	Cabin/Iridium Phone	$2,000	$2,000	$2,000
ANNUAL TRIP SUPPORT COSTS	Catering Service	$61,435	$61,435	$61,435
	Flight Crew Travel	$40,957	$40,957	$40,957
	International Trip Support	$30,718	$30,718	$30,718
	Concierge	$10,239	$10,239	$10,239
	Ground Handling	$20,478	$20,478	$20,478
	Landing/Parking Fees	$40,957	$40,957	$40,957

Kent S. Jackson
Contributing Editor
kjackson@jetlaw.com

Scheduled On-Demand Charter

The way to charter **by the seat**

FAR PART 135 CHARTER TODAY OFFERS A COMPLEX VARIETY of buying options that seem to cross over into scheduled operations. If you buy an "empty leg" of an existing charter flight, is that a scheduled flight? How can you possibly buy a seat on an "on-demand" flight?

The most black-and-white of the gray areas is the sale of "empty legs." Charter operators who know that they have a long repositioning flight would like to have some portion of the flight earn revenue. As long as any or all of the trip elements of departure time, departure location and arrival location are negotiated with the customer, the flight is "on demand."

But the FAA is wary of empty leg sales that only appear to be negotiated. It has stated in a Legal Interpretation:

Again, we would caution [the charter operator] that a scheduled operation is one where three elements are offered in advance by a certificate holder or its representative. To the extent that [the charter operator] holds out these elements, even if the holding out is through different medium, i.e. two elements are published in electronic or page form, and the third is communicated by telephone, we would find this to be scheduled service. To the extent that [the charter operator] simply notifies the public that it has an aircraft in a particular city available for hire, we might consider this an on-demand operation. However, this departure window ranged from several days to as little as 36 minutes, i.e. an airplane is scheduled to travel from point A to point B and is available to depart between 1:24 p.m. and 2:00 p.m. The shorter the departure window or in this case availability window, the more it looks as though this is a scheduled operation. We view these proposed operations as scheduled operations and not authorized by your operations specifications. One example we found on your website was a light jet available in a small airport in Utah for a total of 30 minutes. Such a short window indicates that the aircraft must be en route or in a certain location, once the window expires and therefore, the aircraft is not idle. In fact, to the extent that [the charter operator] needs to move the aircraft to point B after the 30-minute window and to the extent [the charter operator] verbally tells a client where the aircraft is traveling, we would consider such communication to be a holding out of the destination airport. Such a holding out, in addition to a holding out of the departure airport and a time by which an aircraft must depart, is a scheduled operation.

While empty leg sales may not seem to be black and white, putting on-demand passengers together on the same flight is sublimely gray.

The term, "on demand" as defined by FAR Part 110.2, allows some scheduled flights for some aircraft. Rotorcraft and airplanes, other than turbojet-powered airplanes, with nine or fewer passenger seats, and a maximum payload capacity of no more than 7,500 lb., are allowed to conduct scheduled passenger operations up to four trips per week on at least one route between two or more points. This definition is not new, and "on-demand scheduled operations" have always been available in Alaska but have gained great popularity in the lower 48 in both helicopters and small airplanes.

As defined by Part 110.2, "on demand" also allows passenger-carrying operations conducted as a public charter under FAR Part 380, a provision that allows a broker to offer seats for sale on a chartered flight. Part 380 is a source of confusion in the industry, in part because the rule refers to the broker as a "public charter operator" even though the broker does not operate aircraft.

The Transportation Department's new "charter broker" rules also provide new by-the-seat options. FAR Part 295.5(h) defines a single-entity charter as "a charter for the entire capacity of the aircraft, the cost of which is borne by the charterer and not directly or indirectly by individual passengers, except when individual passengers self-aggregate to form a single entity for flights to be operated using small aircraft." The rule later defines a "small aircraft" as "any aircraft originally designed to have a maximum passenger capacity of 60 seats or fewer or a maximum payload capacity of 18,000 pounds or less." This means that groups can "self-aggregate" and charter aircraft without the aid of Part 380.

"Scheduled on-demand" operations are legally complex but increasingly popular. Sometimes gray is the color of money. **BCA**

AIRCRAFT LIGHTING INT'L

PRESENTS

L5800 LED SYSTEM WITH DIMMER FOR G200's, G450's, & G550's

SEE YOU AT AIX LA • SEPT. 10-12 • STAND 2603

Bombardier CL600
Learjet 31
DC-9
Bombardier CL604
Hawker 850XP
Sabreliners
G550
Boeing 727
Learjet 25
Learjet 36
Cessna 560XL
Cessna 525A
Cessna
Cessna 551
S-76A
Astra SPX
Pilatus PC-12
Hawker 800
G450
Global Express
EMB 120
Falcon 2000
Falcon 900
Hawker 1000
Learjet 45
Hawker 700
Learjet 55
1125 Westwind
GV
Gulfstream 100
Cessna 550
SAAB 340
Learjet 35
Hawker 900XP
Cessna 560
Gulfstream 200
Falcon 50
Bombardier CL601
G III
Cessna 750
G IV
Westwind 1124
Hawker 600
Beechcraft 400A

AIRCRAFT LIGHTING INTERNATIONAL

ALI-USA FAA-PMA ISO 9001:2015 AS9100D

PMA APPROVED LED LAMPS FOR THESE AIRCRAFT

TEL: (631) 474-2254 | sales@aircraftlighting.com | WWW.AIRCRAFTLIGHTING.COM

Fred George
Senior Editor
fred.george@informa.com

Learjet 75

Third-generation Model 45 leaves **competitors below and behind**

LEARJET 75, BOMBARDIER'S MARKETING NAME FOR LEARJET 45-456 and subsequent units, has been in production since November 2013 and flies higher, faster and farther than competitive light jets. It's actually a mid-light aircraft offering a flat floor, a 415 cubic foot cabin with double-club seating for eight passengers, an externally serviced toilet and a standard APU.

It's the only aircraft in its class with a full-tanks/full-seats useful load and the only aircraft in class to be equipped with high-pressure dual main tires and thrust reversers for sure stopping on contaminated runways, along with powered nosewheel steering, all attributes noted by Brant Dahlfors and Sydney Zacsek, partners in Bloomer Devere Dahlfors' JetTransactions in Van Nuys, California.

CLAY LACY

The original Model 45 had lackluster takeoff performance because of a series of weight gains and its dependence upon a pair of undersized Honeywell TFE731-20BR turbofans. Model 75 remedies that with Honeywell TFE731-40BR turbofans, rated at 3,850-lb. thrust for takeoff, providing 10% more push. New canted winglets add 3 ft. to wingspan and they reduce high-speed drag compared to the original nearly vertical winglets. The extra thrust and improved winglets reduce runway distance by as much as 12%.

While not best in class, its standard-day takeoff field length is 4,440 ft., sufficiently perky for most general aviation airport operations. Up at *BCA*'s 5,000-ft. elevation, ISA+20C airport, TOFL is 5,272 ft., putting Model 75 on a par with other light jets. It's one of the few aircraft in class that can depart Mexico's Toluca International Airport (MMTO) at MTOW on a 32C day.

Model 75 features Garmin G5000 avionics, with three 14.4-in. flat-panel displays and twin touchscreen control units in the center console. G5000 adds a raft of new capabilities while shaving 180 lb. from aircraft empty weight. Synthetic vision, LPV approach and ADS-B OUT are standard. Doppler weather radar with ground clutter suppression is optional.

The air distribution system has been improved compared to Model 45, thus cockpit and cabin heating and cooling are considerably more effective. The forward galley has been reconfigured to increase volumetric efficiency and there's an optional occasional-use seat that folds down next to the entry door. The galley features an optional microwave oven.

Double-club seating in the main cabin is the only configuration offered by Bombardier. But full-length seat tracks are optional, enabling operators to move seats for more leg room in the aft club section. Some operators have pulled out the two forward seats to increase leg room for the remaining six passengers.

The fully enclosed, full-width aft lavatory offers 15 cu. ft. of internal luggage volume. The 50 cu. ft. aft external baggage compartment is comparatively small by current light jet standards, but operators say it's ample for typical business missions.

Legacy Learjet performance is this aircraft's strong suit. It can climb directly to FL 440 at MTOW, assuming standard day outside air temperatures. Operators say they can routinely cruise at FL 470, or higher, on work-a-day missions. Typical cruise speed is Mach 0.78 and long-range cruise speed is Mach 0.75. Watch for fuel flows at that speed and at those altitudes to be 1,000 lb./hr. or less. Block fuel flows are 1,300 lb. to 1,400 lb. per hour, depending upon mission length, cruise speed and cruise altitude.

Learjet 75 retains all the positive attributes of the original Model 45. It's a delight to hand fly, having the most docile low-speed and high-speed handling qualities of any Learjet yet built. The high fidelity flight controls provide excellent tactile feedback, the strong rudder boost assists during engine-out operations and a flap/spoilers/stab interface neutralizes pitch force transients with configuration changes. Pitch and roll control forces are heftier than on the original 20- and 30-series Learjets, but that helps prevent over control. Fly-by-wire spoilerons provide strong roll control authority at low speeds.

Basic scheduled maintenance intervals are 600 hr./12 months. Outside of checking tire pressures and engine oil levels, plus cleaning the aircraft, there is little care demanded by this machine. But the aircraft isn't inexpensive to maintain. Honeywell MSP runs $288 per engine per hour, Bombardier Smart Parts costs $107 per hour and APU reserves are $78 hr., Zacsek says.

Dahlfors says early Model 75 aircraft sell for $5.5 million to $5.6 million while late models retail for about $8 million. Its main competitors are Textron Cessna Citation CJ4, Embraer Phenom 300 and Nextant 400XT. Model 75 is more expensive to operate than other light jets, especially as it's a two-pilot airplane. But, as noted, it's the only one in its class to offer full-tanks, full-seats loading flexibility and it has a larger, longer cabin. It's the nicest flying aircraft in class in our opinion.

Learjet 75 is pricier, but it's also an excellent value considering its speed, altitude, runway performance and range capabilities. Clearly, this is the best business aircraft ever produced by Learjet. **BCA**

INCREASE RANGE

FLIGHT PLAN (B350):
KLAS - KTPA
1,724 NM
5h-10m
FUEL: 3,788 LBS
RESERVES: 627 LBS

LAS

TPA

SADDLE TANKS

KING AIR 90, 200, 250, 300 & 350

Flight image courtesy of
FlightAware (flightaware.com)

IN GOD WE TRUST

CENTEX AEROSPACE INCORPORATED

254-752-4290 | www.centex.aero

On Duty

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

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

JON LASSAK

CARLOS BRANA

ED KOHARIK

DANNY ROBAYO

ROB FISHER

▶ **Air Charter Safety Foundation**, Boston, Massachusetts, announced that **Joshua Hebert**, found and CEO of Magellan Jets, will become chairman of ACSF, where he currently serves as vice chairman.

▶ **Allianz Global Corporate & Specialty**, France, appointed **Tom Fadden** global head of aviation. Fadden, who joined Allianz in 2004, has been the regional head of aviation.

▶ **Cutter Aviation**, Phoenix, Arizona, promoted **Jon Lassak** to chief pilot in its charter and flight management department. Lassak has been a HondaJet and Pilatus PC-24-rated captain for the Arizona-based company.

▶ **Dassault Aviation**, Saint-Cloud, France, appointed **Carlos Brana** executive vice president, Civil Aircraft. He succeeds Olivier Villa, who retired on July 1. He began his career with Dassault in 1984 as a design engineer on the Rafale, Mirage F1 and Mirage 2000 combat aircraft programs.

▶ **FlightSafety International**, New York New York, promoted **Ed Koharik** to senior vice president and **Danny Robayo** to vice president. They will lead Building Our Future, a company-wide transformation effort.

▶ **Global Jet Capital**, Danbury, Connecticut, appointed **Stefan Abbruzzese** as chief commercial officer. He will lead market facing activities focused on the development of new business.

▶ **Global Jet Services**, Avon, Connecticut, announced that **Rob Fisher** has joined the company as a Falcon aircraft instructor on the maintenance training program.


ARIA BAHAWDORY


SAMANTHA LANGEN


GRISCHA SCHMIDT


JEREMY OJERHOLM


ANDY OSANTOWSKE

▶ **Greenwich AeroGroup**, Atlanta, Georgia, announced that **Aria Bahawdory** has joined the company as a regional sales manager for Professional Aviation associates and Greenwich AeroGroup company.

▶ **Guardian Jet**, Guilford, Connecticut, promoted **Samantha Langen** to sales director for the Midwest.

▶ **Gulfstream Aerospace**, Savannah, Georgia, appointed **Chris Edwards** regional vice president of Sales for Northern Europe based in London. Alessandro Scarpellini has been named regional vice president of sales for Southern Europe including Switzerland and will be based in Rimini, Italy.

▶ **International Council of Air Shows (ICAS)**, Leesburg, Virginia, named **Michael Kaufman** as its full-time executive director/CEO. He assumed his new position on July 15.

▶ **Jet Aviation**, Basel, Switzerland, announced that **Grischa Schmidt** has been appointed as the new senior director Design Studio. He will manage a team of 16 designers and report to **Dirk Sapatka,** General manager Basel.

▶ **Meridian**, Miami, Florida, announced the **Jeremy Ojerholm** has joined its charter sales team based in the company's newly opened sales office at Opa-Locka Executive Airport in Miami.

▶ **National Air Transportation Association,** Washington, D.C., named Van Nuys Airport Manager, **Flora Margheritis** as the recipient of the 2018 NATA Airport Executive Partnership Award, given annually to recognize an airport manager for his or her outstanding efforts in fostering relationships between aviation businesses and airport operators.

▶ **Robotic Skies**, Albuquerque, New Mexico, hired **Andy Osantowske** as direcgtor of Operations responsible for the

ROBERT RANDALL

HERVE ROUSSELLE

BOB SANCHEZ

ALEX ALMONTE

day-to-day operations it the company's global network of maintenance service centers.

▶ **Skyservice Business Aviation**, Ontario, Canada, named **Emlyn David** president and CEO, succeeding Marshall Myles who retired. David has been a director and president since 2012.

▶ **Stevens Aerospace and Defense Systems**, Macon, Georgia, announced that **Miguel Gallardo** is a Gulfstream maintenance sales representative, focusing on the northern half of the U.S. and abroad.

▶ **Universal Avionics**, Tucson, Arizona, named **Robert Randall** to the newly created position of director of strategic business development. Randall, who has 35 years of avionics experience, joined the company in 2008 as Midwest regional sales manager and later became U.S. senior sales manager. **Herve Rousselle** has been appointed to the position of regional sales manager for Europe. He will be based in Lyon, France. **Bob Sanchez** has been appointed to the newly created position of director of Government Business Development overseeing efforts to promote Universal's commercial products to governments customers worldwide.

▶ **Western Aircraft, Boise**, Idaho, announced that **Alex Almonte** has joined the company's MRO Sales team and will cover the Southwest and Midwest regions for Falcon, Gulfstream, Embraer and Hawker customers. **BCA**

Advertisers' Index

August 1969 News

ATC slowdown is the major problem today for those using high-density terminals and prime contributor to the 1-, 2-, 3-hr. delays we are now "enjoying." – *BCA Staff*

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

A "temporary" airport/airways plan to generate $460.8 million has been put forth by the NBAA as a short-term (18-24 months) solution to airport restrictions at high-density fields.

1969 Aerial Salon at Le Bourget: Jumbos, SSTs, spaceships, weaponry, aerobats and, oh yes, business airplanes entice and thrill 50,000 in a most sophisticated and very international way.

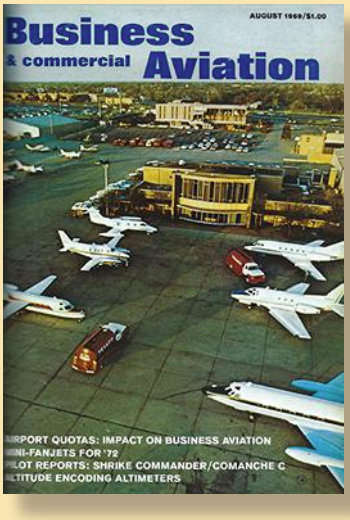
500S Shrike Commander: Can a businessman-pilot fly an aircraft traditionally left to the professionals? Aero commander successfully marketed it as the most elite of the non-professionally flown twins.

Norman Nymph A unique concept in lightplanes, this is a 4-place, high-wing aircraft supplied as a kit of finished parts for assembly under license in the country where it is sold. The BN-1 Nymph ill be available with three Lycoming options. Finished costs will be around $10,000.

The Twin Otter series 300 The Twin Otter series 300 made its grand entrance at the Paris Air Show with new PT6A-27 powerplants rated at 620 shp each. TBO is now 1,700 hr. Series 300 carries 20 passengers and crew of two. It cruises at 192 mph and takes off and lands over an obstacle in 1,200 ft.

Ziff-Davis Publishing (*BCA, Flying, Airline Management & Market* among other) acquired through merger, American Aviation Publications including *Aviation Daily, Air Cargo, Armed Forces Management* and the *Weekly of Business Aviation.* The unit will function as part of Ziff-Davis Aviation Division under Edward D. Muhlfeld. **BCA**

THE ARCHIVE



The impact of the turbojet on modern business travel on general aviation ramps can be witnessed at leading airports all over the country here, at Southwest Airmotive's Jet center, Love Field, Dallas, a representative sample of business aviation aircraft pause briefly in gather flights that crisscross the country.

The Art of Modification: Butler Aviation, headquartered in New York at La Guardia Airport, requests the challenge of designing your requirements and presenting our capabilities to you.

M600. MISSION: ***POSSIBLE.***

1,658 NM RANGE · 2,400 LBS USEFUL LOAD · G3000 AVIONICS

Meet the powerful, pressurized cabin-class turboprop designed for your mission. Everything you need, including the lowest operating and acquisition costs in its category. An evolution of the popular Meridian, the Piper M600 is designed with a robust clean sheet wing and vastly increased fuel capacity for a smoother, more stable flight, 658 nm more range, 700 lbs more useful load and 250 kcas Vmo. Contact your dealer for a demo, or experience the Freedom of Flight™ at **piper.com.**

***M**-CLASS: **M**350 | **M**500 | **M**600*

piper.com
1.772.299.2403

Piper®
FREEDOM OF FLIGHT

ONE SOLUTION FOR ALL YOUR FLIGHT PLANNING NEEDS

FLEET SCHEDULING AND TRACKING | TRIP SUPPORT | PDC, eAPIS AND MORE | SAFETY MANAGEMENT SYSTEM

FLTPLAN.COM/ABOUTUS

FltPlan.com