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AirMaintenance UPDATE

The Magazine for Aircraft Maintenance Professionals

Transport Canada Approved for R/T

European Business Aviation Convention & Exhibition Highlights

2017 Recurrent Training Exam

PAMA and AME news

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Leave flight-ops to others

Recently, AMU reader Keith Olson contacted us regarding editorial content. Mr. Olson said that while he enjoyed the magazine he felt there was a growing trend toward flight-ops stories. Keith cited last year's June/July issue in which there were two separate articles that featured DC-3 aircraft. "Though interesting, they are flight-ops stories and have nothing to do with maintenance," he said, going on to add that "I have noticed similar articles in previous issues. Why not leave the flying stories to other publications? There must be good maintenance material out there."

We think it's great when readers like Keith reach out to us with their comments and concerns. Ultimately, it's this kind of feedback that helps us do our jobs. But to address the specific concerns he raises, allow me to explain that the approach to editorial content here at AMU is to offer a mix of trends, new technologies, and new aircraft emerging in the industry that will directly affect the working lives of AMEs.

In one sense, it's true that there is a "flight-ops" component to stories such as, say, "The Morphing Wing" in the Dec/Jan 2016 issue, but the intent is to shine a spotlight on technical developments even if they are still only in the theoretical stage. It's these developments that will ultimately shape the careers and challenges of today's AMEs and those who will enter the trade in the years to come.

While what Mr. Olson says is true — that some of these are not straightforward wrenching stories — it's our hope that technicians will also want to read about things that are, for the time being, beyond the bench.

Just getting back to the June/July issue for a moment, the DC-3 story "First One Out Kiss the Runway" was written by a retired AME and is about how he dealt with a mid-flight mechanical problem under stressful conditions. Again, this is not a nuts-and-bolts piece, but it is an insight into the working mind of an AME whose knowledge is put to the test under trying circumstances.

We hope that these kinds of stories are important, and that they add a broader flavour to the magazine. We'll continue to seek out stories such as the DC-3 piece, as well as restoration articles or stories about new learning opportunities and new materials, and we will also be vigilant against inadvertently becoming overtly flight-ops-biased. ■

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Upcoming Events

AirVenture Oshkosh 2017

Legendary aircraft will fly again

Some of the World War II era's most significant military aircraft that have been restored and preserved by the Commemorative Air Force (CAF) will be among the highlights of the annual warbird gathering at EAA AirVenture Oshkosh 2017. Among the airplanes is the Boeing B-29 FIFI, which will join the world's only other flying B-29 bomber, Doc, on the flightline for the first appearance of multiple B-29s in more than 50 years. In addition, CAF B-25 bombers will appear as part of the 75th anniversary of the famed Doolittle Raid of April 1942.

"While more than 300 vintage military aircraft at Oshkosh each year create the world's largest annual warbird gathering, the CAF has been at the forefront of restoring and preserving many marvelous examples of flying history," said Rick Larsen, EAA's vice president of communities and member program.

While at AirVenture, the B29 FIFI will be available for flights on July 26-27, based from Appleton, Wisconsin. More information is available at CAF's Air Power History Tour website. At other times, the aircraft will be displayed at Oshkosh for cockpit and aircraft tours.

"The Commemorative Air Force is again excited to bring a number of our aircraft to Oshkosh for the World's Greatest Aviation Celebration," said Stephan Brown, Commemorative Air Force president. "These airplanes represent a tribute to the men and women who have dedicated themselves and sacrificed to preserve our freedom." Visit www.eaa.org

CANADA

Canada Day Fly-By
July 1, 2017
Ottawa, Ontario
www.canada.ca

Lethbridge International Air Show
July 14 – 16, 2017
Lethbridge, Alberta
www.lethbridgeairshow.ca

Fort St. John International Air Show
July 22 – 23, 2017
Fort St. John, British Columbia
www.fsjairshow.com

Wings over Springbank Airshow
July 29 – 30, 2017
Springbank, Alberta
www.wingsoverspringbank.com

Aerospace, Defence & Security Expo
August 10 – 11, 2017
Abbotsford, British Columbia
www.adse.ca

Canadian Aerospace Summit
November 7 – 8, 2017
Ottawa, Ontario
www.aerospacesummit.ca

HAC 2017 Convention & Trade Show
November 10 – 13, 2017
Ottawa, Ontario
www.h-a-c.ca

Advertisers Index

STCs & new products

Piper M600 composite prop approved

Hartzell Propeller's new five-blade composite swept tip prop has received FAA approval for installation on the Piper M600 turboprop aircraft. This propeller features thin airfoils that are said to increase performance and are purported to be five to 10 times stronger than similar wood core blades. The design also features a stainless steel shank, nickel cobalt leading edge, and mesh erosion screen for FOD protection.

For more information visit www.hartzellprop.com

Advent Aircraft Systems gains FAA certification

The FAA has granted certification for Advent Aircraft Systems's eABS anti-skid braking system for the Pilatus PC-12. The STC applies to all models of PC-12, provided the aircraft is equipped with a WAAS enabled GPS, such as the Honeywell Apex, Garmin or IS&S WAAS GPS products. The eABS weighs 27 pounds installed and comes with all required installation hardware. The STC enables improved braking in all runway conditions without the risk of flat spotted or blown tires. It is meant as an alternative to the use of reverse thrust to reduce prop erosion and the risk of FOD ingestion. **For information visit** www.aircraftsystems.aero

New nose wheel fairing deflects debris

Twin Commander Aircraft has engineered a nose wheel fairing intended to address the vulnerability of Twin Commanders as they extend their landing gear and inadvertently throw up debris from grass, gravel, or deteriorating paved runways. The heart of the system is a small, louvered fender positioned immediately aft of the nose wheel that deflects debris picked up on the takeoff and/or landing roll, preventing it from striking and possibly damaging the fuselage belly skin.

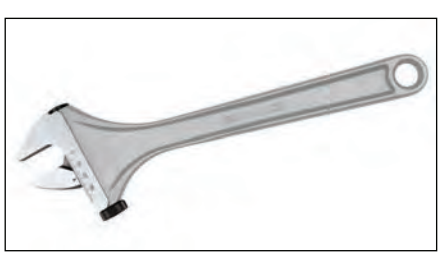
For information visit www.twincommander.com

Fly-Away axle jack from Malabar

Malabar International's Fly-Away axle jack is designed for business and regional jets and consists of a three-stage cylinder assembly and a hand pump with hydraulic reservoir. A lifting handle is also supplied for ease of handling. This portable jack has a net weight of 35 pounds and features an optional shipping and storage case, which has an additional weight of 35 pounds and can be carried onboard.

For more information visit www.malabar.com

Side nut adjustable wrenches for special applications



BAHCO has announced a new line of side nut adjustable wrenches for special applications. They feature a wide grip and thermoplastic handle for comfortable use. Their slim side nut profile and 15-degree angle offers enhanced accessibility to tight spots. Sizes: six, eight, 10, and 12 inches. **For more information visit** www.snaponindustrialbrands.com

Digital torque multiplier with advanced accuracy

Digital torque multipliers from Advanced Torque Products are said to have accuracy to within plus-minus one percent of total capacity. ATP wrenches range from 300 to 40,000 foot-pounds and are reportedly widely used by the US military, with four of its products servicing the CH-47. **For more information visit** www.AdvancedTorque.ca

To announce your STC or new product, email a JPG photo and a product description to amu.editor@gmail.com or amumag2015@gmail.com

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- Gulfstream G200
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TEST DRIVE FLEXSTEEL TAKE HOME MUSTANG

Walter Surface Technologies is running a promotion that's hard to resist. As of May 15th through to November 15th, if customers are willing to test-drive the company's Flexsteel flap discs there's a chance to win a brand new 2018 Ford Mustang GT. Ten-pack packages of Flexsteel contain promo codes inside. Enter the code at the website and you're eligible to win the grand prize, or 75 others. Flexsteel discs feature a zirconia abrasive grain that's said to self-sharpen with less pressure than ordinary flap discs. Get some from your local dealer and take a shot at that Mustang.

FASTFIN GETS TC THUMBS-UP

Washington State-based BLR Aerospace announced in early May that its FastFin Tail rotor enhancement and stability system has been approved by Transport Canada for installation on Canadian registered Airbus H125/AS350 helicopters. The H125 FastFin system was certified in late 2016 by the Federal Aviation Administration (FAA) and recently received approval from the European Aviation Safety Agency (EASA). The system is available to the aftermarket and as a factory-installed STC option on new Airbus H125/AS350 helicopters. Benefits are said to include a useful load increase up to 130 pounds, easier control in hover-hold operations, and better management of the yaw axis when hovering in challenging crosswinds. Currently, there are more than 700 Airbus helicopters operating across Canada.

DEFENCE MINISTER WANTS HELICOPTER UPGRADES

The CBC has reported that Canada's defence minister Harjit Sajjan said upgrades of Bell Griffon and Leonardo Cormorant helicopters must be prioritized in defence spending or be removed from service. Sajjan made the statement in early May at a conference involving retired military personnel and defence industry executives. The upgrades are expected to cost up to $2 billion. The potential cost has created some debate in parliament, but Sajjan says the helicopter is one of several facets of the military that has been neglected in recent years. Upgrades to the Griffon are expected to cost $1.5 billion, with the Cormorant projected to cost between $500 million and $1.5 billion.

BOEING HAS PLANS FOR DEEP SPACE

Boeing recently unveiled concepts for the Deep Space Gateway and transport systems that could help achieve NASA's goal of having robust human space exploration from the moon to Mars. NASA's Space Launch System, which Boeing is helping develop, would deliver the habitat to cislunar space near the moon. Known as the Deep Space Gateway, the habitat could support critical research and help open opportunities for global government or commercial partnerships in deep space, including lunar missions. It would be powered by a solar electric propulsion system.

"The ability to simultaneously launch humans and cargo on SLS would allow us to assemble the gateway in four launches in the early 2020s," said Pete McGrath, director of global sales and marketing for Boeing's space exploration division. The Deep Space Gateway could be the waypoint for Mars missions. Utilizing a docking system akin to what the International Space Station uses for commercial operations, it could host the Deep Space Transport vehicle, which would take humans to Mars. Once near Mars, crews could deploy a lander for surface missions or conduct other scientific and robotic missions in orbit.

ENGINEWISE BRAND UP AND RUNNING

Pratt & Whitney has introduced a new service brand called EngineWise, which is intended to help airlines and lease companies run their businesses efficiently.

"Our EngineWise brand is all about sharing our engine expertise and fleet

intelligence with Pratt & Whitney customers so they can optimize engine performance and keep their operations running smoothly," said Chris Calio, president, Pratt & Whitney Commercial Engines. Some of the services that EngineWise intends to offer include data analytics, fleet management programs, and engine overhaul services.

LACK OF SKILLED TALENT COSTS INDUSTRY BIG-TIME

Virginia-based Aeronautical Repair Station Association says its members could miss out on close to $200 million in foregone revenues during 2017 as a result of unfilled technical jobs at their companies. Fifty-five percent of respondents to ARSA's recent member survey reported having unfilled positions. Based on the average number of vacancies at the responding organizations, the association estimates its members have 1,045 open technical jobs. The total economic loss figure of $185 million was derived by multiplying the number of open positions by the $177,000 in average annual revenue per employee reported by respondents.

Projected across the entire population of Federal Aviation Administration-certificated repair stations in the United States, the number of open positions may be close to 11,000. If those positions go unfilled, the industry could stand to miss out on as much as $1.95 billion in economic activity in 2017.

"These numbers are a snapshot of how just one industry is being affected by the technical worker shortage plaguing the US economy," ARSA executive vice president Christian Klein said. "Well-paying jobs in the high-tech aviation maintenance sector are going unfilled because workers aren't available or candidates lack basics skills.

PORSCHE CAYENNE TOWS AIRBUS TO QUIRKY RECORD

A stock Porsche Cayenne towed an Air France Airbus A380 weighing 314 tons to a new Guinness World Record. The Cayenne, driven by Porsche GB technician Richard Payne, made the record pull on May 1st, hauling the aircraft 42 metres at Paris Charles de Gaulle Airport to set a new benchmark for Heaviest Aircraft Pull by a Production Car. The Cayenne was connected to the largest passenger aircraft in the world by a special towing attachment that sat on the Cayenne's tow bar. "We don't usually go this far to test the limits of our cars but today we got pretty close," said Payne.

TURBINE MAINTENANCE GROUP LAUNCHED BY BRANT AERO

Brantford, Ontario-based Brant Aero has formed a dedicated turbine engine maintenance group and has selected industry veteran Mitch Callaghan to head the new group.

"We are fortunate to have Mitch (Callaghan) oversee our new turbine engine group," said Todd Collins, CEO of the Progressive Air Group of Companies, to which Brant Aero belongs. "Mitch is a Transport Canada Minister's Delegate for 523 certified aircraft, as well as restricted category aircraft. He also holds aircraft certification authority certification for the Cessna CJ525-series, King Air-series, and other popular general aviation piston and turbine aircraft."

As well as turbine engine services, Brant Aero will provide turboprop and light jet owner/operators with airframe maintenance and inspection services, and inspection and installation services including Reduced Vertical Separation Minimum compliance and testing. ■

The Big Show: the energy and strength

EBACE 2017: Reasons for Cautious Optimism

Above left: Trade show floor at the European Business Aviation Convention & Exhibition 2017.
Above right: Demand for ultra-long-range aircraft in Europe has remained strong, and light jet activity was up 10 percent in 2016.

# of business aviation in Europe

As the final day of the 2017 European Business Aviation Convention & Exhibition (EBACE2017) wrapped up, organizers said the show was one of the most successful in recent memory, reinforcing its reputation as the industry's most important event in Europe. The National Business Aviation Association (NBAA) and the European Business Aviation Association (EBAA) jointly host EBACE. This year's show took place from May 22 to 24 at Geneva's Palexpo conference center and Geneva International Airport.

"Anyone who spent the last week at EBACE can see the passion and professionalism that define this industry," said EBAA CEO Brandon Mitchener. "This show was full of energy and excitement for the future, with amazing technology on display, in-depth policy discussions and more than a few deals closed."

Mitchener joined EBAA as CEO in April 2017, and this year attended EBACE for the first time. "I'm thrilled to be a part of this industry at such a pivotal time," he said.

On display at EBACE2017: Textron Aviation – Bell Helicopter 497GX.

"Business aviation in Europe is growing, and this show featured several new business models that offer new opportunities to grow the market further."

NBAA President and CEO Ed Bolen agreed, stating: "This show was an all-around success for attendees, exhibitors and the entire industry. This week once again highlighted the enduring value of EBACE, and of business aviation around the world. Clearly, ours remains a forward-looking industry, and we are confident EBACE will continue to be an important part of its future."

Bolen and Mitchener pointed to several indicators illustrating the strength of this year's EBACE. For example:

1. EBACE2017 featured more than 400 exhibitors, representing nearly 40 different countries, on the show floor.

2. Many of the exhibitors unveiled new products and services at EBACE2017, and more than 450 journalists from Europe and around the world covered the event.

3. At EBACE2017, 56 aircraft were on display at Geneva International Airport, and three more aircraft were displayed inside the Palexpo exhibit hall. Several aircraft were at EBACE for the first time.

The week kicked off with an inspiring Opening General Session address by solar aviation pioneer, Dr. Bertrand Piccard. As the first pilot to fly around the world entirely on solar power — aboard the groundbreaking Solar Impulse aircraft — Piccard predicted innovation would lead aviation toward a more sustainable future.

Above: Static Display of Aircraft at the Geneva International Airport.
Below: "OEMs are spending heavily on new models. That's a reason to be concerned."

At the lower end of the market, with turboprops and light jets, operators throughout Euope and elsewhere could grow a successful business model based on digital booking.

Panels and education sessions held throughout the show covered timely and important issues, such as the implications of Brexit for business aviation, expanding opportunities for young professionals, security and top advocacy priorities across Europe. The EBACE2017 programming also included two well-attended day-long seminars – with expert analysis and advice for aircraft transactions and business aviation safety.

The first EBACE Careers in Business Aviation Day introduced more than 250 high school and university students, from about 120 area schools across Europe, to the broad range of opportunities in the industry.

"This was an incredible show, from start to finish," said Mitchener. "As EBACE draws to a close, I know that our industry faces real challenges and thrilling opportunities, and I am confident that business aviation in Europe will rise to the moment, and that our future is brighter than ever before."

Next year's EBACE will return to Palexpo and Geneva International Airport on May 29-31, 2018.

Also on display at EBACE2017 was the Pilatus Aircraft Ltd. – PC-24.

EBACE2017: What's trending now

Amid lingering aircraft oversupply, analysts see future growth in Europe. In part, this is due to the fact that after a decade of false recoveries, business aviation has posted steady growth across Europe for the six months to April 2017. This was the word at the 2017 version of the EBACE2017, which brought thousands of industry players from Europe and around the world to Geneva for three critical days in late May. With over 500 exhibitors showcasing the latest products and services EBACE is considered to be Europe's most important aviation business gathering but the flip-side big question in Geneva was, do two positive quarters portend a full recovery, or just another blip?

"If you look at the trend lines for the business aircraft fleet and GDP, [historical proxies for supply and demand], we probably had overbuilding from about 2005 to 2008, but after 2008, we probably under-built aircraft," said Richard Aboulafia, vice president of analysis at Teal Group.

If that's true, market demand is still catching up to oversupply, reasoned Aboulafia in a State of the Industry panel during EBACE 2017. "I'm not quite ready to declare green shoots are taking hold," he said. "We will return to growth, but we might not return to the 2007 market peak until 2021."

Too Many Platforms?

Analysts at the panel admitted forecasting was as difficult as ever. The stock market is often a leading indicator for aircraft deliveries, and global markets are up in the last six months. However, investors have shown signs of skittishness.

"If you look at the fleet data, and read between the lines, about 13 percent of business aircraft are for sale," said Rolland Vincent, creator and director of JETNET iQ. "So, we definitely have oversupply."

The oversupply of pre-owned aircraft is exacerbated, the panelists agreed, by OEMs rolling out new platforms and cutting prices to keep factories open.

"OEMs are spending heavily on new models. That's a reason to be concerned," said Aboulafia. "We're seeing some aircraft platforms end. We better have the growth we're forecasting, otherwise we're going to see some pain."

Digitization. Commodification?

Against those concerns, based on fleet and delivery data, Richard Koe, managing director of WINGX Advance, pointed to aircraft utilization data for signs of optimism.

"If you look at utilization for on-demand charter, we're seeing annual growth of 10 percent," said Koe. "Our inventory is being digitized, charter is being digitized. Don't underestimate the effect of digitization on demand. As our product becomes more transparent to people booking travel, it could grow the market by three times."

Oliver King, acting CEO of Avinode Group, agreed that "charter is definitely on its way to becoming a digital product. 'Do people want to book aircraft online?' That discussion is over. The answer is yes. Now the question is: Can an operator make money that way?"

At the lower end of the market, with turboprops and light jets, the panelists agreed operators could grow a successful business model based on digital booking.

"What we're basically talking about is commodification," said Aboulafia. "OEMs developing new platforms and new products is driven by a largely owner-operator market. If the market is commodifying and expanding, it may mean demand for simpler products."

EBACE2017: Three more European business aviation trends

While the US is seeing resurgence in business aircraft ownership, Europe has seen more narrow growth, in specific categories and markets. Demand for ultra-long-range aircraft has remained strong, and light jet activity was up 10 percent in 2016 over 2015.

Operations by turboprop and piston aircraft remained sluggish, but new usage models in charter and shuttle services drive demand for light jets in Europe.

"It's a very different charter market from North America," said Richard Koe, managing director of WINGX Advance. "What we're seeing in Europe in terms of online brokerage is actually somewhat ahead of North America, and appears to be succeeding in creating a genuine spot market."

While traditional aircraft brokers are well established in the United States, and many American flight departments choose to put their aircraft on a Part 135 certificate for supplemental revenue, the charter market in Europe is not as consolidated. This has left an opening for new entrants, particularly brokers leveraging online sales platforms.

On the online marketplaces, light jet charters have flourished, especially with infrequent users of business aviation, who are on the fence about stepping up to fractional or private ownership.

Historically, it's also been harder for charter operators in Europe to become true regional players, because of cultural

Boeing Business Jets were a significant presence at EBACE2017.

and market differences across the continent. In 2016 for example, business aircraft charters in Germany were down 4.2 percent over 2015, while France was the continent's top charter market, with activity up 7.2 percent.

Brokers on the online marketplace are finding a way to bridge these differences in Europe, by consolidating real-time supply and matching it to requests submitted through apps and web portals.

"Companies such as JetSmarter, for example, are building transcontinental membership bases and leveraging prepurchased inventory to provide guaranteed charter availability," said Koe. "They're also introducing city-to-city business aircraft shuttles, similar to those that have been successful in the US."

Koe presented a session on business aviation trends in Europe at the 2017 European Business Aviation Convention & Exhibition (EBACE2017), during the International Aircraft Transactions Seminar on May 21. The seminar leading into EBACE also featured sessions on how the US market affects the European market, and vice versa; details on the emerging business models driving aircraft utilization; and a panel of leading aircraft financiers. ■

An SAE success story

This organization has brought together aircraft engine makers to develop a common training program that reduces expenses for parts release.

BY PATRICK PONTICEL

SAE International is a global body of scientists and engineers whose mission statement is the advancement of aerospace, commercial vehicle and automotive engineering. Under this umbrella there are various study committees and participant groups — among them are the SAE G22 Standards Committee and Aerospace Engine Supplier Quality (AESQ) Committee, which was established to develop quality standards and best practices specific to the Aerospace Engine supply chain.

Since their formation in 2013, SAE G22 and AESQ have developed four aerospace standards focused on streamlining methodology and management practices within the aerospace engine supply chain. An additional six new standards related to risk mitigation, process control and supplier management are currently in progress. Several of these standards have been adopted internationally as a mandated requirement by the global aero engine supply chain. And now, under SAE G22 AESQ auspices, aircraft engine makers are

Above: Instructor Kevin Sung leading a July 2016 class (class #142) in Kaohsiung City, Taiwan.

coming together to develop a special training program intended to help aircraft engine parts suppliers reduce parts-release costs. It's called "Aerospace Supplier Quality: Common Training for Self Release Delegates," and is spelled out in SAE standard AS13001.

Earl Capozzi, Discipline Chief, Global Supply Chain Quality, Pratt & Whitney says that through this training program, aircraft engine makers themselves are also enjoying some cost savings because of efficiencies associated with establishing harmonized training requirements and implementing a common training program.

"It's a big win for everyone," says Capozzi, who leads a subgroup of the SAE G22 AESQ committee focused on the training program. AESQ is comprised of aerospace global giants such as Pratt & Whitney, Rolls-Royce, GE, Honeywell

and Safran and acts a a single source for all information related to standards developed by the G22 committee.

Capozzi explained that in years past, each engine maker had its own training program to certify individuals from suppliers as "self release delegates", a delegate who is an employee of a supplier who is given authority by an engine maker to give final approval and release authority on the engine maker's behalf. This entails making sure the part is produced and shipped according to the engine maker's requirements.

Instead of each engine maker developing and carrying out its own self-release training program, they decided to work together through SAE to commonize their training programs as much as possible. The idea was to make life easier for the self-release delegates, who previously had to undergo a three-day training program by each engine maker every two or three years. This was inefficient and expensive not only because the delegates had to travel to each of the engine makers for training, but also because much of the same content was covered in each of the engine makers' training. Now, to be certified as a self-release delegate, one need only pass the single SAE training program.

After launching in March 2015, the number of public course offerings quickly increased to cover 10 US states and 10 countries, including Canada, China, Germany, India, Israel and Russia. Since then, more than $50 million has been saved across the aerospace engine supply chain as a result of more than 4,000 participants in 20 countries . . .

"Common training is the ticket to the dance," said Capozzi, noting that each engine maker still requires a certain amount of specialized training outside the scope of SAE's. "But it sets that baseline and teaches that trade." By 'trade,' Capozzi means the self-release delegate becomes like a traditional tradesman in that he or she can apply an acquired knowledge base and skill set across different situations/customers. The SAE training has a core curriculum of 13 modules. The training takes three days, and open registration is offered at various public locations. In addition, suppliers may contact SAE to inquire about whether bringing an instructor into the supplier's facility to present the course is a viable option. At Pratt & Whitney, Capozzi's job is, he said, "to figure out ways for us to work smarter, not harder. The SAE training is a perfect example of that. It's a gain to the supply base, and a gain to us."

After launching in March 2015, the number of public course offerings quickly increased to cover 10 US states and 10 countries, including Canada, China, Germany, India, Israel and Russia. Since then, more than $50 million has been saved across the aerospace engine supply chain as a result of more than 4,000 participants in 20 countries completing the training course.

In addition, many companies are requesting private in-house training, which has been delivered in 14 US states and 12 other countries spanning the globe. Twenty-five instructors have been recruited and trained to deliver the course, and learning materials have been translated into several languages. The total population who ultimately need to be trained has grown to more than 6,000, as many suppliers—after experiencing the benefits for their companies—are requiring the training further down into their own supply chain.

Under the program, SAE instructors guide self-release delegate trainees through technical subjects such as documentation requirements, visual inspection, dimensional over-inspection, part marking and serialization, and nonconformance control. This course also presents modules on topics such as airworthiness regulations and standards, human factors, flight safety, and counterfeit parts awareness.

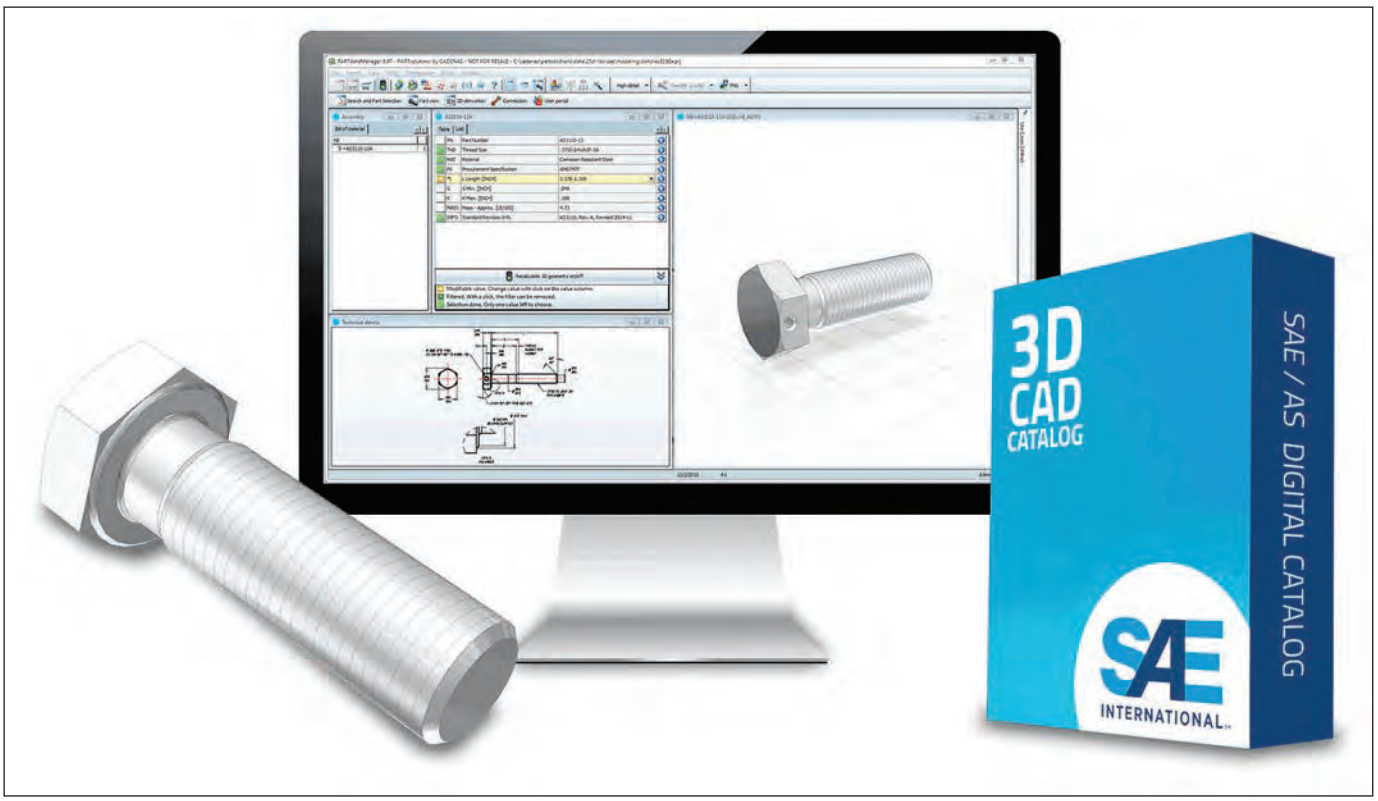
Attending and participating in the full three days is a requirement, along with passing a comprehensive learning assessment to successfully complete the course. Upon successful completion of the training, self-release delegates earn a three-year certification from Probitas Authentication, an aerospace Auditor Authentication Body that operates within SAE's Industry Technology Consortium. Aircraft Engine OEM personnel are able to access the Probitas database to view information about its certified self-release delegates. Probitas also notifies each self-release delegate when their three-year certification is nearing expiration so they can plan to take the next required training, which SAE is already planning with the G22 committee.

At the time of publication, the AS13001 standard is currently being revised. One of the primary objectives of the new revision, titled "AS13001A - Delegated Product Release Verification Training Requirements," is to align with and support the recently published AS9117 Delegated Product Release Verification (DPRV) standard. The publication of AS13001A (along with a change to the supporting course title and certification to "Common Training for DPRV Personnel") represents an opportunity for the larger aerospace community to utilize AS13001A's training and certification as a complement to SAE AS9117, where specific DPRV training is a requirement.

For more information on the SAE self-release delegate training program, contact SAE customer service at (877) 606-7323 (724/776-4970 outside the US and Canada) or at CustomerService@sae.org.

To view the full course description along with the schedule of upcoming class dates and locations, visit http://training.sae.org/seminars/c1501/.

(Patrick Ponticel is SAE Update editor.) ■



Above: Part of being a self-release delegate is making sure the part is produced and shipped according to the engine maker's requirements. Below: V2500 engine overhaul.

ONTARIO

AME Association of Ontario

c/o Skyservice F.B.O. Inc., PO Box 160, Mississauga, Ontario L5P 1B1
tel: 1-905-673-5681 fax: 1-905-673-5681
email: association@ame-ont.com website: www.ame-ont.com

Careers in Aviation Expo 2017

On April 22 I had the honour of being one of many guest speakers at the CIA Expo, which has become an annual affair created by Wings and Helicopter Magazines. Of course my presentation was all about the realities of being an Aircraft Maintenance Engineer, but there were many others discussing every other aviation career imaginable, including pilots, maintenance professionals, aerospace manufacturing, air traffic controllers and many others.

This year's function was hosted by Jazz in their aircraft hangar at Pearson International airport. The venue was well set up with a Dash 8 and RJ both set up for tours and nosed up to the presentation stage. In addition there was a good cross section of vendors booths set up, representing a broad spectrum of Aerospace companies and trainers. Matt Nichols (Wings & Helicopter Editor) and his team did an excellent job, as always, putting it all together.

Attendance was good and I had a great time chatting with young folks and parents eager with many questions about the business. Reaching out and mentoring young people is a strong mandate of the AME Association of Ontario and this is a great venue to do just that. Kudos to Wings Magazine, Air Canada/Jazz and all the participants involved. It is the right thing to do and a positive investment in Canada's Aviation future. Please don't be shy, do your part and get involved.

— Sam Longo

Ontario Technological Skills Competition

The Ontario Technological Skills Competition took place in Toronto on May 1-2. Our AME Association of Ontario supported the competition by supplying our association booth and volunteers to support the Aircraft Maintenance Competition.
Our booth looked great with Sam, John, and Carolyne beautifying the otherwise drab surroundings! We met some folks, chatted with people, handed out some toolbox stickers and even had a visit from a few AMEs and leaders of the Canadian aviation industry! Carolyn queued up our association video for anyone who wanted to know a bit more about us.

The transport of the Dakota Hawk aircraft from CNC3 and back went flawlessly and the landing gear training device lent to us from Centennial College was a great hit with many of the visiting high school students.

A special thank you to Josh James of Centennial College, who went out of his way on a rainy afternoon to make sure the LG trainer arrived.

Big thanks to Sean Fleming of Kitplane Builders, at Brampton Airport, for letting us use his Dakota Hawk aircraft. The aircraft brought a lot of attention, visitors and many questions. It served as a great static display, and there was not a time when someone wasn't snapping pictures in front of it. All in all, it was an excellent event this year. Thanks again to all who supported and helped.

— Submitted by Stephen Farnworth for the Board of Directors

WESTERN

Western AME Association

For the Board of Directors

The Western AME Association is one of five similar associations across Canada, the others being the Atlantic, Ontario, Central and Pacific associations. These associations represent regional interests as well as concerns of national importance.

This Association is run by a volunteer group of AMEs who are elected by the member AMEs to the Board of Directors. The membership is comprised of AMEs, non-licensed personnel working in the industry, students and apprentices as well as corporate members.

A separate committee, under the auspices of the association, runs an annual symposium/workshop. This workshop is a two-day event, which features speakers on a variety of related topics, as well as an industry tradeshow with over 50 booths from various companies, suppliers, manufacturers and other organizations.

Attendance at this and our various other smaller workshops may be counted towards the recurrent training requirements required by Transport Canada.

www.wamea.com

Central AME Association

About CAMEA

The Central Aircraft Maintenance Engineer Association is an organization dedicated to maintaining and enhancing the standards, rights and privileges of all AME members in the central region of Canada. Our chapter is one of five similar associations across Canada who collectively supports the national body CFAMEA (Canadian Federation of Aircraft Maintenance Engineers Association). Our organization works with Transport Canada in the formulation of new rules and regulations and provides a collective viewpoint for all AMEs.

CAMEA Outstanding AME Award

Congratulations go to our 2017 CAMEA Outstanding AME Award winner Mike Fennesy, who started work at Trans Canada Airlines in Winnipeg in1967. He developed an interest in aircraft from being in Air Cadets and obtaining his pilot's licence when he was 17. After graduation, he was hired to a term job at TCA as an aircraft mechanic apprentice. The YWG Heavy Maintenance facility overhauled Vickers Viscount, a four-engine turbo-prop aircraft. The company at that time was closing the YWG base and setting up their new maintenance base in Dorval, Quebec.

He worked for Canadian Aviation Electronics-Aircraft Division, the company that took over the work in maintaining Air Canada's Viscount Fleet of 51 aircraft. Well experienced in all aspects of this aircraft (overhaul, M.O.C. and spar mod, multiple engine changes, interconnection runs and taxiing authority) Mike wrote the required exams to become a D.O.T Certified Pre-Flight Engineer with CAE.

His recall back to what was now Air Canada took Mike to Toronto. Within the year, he was posted to the Chicago's O'Hare Airport as an outstation mechanic where he worked for 4 ½ years.

On his return to YYZ, Mike set out to obtain the licence credentials in the Air Canada system and to bid on the next permanent opening. He gained lots of experience on numerous aircraft doing Line, A & B-Checks, on 747, L1011, DC8, DC9, B727—lots of snags and lots of good people to work with.

Air Canada announced Winnipeg to be a Heavy Maintenance Base for the B-727. Mike bids successfully to the promotion and returns with his young family to YWG as an Aircraft Inspector. The introduction of the A320 Airbus was the next big change and opportunity that Mike obtained. He was selected to be on the Nucleus Crew for training and was also sent to Toulouse and Hamburg as the first inspector to provide some progressive inspections on the assembly line.

Between 1996-2001 Mike accepted the task as Base Auditor in YWG. He also became part of the Core Audit Team with other inspectors and auditors located in YUL. Mike was called upon to participate when the group performed vendor, fuel and base audits at stations throughout Canada. During this period, Mike was requested to initiate setting up an internal NDT Department in YWG.

Mike was involved with the union. He began as a shop steward and served in several positions throughout the years (Secretary Treasurer, Shop Committee, Trustee, Vice President, Recording Secretary and President). He represented the members on several committees and was involved in many issues and discussions to improve working conditions and efficiencies. His interest was always to ensure the betterment of both the members and the company and to work to the agreed to Collective Agreement.

Around 2002-2003 there was lots of talk about Quality. The present system of Quality Control was felt to be inefficient. Quality Assurance was determined to be more productive and more efficient. Transport Canada made the necessary changes and the company transitioned the Aircraft Inspector position into the Process Auditor. Mike was selected to be on the committee to represent the licensed group in Winnipeg during negotiations with the union.

Mike was in the Quality Department as an Aircraft Inspector for 23 years. Through the years, he held the endorsements on the Viscount, B-727, DC-9. A-319, A-320, and A-321. From this point, Mike became a Quality Assurance Process Auditor, a position he held for the next 10 years. He concluded his working career after 44 years and 10 months of service.

With the bankruptcy of Aveos and dismissal of 400 maintenance and support personnel in YWG he chose not to pursue other employment. He had been working since July 1967-March 2012. With his extensive involvement with the union he was asked to remain and take over as president, a position that he had formally held during the troubled times of 9/11, CCAA, the merger of AC and CAIL, the end of HPWO. This was to help to stabilize the local lodge. It was also to mentor some upcoming fellow members who will be leading and supporting the membership.in the future.

In the community, Mike volunteered for several years as Board Member for the Assiniboia West Community Centre doing promotions and the newsletter. During those years, he also coached or managed hockey, baseball and soccer teams enjoying the experience with his sons Chris and Ryan and their friends.

Mike and his wife Judy volunteer with Dreams Take Flight and with the Manitoba Riding for the Disabled Association (MRDA). He also helps with the AC Maintenance Retiree Breakfast Club.

For over 20 years Mike has been on the Board of Directors for Softball Manitoba and is President of the Winnipeg Men's Slo-Pitch League. He is a facility and maintenance volunteer at the John Blumberg Softball Complex. This site will be the host venue for softball at the 2017 Canada Summer Games where Mike is volunteering as the Materials Management Representative for the venue. This is the 50th Anniversary of the Canada Summer Games.

www.camea.ca

ATLANTIC

Atlantic AME Association

Objectives of AME Association Atlantic

To provide a forum of AMEs elected by AMEs or AMEs voluntarily offering to serve on such a body, to act as a vehicle to represent the views and objectives of the AME Association (Atlantic) Inc. at any level required to preserve or alter as the case may deem necessary, the rights, privileges and legislation of AMEs as a whole.

Membership

Regular Membership

All voting members of the Association must currently hold an AME licence in any category, or a non-licensed aviation maintenance technician, technologist or individual meeting a recognized aviation trade standard (CGBS, Mil Standard, CAMC, SCA) or holding a position named in a MCM, MPM, ATO.

Student Membership

Student membership is available at a reduced rate and this specified membership can only be renewed over a six-year period. Student members are non-voting members. Student members attaining AME licenses may become full voting members by paying the difference between student membership fees and regular fees.

Corporate Membership

A corporate member is any corporation supporting the objectives of the association, and which is actively involved in the aviation industry in the Atlantic Region.

www.atlanticame.ca

CENTRAL OHIO

Central Ohio PAMA

May 9th Topic: Aircraft Ownership Costs

Our May meeting featured a presentation by Dr. Richard Wetherald on "Aircraft Ownership Costs." It was held at Lane Aviation's Media Room, 4387 International Gateway on the second floor with the social gathering at 5:30 with a light dinner at 6:00 and Dr. Wetherald's presentation immediately following. Those in attendance were able to sign up for FAASTeam Wings and AMT credit.

The presentation brought up several topics that should be considered before making that leap to aircraft ownership. How often you fly, type of flying, your certifications and your proximity to local airports are all of concern in deciding to purchase or continue to rent aircraft. His full presentation is available for download from the www.EAA9.org website and is well worth the time to review. It also includes examples of expenses he's incurred during the 30-year ownership of a Cessna 172.

We wish to thank Richard for his informational topic and thank Lane Aviation and staff for the use of their facility. This is our last monthly meeting of the year so we wish everyone a fun and productive summer 2017!

April 11th Topic: BasicMed Medical Changes

Our April meeting featured a presentation by Dr. Mike Stretanski AME on the upcoming changes on May 1st to alternate Third Class Medical Certification called Basic Med. Twenty-seven people attended the meeting, which included portions of two PowerPoints to show what details are available on the upcoming rule change. Dr. Stretanski noted that with 20 days remaining from the night of our meeting to the May 1st date, the training and other details for obtaining a BasicMed Certificate are still not available on the FAA's BasicMed website. He then presented known changes in the forensic examination the doctor will perform in comparison with the current Third Class Medical Certificate. There also are limitation related to past health issues and medical certification that determine if a BasicMed Certificate may be obtained.

He also expanded on prescribed drugs and drug abuse that will cause special handling or outright denial of even a BasicMed certificate for flight operation of an aircraft. We want to thank him for spending the evening with us after a long day of personal medical attention.

There was a short organizational meeting after the event to discuss the future of COPAMA. Nine people including one member, six board members and two visitors stayed to help plot our future course. Those plans will be finalized and announced at next month's meeting.

www.copama.org

February 2017 Meeting Wrap

The SoCal Chapter thanks Mr. Steve Borger, Regional Sales Manager, Mr. John Babich, Field Service Rep and all at SatCom Direct for their time and generosity in hosting the February 2017 Chapter dinner meeting and excellent technical presentation on "Did You Know? The Latest in Satcom Innovation" at the 94th Aero Squadron Restaurant in Van Nuys, California. Steve and John can be reached by email at sborger@satcomdirect.com and jbabich@satcomdirect.com.

Final Flight: Neil Looy

SoCal PAMA is saddened by the loss of long-time Chapter supporter and Corporate Air Parts (CAPS Aviation) founder Neil Looy who passed on February 3, 2017. Neil and his team at CAPS hosted many Chapter meetings at not only the 94th Aero Squadron Restaurant, but at the CAPS facility in Van Nuys. Neil's presentations were popular for group participation demonstrations of many types of survival equipment. Neil graduated from Van Nuys high school and Arizona State University, became a USAF F4 pilot, World Airways pilot, aerobatic pilot, helicopter pilot, actor, member of the Directors' Guild of America, and a founding member of the Motion Picture Pilots' Association. Neil flew for Glenn Larson, the producer of many 1970s and '80s television series including Magnum P.I., Fall Guy, etc. He helped Glenn purchase a Lockheed JetStar, one of the first long-range business jets.

Along with Dave Chamberlain, his Director of Maintenance, he started Corporate Air Parts & Service (later known as Corporate Air Parts, Inc.), now CAPS Aviation. Being an engineer, military life support specialist and having long-range overwater piloting experience under his belt, he started an FAA Repair Station, which focused on the sale and service of cabin safety equipment and emergency procedures training for crew members and frequent flyers. The business is now in its 35th year with his daughter Jennifer Gamon as President and CEO.

Also an avid horseman, Neil was a member of the Santa Monica Mounted Police and Ventura Sheriff's Department Posse. Earl Marchesi, Director of Operations & Development for CAPS Aviation, fondly recalls many stories. "Having worked with Neil for almost 20 years, I wish I could share all the examples of his kindness and laughter, and how generous a mentor he was to me and all his employees. He always had time for us, and he treated us all like family. He was only 66, larger than life, and he lived it that way too. He had an intense love of aviation, often leaving the office mid-afternoon saying he needed an 'attitude adjustment.' Shortly afterwards, I'd hear the Pitts roaring overhead. He loved his daughters, Jennifer and Crystal, his Harley-Davidson, his Labrador retrievers and his horses. It has been a tremendous loss for me both professionally and personally, and he will be greatly missed by all who knew him."

SoCal PAMA Sponsorship Opportunities

As I am sure you are aware the Professional Aviation Maintenance Association (PAMA) is a national organization comprised of regional chapters of Aviation Maintenance professionals. These chapters represent the full spectrum of maintenance activities within the Aviation industry. We are proud to say that the Southern California (SoCal) Chapter is one of the most dynamic with in the PAMA organization. Our bi-monthly schedule has a goal to provide our members a Technical Forum /Dinner Meeting with a technical presentation by leading Aviation Maintenance Organizations.

For the past 30 years SoCal PAMA has developed a close working relationship with 94th Aero Squadron Restaurant, which sets on the Van Nuys airport runway, as the location for our dinner meetings. This venue sponsored by our Technical Forum presenter, creates for an enjoyable evening for all the Aviation Maintenance Professionals in attendance and allows the sponsor to reach an audience outside of the normal marketing arena.

Once a year in December we host the Southern California Chapter of PAMA Holiday Dinner Meeting so that as professionals we can enjoy each other's professional camaraderie and holiday spirit. Many organizations and members ask how they can be involved in the festivities so this year we are opening sponsorship opportunities.
All sponsors will be noted as sponsors on the SoCal PAMA website, as well in all PAMA notification of support of the SoCal PAMA organization/holiday dinner meeting.

Sponsorship opportunities are the following:

- Diamond Sponsor: $1,500 (15)*
- Platinum Sponsor: $1,000 (15)*
- Gold Sponsor: $800 (10)*
- Silver Sponsor: $500 (50)*
- Bronze Sponsor: $250 (2)*
- Honourable Mention: All donations will be accepted.

As usual all PAMA members are welcome with their significant other, but as a sponsor you are welcome to invite other folks from your family and or organization based upon your sponsor level. (*See number above.) Also you can always pay for an additional head count that is over your sponsorship level. Contact:

- Chris Cancelosi: (818) 997-7667; chris@rotorcraftsupport.com
- Bill Johnston: (805) 210-1873; wdjohn805@att.net

Submitted by Dan Ramos
www.socalpama.org

AirMaintenance Update

open book exam 2017

open book exam 2017

AirMaintenance Update is Transport Canada-approved for recurrent training. This is our 14th exam, published annually in our June-July anniversary issue, in accordance with our agreement with Transport Canada. The exam consists of questions based on articles appearing in all six issues from the past year: June-July 2016, Aug.-Sept. 2016, Oct.-Nov. 2016, Dec.-Jan. 2017, Feb.-March 2017, and April-May 2017. You will require all six issues in order to write the exam. If you are missing any issues, call us at (604) 214-9824 or email us at amumag2015@gmail.com, and we will mail them to you at a cost of $7.95 per magazine postpaid.

A 75% pass rate is required in order to qualify for your 16 hours toward RT. The questions in the exam are arranged in order of their appearance in AirMaintenance Update according to issue and individual article. The exam can also be downloaded as an Adobe Acrobat PDF file via our website: www.amumagazine.com. Answers should be printed in the spaces provided and must be drawn directly from the text of the articles in order to be considered correct. All questions requiring a longer answer than the space allowed must be typewritten on a separate sheet of paper. Completed exams should be submitted to: AirMaintenance Update, Unit 7, 11771 Horseshoe Way, Richmond, BC, V7A 4V4. The exam must be postmarked no later than October 31, 2017. We will mark your test and return it along with documentation supporting your submission. We will keep a copy of your written test and results on file for future reference, and a copy will be forwarded to Transport Canada. Once again, good luck to all participants!

Your Contact Information

For a prompt and accurate response to your 2017 Exam answers, please fill in the following information (print clearly)

Name .....

Address .....

.....

.....

Phone .....

Email .....

June - July 2016 (Volume 15/Issue 1)

The GE9X: Thinner is Always Better

Finish the following sentences:

1) Additive manufacturing is popularly known as...

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2) CMCs operate in temperatures as high as...

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3) No other commercial engine in service has a...

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4) GE will also replace the titanium leading edge that is currently used...

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5) Where the GE90 has 22 blades and the GEnx holds 18, the GE9X will have only...

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Raising the Bar: All Present not Accounted For

Finish the following sentences:

6) The Pratt and Whitney R1830-92 Twin Wasp 14-cylinder radial engine was air-cooled and had...

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7) The 14 cylinders were each composed of...

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8) The cylinder barrel was forged from steel alloy and included a flange for attachment to the crankcase and...

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9) The cylinder head was machined from aluminum casting and housed the intake and exhaust valves as well as...

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10) For assembly to the cylinder barrel, the cylinder head was heated then threaded onto the barrel while hot; it shrank while cooling creating a...

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Aug. - Sept. 2016 (Volume 15/Issue 2)

Bombardier C Series: Finally off the Ground

Finish the following sentences:

1) Bombardier's C Series is a family of narrow-body, twin-engine, medium-range jets targeted to compete against other airliners such as the...

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2) ...the C Series aircraft that will take to the skies with Pratt & Whitney PurePower PW1500G engines, 19-inch-wide seats, and...

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3) Bombardier Aerospace and Pratt & Whitney announce that P & W achieved Transport Canada type certification of its first PurePower Geared Turbofan engine...

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4) The C Series aircraft's maximum range was confirmed to be up to 3,300 NM (6,112 km), some 350 NM (648 km) more than...

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5) In December, the CS100 receives its Transport Canada Type Certification following a testing that included...

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Raising the Bar: Hot Mess on No. 4 Bearing

Finish the following sentences:

6) After the occurrence, the thermal environment in the No. 4 bearing compartment was reassessed using a...

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7) Between the issuance of the RSI in July 2013 and the occurrence in May 2014, seven shutdowns with a cool-down period of less than five minutes took place on...

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8) Testing demonstrated that, once the seal was compromised, oil leaked into the turbine intermediate case (TIC) and was drawn into...

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9) One or more hot shutdowns caused heat soaking, which allowed the oil feed tube's Teflon C-seal in the No. 4 bearing to fail, which in turn allowed...

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10) Production engines will feature an enhanced design configuration for the oil supply tube and cooling airflow that will...

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Oct. - Nov. 2016 (Volume 15/Issue 3)

Can PMA Parts Compete with OEM Aftermarket?

Finish the following sentences:

1) Parts Manufacturer Approval is, of course, an authorization granted by the Federal Aviation Administration (FAA) to a...

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2) PMA parts must pass the same rigorous quality and testing requirements as OEM parts, but are often...

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3) In North America, the majority of air carriers already accept...

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4) OEM repair shops, on the other hand, can offer...

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5) A prime example of the push-pull between OEM and PMA provider can be found in the maintenance and repair of Environmental Control Systems used in...

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Raising the Bar: When Rubber doesn't meet the Road

Finish the following sentences:

6) The investigation determined that some airlines have found that the number three main tire fails more frequently than...

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7) An unexpected high rotational imbalance was created on the number three tire when...

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8) If there are no specific requirements for dynamic vibration testing of components or completed airframes, there is a risk that similar or other aircraft systems could...

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9) Short-radius turns with hard braking may cause an extreme shearing force on the tread area and on the sidewalls of the number three tire in particular, because...

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10) Other operators that use this aircraft have changed operational procedures to mitigate effect of the sharp right turns on the ramps near the gates in order to lessen the extreme shear loads primarily affecting...

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Dec. - Jan. 2017 (Volume 15/Issue 4)

The Morphing Wing

Finish the following sentences:

1) When the Wright brothers accomplished their first powered flight more than a century ago, they controlled the motion of their Flyer 1 aircraft using...

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2) Thanks to high-tech wizardry developed by engineers at MIT and NASA, some aircraft may be returning to their roots, with...

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3) In the team's new approach, the whole shape of the wing can be changed, and twisted uniformly along its length, by activating two small motors that...

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Raising the Bar: Hard Highway Landing

Finish the following sentences:

4) Vapour lock occurs when fuel, normally in liquid form, changes to vapour while...

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5) An engine is more likely to undergo vapour lock with increased temperatures, lowered pressures (density altitude), higher Reid vapour pressure (RVP) of the fuel, or...

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6) Because AVGAS has a lower and more uniform vapour pressure than automotive gasoline does, it will remain in the liquid state at a higher ambient temperature during...

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7) More often than not, the electric boost pump was required to...

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8) Also, lower atmospheric pressure, as the aircraft continued to climb, increased the probability of...

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9) If MOGAS is used in aircraft that are not certified for its use, there is an increased risk of engine power loss due to fuel delivery issues such as...

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10) In the event of a power loss or engine failure, the Beechcraft Pilot's Operating Handbook and Airplane Flight Manual directs the pilot to...

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Feb. - Mar 2017 (Volume 15/Issue 5)

Lessons in a New Material World

Finish the following sentences:

1) As manufacturers build more wings, fuselages and other major commercial aircraft parts out of solid-laminate composite materials, Sandia National Laboratories has shown that aircraft inspectors need training to...

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2) An eye-opener for course participants was noticing that the scanner signals decreased in amplitude or intensity due to the presence of...

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3) The Boeing 787 makes greater use of composite materials in its airframe and primary structure than...

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4) For example, aluminum is sensitive to tension loads but...

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5) The expanded use of composites, especially in the highly tension-loaded environment of the fuselage, greatly reduces maintenance due to fatigue when compared with...

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Raising the Bar: Engine Failure during initial Climb-out

Finish the following sentences:

6) Engine Indicating and Crew Alerting System (EICAS) parameters displayed rapid decreases in fan speed (N1), compressor speed (N2), fuel flow, and...

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7) The propulsor core was seized by several HPT stage 2 nozzle fragments jammed in different locations, which prevented the core from...

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8) It is believed that, under the right operating conditions, a fuel-rich zone can exist...

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9) In normal hardware conditions, this fuel-rich zone would pass through the HPT and into cooler temperatures, following work extraction in the turbine stages, with...

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10) The larger volume of air in this region can mix with the fuel-rich air and become a...

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April - May 2017 (Volume 15/Issue 6)

Raising the Bar: Men on the Wire

Finish the following sentences:

1) The Hughes 369D, also referred to as an MD Helicopters Inc. 369D, was a five-place, single-turbine-engine (Rolls Royce 250-C20B, serial number CAE832457) helicopter equipped with a five-bladed, fully articulated main rotor system and...

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2) All helicopter operations include a state of hover during various transitions in flight, such as...

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3) The compressor section of a gas turbine engine takes in ambient air and increases air pressure for use in...

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4) The compressor assembly consists of an axial compressor, centrifugal compressor/ impellor, compressor case, and...

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5) Lack of damage to the front support struts or to the stage 1 compressor blades suggests that the engine did not...

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6) When considering the flow of air during compressor operation, the damage would progress downstream from...

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7) If operators do not follow manufacturer-recommended procedures when operating in an erosive/corrosive environment, there is an increased risk of...

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8) For the Hughes 369D helicopter to achieve a successful autorotation from a state of hover with no airspeed, required conditions include having a minimum altitude of 500 feet above ground level and then immediately transitioning into forward flight to maintain the rotor energy required to...

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9) Without engine power, the helicopter's continued flight depended on the energy remaining in the rotor disc and on...

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10) A significant amount of rotor energy was expended while pulling back, and...

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AirMaintenance Update

Unit 7, 11771 Horseshoe Way
Richmond, BC, V7A 4V4

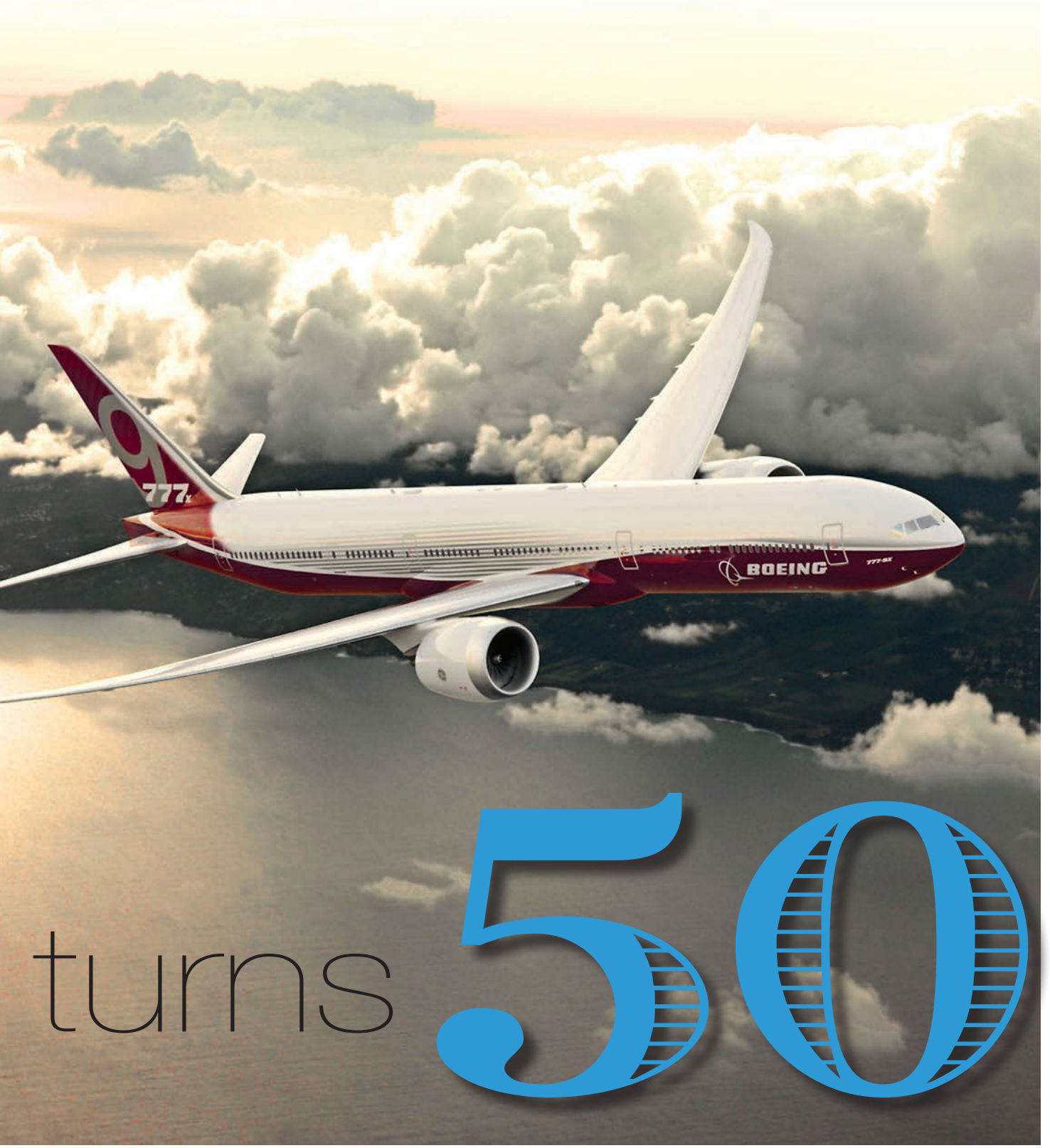
amumagazine@outlook.com
amumag2015@outlook.com

The Grand Old Factory

The month of May was special for Boeing, as its legendary plant in Washington State celebrated an important occasion.

Above: The 747 was known not just for technological achievements but also for its glamour. With a lounge, cocktail service and sometimes even a piano, it held the promise of an elegant, relaxing travel experience.

Facing Page: When complete, the 777X series will be the world's largest and most efficient twin engine jet.



turns 50

In May 1967, Boeing employees moved into a new factory built beside Paine Field near Everett, Washington. Thirteen months later, the group that became known in aerospace legend as "The Incredibles" rolled out the 747.

A half-century later, more than 40,000 employees, customers and suppliers visit Boeing's largest manufacturing site daily. The hub of widebody factories is home to the 747-8, 767, 777, 787 Dreamliner, the KC-46 Tanker and several derivative programs. Building renovations and new construction tell a tale of continuous improvement and transformation—including the 1.3 million-square-foot (120, 800-square metre) Composite Wing Center—as today's production system prepares for the 777X.

Boeing President and Bill Allen and Pan Am CEO Juan Trippe (right) celebrate the launch of the Boeing 747 "Jumbo Jet" in 1968. The longtime friends sealed the deal on selling the airplanes to Pan Am with a handshake while on a fishing trip.

From the tour balcony visitors to Boeing's Everett plant can see 777 airplanes under various stages of construction.

During the month of May of this year, Boeing commemorated 50 years of Team Everett's contributions, those changes reflect the company's continued investment in the region, company leaders say. And several employees who joined the Everett site in the 1960s added their unique perspectives about the past and future.

"The 777X represents a tremendous commitment and 787 and our freighters are well positioned – customers love them," said Bill Rietkirk, a 767 Tanker engine program manager who joined Boeing right out of college in 1966. He believes Everett's future is bright. "If we can keep the other programs going, it looks like the company will be building planes in Everett for quite some time," he said.

Cognizant of the "incredible" legacy they inherited, employees reflected on those first years at the site.

"Boeing was bringing a lot of people into the company," Patricia Walters, a technical designer on the 767 program, recalled of the ramp up to support the 747. It also seemed that we were always adding onto the factory and making the buildings bigger to accommodate the newest airplanes," she said.

Woo Lee, currently on the 747 program, was working in Renton in 1966 when the Everett site was announced.

"I volunteered and got a job doing operational planning for 747 scheduling and have been here ever since," he said. First flights and VIP visits are highlights of his time in Everett.

"It is always exciting to see dignitaries and U.S. presidents come to Boeing. We were proud of our products and always trying to sneak a peek to see what they were doing," Lee said.

Among the many VIPS who have toured and spoken at the site are, in recent years, former US presidents Bill Clinton, George W. Bush and Barack Obama; former US vice president Al Gore; China's president, Xi Jinping, and former Russian president Boris Yeltsin.

Today, Boeing's Current Market Outlook forecasts 9,100 new widebody airplanes will be needed over the next two decades — a $2.8-trillion opportunity.

Employees and leaders said the 777X and other widebody programs, coupled with a sharp focus on quality and affordability, will help the company compete— ensuring the likelihood of future first flights and VIP visits.

Come take a look at what the future holds for aviation. You can visit the factory by booking a tour here: www.futureofflight.org/boeing-tour-seattle ■

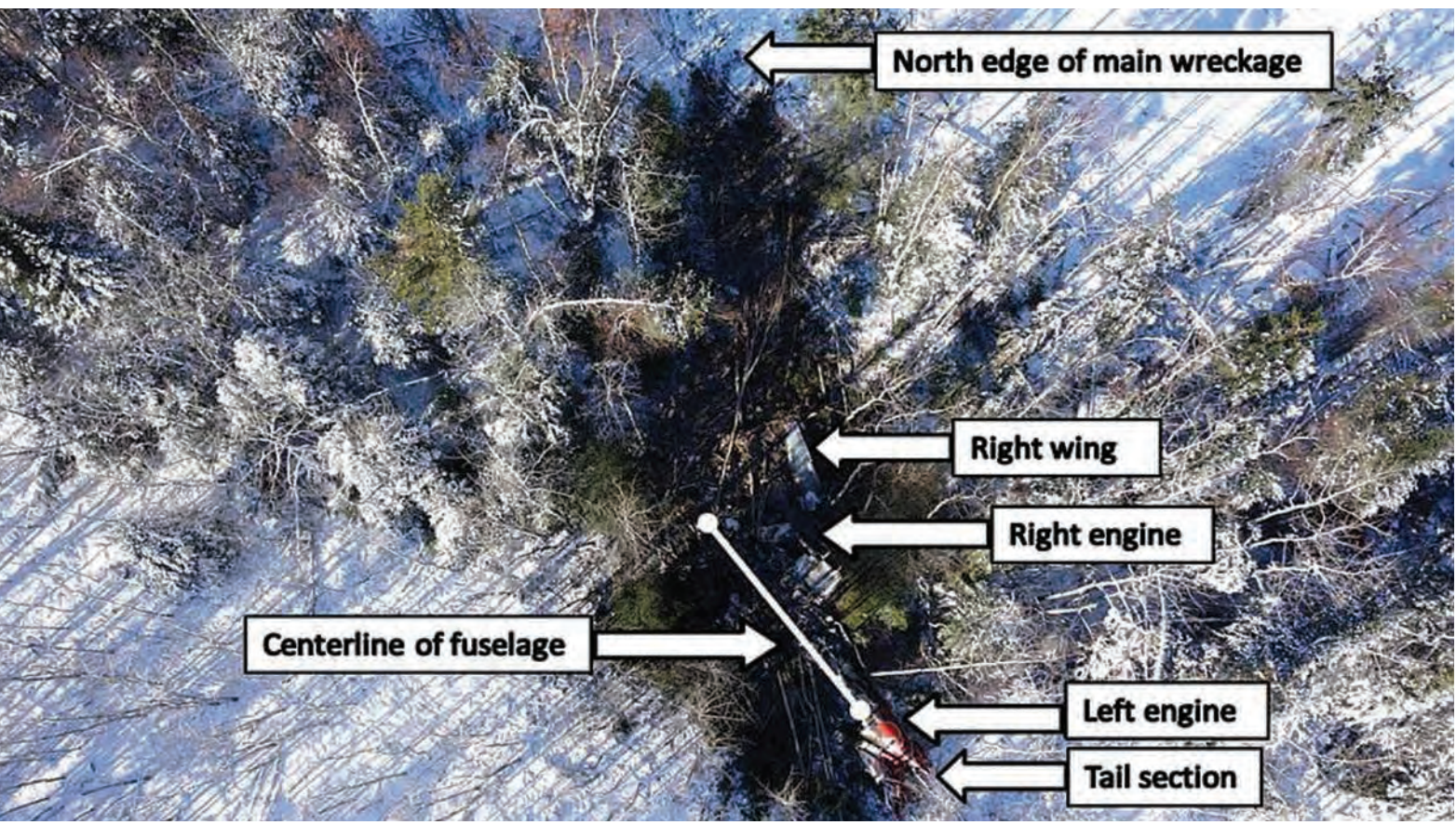
Above: Boeing's largest site located in Everett, Washington.

Building the house

The main assembly building of Boeing's largest site located in Everett, Washington, has grown over the years to enclose 472 million cubic feet of space (13.3 million cubic meters). Its footprint covers 98.3 acres (39.8 hectares).

The original factory was completed in 1968. From its original size, it was expanded by more than 45 percent in 1980 to house the 767 assembly line, and another 50-percent enlargement was added in 1993 for 777 assembly. The site, too, has grown to 1,025 acres (415 hectares), including 215 acres (86 hectares) of paved yards and parking, and 282 acres (113 hectares) of building area. ■

Bearskin on the Ground



Turbine wheel blade failure and misinterpretation of a negative torque sensing system combine for a bad outcome.

On November 10, 2013, Bearskin Lake Air Service LP flight 311 (Bearskin 311), a Fairchild SA227-AC Metro III (serial number AC 785-B, registration C-FFZN) departed Sioux Lookout, Ontario, with two pilots and five passengers on an instrument flight rules flight to Red Lake, Ontario. The flight from Thunder Bay and the subsequent departure from Sioux Lookout were uneventful.

At 1815,1 inbound to Red Lake, the crew advised Kenora Flight Service Station (FSS) of their position (distance and altitude), their estimated time of arrival at the Red Lake Airport, and that they were still working with the Winnipeg Area Control Centre (ACC) for air traffic control. The FSS specialist advised the crew as to the current wind speed and direction, and runway condition. The FSS specialist then asked the crew to report their intended runway for landing, and the crew advised that they would be landing on Runway 26.

At 1816, Winnipeg ACC cleared Bearskin 311 to the Red Lake Airport for the VOR/DME3 Runway (RWY) 26 approach and advised the pilots to contact Kenora FSS on 122.2 MHz. The descent checklist was carried out and at 1817 the crew advised Kenora FSS that they had been cleared by Winnipeg ACC for an approach to Runway 26 at the Red Lake Airport. Because the crew were expecting to encounter visual conditions prior to landing a full approach briefing was not carried out. The landing checklist was completed and, at 1827:06, the crew advised Kenora FSS that they were five nautical miles on final approach for Runway 26 at the Red Lake Airport.

At 1828, at approximately 500 feet above ground level (agl) and approximately 1.4 nm from the runway, the crew noted an aircraft malfunction but did not immediately identify the nature of it. Maximum power was applied to one or both engines, and the landing gear was initially selected up and then re-selected down before it could fully retract. The crew declared an emergency with Kenora FSS and unsuccessfully attempted to initiate a climb. Shortly afterwards, the aircraft veered and rolled to the left, descended, and struck trees with its left wing. The aircraft continued through the trees and struck a series of hydro lines that ran parallel to Ontario Highway 125, before coming to rest in a wooded area adjacent to the highway.

The aircraft was destroyed by impact forces and a post-crash fire. The aircraft's emergency locater transmitter (ELT) was destroyed by impact forces and did not activate.

The aircraft damaged trees, six hydro lines, and one communication cable, which paralleled Ontario Highway 125 leading to the airport. The hydro lines and communication cable were stretched and broken, and four hydro poles were snapped off. The breakage of the hydro lines led to a loss of power and communications to numerous houses and businesses in the community and on the airport property.

The crash site was contained in a small, forested area and was assessed as having minimal environmental impact. The aircraft was not carrying hazardous cargo. Fuel and oil were burnt off in the post-crash fire.

Flight crew information

There were two pilots operating C-FFZN. The captain was the pilot flying (PF) and was seated in the left pilot's seat. The captain held a Canadian airline transport pilot licence (ATPL), which was endorsed for the Swearingen SW4 and SW55 aircraft types. He had been employed with the company since 2009. The captain's most recent pilot proficiency check (PPC) was completed on June 1, 2013, and a company line check was completed on October 8, 2013; both were successful. The first officer (FO) was the pilot monitoring (PM) and was seated in the right pilot's seat. The FO held a Canadian commercial pilot licence (CPL) which was endorsed for SW4 and SW5 aircraft types.

He had been employed with the company since July 2012. The FO's most recent PPC was completed on July 13, 2012, and a company line check was completed on August 2012; both were successful.

Records indicate that the flight crew were certified and qualified for the flight in accordance with existing regulations. A review of all available information indicated that the crew was adequately rested.

Aircraft information

The Metro SA227 is a low-wing pressurized turboprop aircraft configured to carry 18 to 19 passengers. Records indicate that the aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. There were no reported outstanding defects with the aircraft.

Engines

The aircraft is powered by two Honeywell TPE331-11U-612G turboprop engines. Each engine comprises a single spool with a two-stage centrifugal compressor driven by a three-stage axial-flow turbine, a single reverse-flow annular combustor, and an integral reduction gearbox that drives the aircraft propeller. The engine has a maximum continuous rating of 1,000 shaft horsepower. The engine is designed to run at a constant speed (N1), and each engine is controlled by use of an engine power lever and an engine speed lever mounted side-by-side on the throttle quadrant in the cockpit. N1 speed is directly proportional to propeller speed (rpm) and displayed in the cockpit by a percent rpm gauge. Engine power, or torque, is displayed in the cockpit by a percent torque gauge. The gauges are located on the instrument panel, left of the throttle quadrant.

The engine power lever connects to the propeller pitch control and the manual fuel valve. The engine speed

lever connects to the propeller governor and to the underspeed fuel governor.

The power lever controls the engine power by positioning the manual fuel valve in the fuel control unit (FCU), which varies fuel flow (power) in direct response to the manual positioning of the power lever.

There are two modes of operation dictated by the power lever position. When the engine power lever is forward of the flight idle stop, the engine is in the propeller governing mode; this mode maintains a constant rpm by varying the propeller blade angle in direct response to movement of the power lever, which adjusts the fuel flow. When the engine power lever is aft of the flight idle stop, the engine is in beta mode.

In beta mode, the engine power lever varies the engine load by changing the propeller blade angle through the propeller pitch control. The engine rpm is maintained, in response to the load, by varying the fuel flow through the underspeed fuel governor in the FCU.

The engine speed lever incorporates a high- and low-rpm lever position that enables the flight crew to reduce the engine rpm for noise reduction and fuel economy. The rpm selected by the speed lever depends on the positioning of the power lever in either of its two modes of operation.

With the power lever forward of the flight idle stop in the propeller governing mode, the speed lever high position sets the propeller governor rpm at 100 percent for takeoff and landing. During cruise, the rpm is set by the crew to 97 percent with the speed levers as per the aircraft flight manual (AFM).

With the power lever aft of the flight idle stop, in beta mode for ground operations, the speed lever low and high positions set the rpm range of the underspeed fuel governor between 71 percent and 97 percent. The engines were maintained under a continuous airworthiness maintenance (CAM) inspection schedule that requires an engine overhaul at 7,000 hours with a mid-life hot section inspection at 3,500 hours.

The serviceability of the internal engine components is controlled by inspection criteria, time and/or life-cycle limits. Some of the components to which this applies are fuel atomizer nozzles. Because blocked or damaged nozzles can affect flow rates and patterns, which in turn can create a condition known as streaking, they are removed and checked for damage and cleanliness at 450-hour intervals.

Information supplied by the manufacturer suggests that it would be possible to boroscope-inspect other internal engine components, such as stator guide vanes and first-stage turbine blades, at the time the fuel nozzles are removed. Currently, there is no requirement to inspect these other components in conjunction with the fuel nozzle inspection, unless "fuel nozzle plugging or adverse streaking is suspected."

The left engine was installed on the accident aircraft on May 15, 2011. At the time of the occurrence, the engine had accumulated 32,267 hours time since new (TSN) and 2,948 hours since its last major overhaul CAM inspection. The right engine was installed on the accident aircraft on August 4, 2012. At the time of the occurrence, the engine had accumulated 18,526 hours TSN and 1,029 hours since its last major overhaul CAM inspection.

Propellers

The aircraft is equipped with two McCauley 4HFR34C652-K four-bladed, full-feathering, constant speed, reversing-pitch aluminum propellers. Springs and counterweights move the blades towards high pitch to decrease rpm, and the propeller governor boosts engine oil pressure to move the blades towards low pitch to increase rpm.

The governor oil pressure is transferred through the propeller pitch control and the beta tube into the propeller hub to move the piston and blades. The blade travel angle is from -5˚ for full reverse to +88.5˚for full feather, with physical stops at those locations.

A variable low pitch stop provides a hydraulic lock between the beta tube and propeller pitch control, and controls the blade angle on a varying scale from 15˚ at the flight idle stop position to 21.5˚ at the 90˚ power lever position.

The propeller has an internal start-lock flyweight arrangement, which locks the propeller servo piston at a 6˚ blade angle setting during engine shutdown, which facilitates engine restart. Feathering is provided for by a crew-operated engine stop and feather knob mounted on the centre pedestal in the cockpit.

Pulling the knob stops the fuel to the engine and then pushes the high-pressure governed oil through a feathering valve. This allows the internal propeller feathering spring and the external counterweights to move the propeller blades into the feather position.

Negative torque sensing system

The negative torque sensing (NTS) system is designed to reduce propeller drag forces on the aircraft which cause yaw if an engine fails during flight. The NTS system senses negative torque on the engine if the propeller is windmilling and driving the engine. The NTS system cycles the propeller blades to provide momentary protection from a windmilling propeller and in-flight negative torque protection for the engine. When negative torque is detected, the NTS valve directs oil pressure to the feathering valve, which increases the blade angle to reduce the unwanted propeller drag. The NTS system is calibrated by three torque load assemblies to sense a negative torque of –3% to –4% before activating.

The investigation revealed that the descriptions of the NTS system in several SA227/SA226 training manuals were such that pilots could interpret them to mean that the system would automatically provide anti-drag protection in the event of an engine failure or power loss. The NTS system does provide partial anti-drag protection if negative torque is sensed, but not to the extent that is provided by a fully feathered propeller. An auto-feather system completely feathers an affected propeller permanently to provide anti-drag protection in the event of a loss of propeller thrust associated with an engine failure.

Misinterpretation by flight crews of the purpose or function of the NTS system in the event of an engine power loss may lead them to believe that the NTS system will always ac-

tivate in the event of a power loss or that NTS activation alone will provide adequate anti-drag protection.

As a result, flight crews may not initiate the Engine Failures In Flight checklist in a timely manner. If the NTS system activates due to an engine failure, standard operating procedures (SOPs) require flight crews to feather the affected propeller, as directed in the AFM, to eliminate propeller drag.

Wreckage and impact information

The aircraft struck trees while in a steep left-wing-low attitude approximately 2,300 feet south of the approach end of Runway 26. The outboard eight-foot section of the left wing was torn off, and the aircraft travelled approximately 375 feet before striking hydro lines that paralleled Ontario Highway 125 leading to the airport. The aircraft contacted the south edge of the highway roadbed, at which point the left engine and propeller separated from the aircraft. The aircraft cartwheeled and slid tail first coming to rest 150 feet from the highway in an area of trees.

The left engine came to rest underneath the tail section. The right engine and wing broke off during the impact sequence. Both propellers had detached from their respective engines. The front of the aircraft forward of the wing main spar was severely crushed and deformed; the cabin area aft of the wing trailing edge remained largely intact. Most of the aircraft was consumed by the post-crash fire.

Continuity of the flight control systems was established to the extent possible considering the fire damage. The landing gear and flaps were determined to be in their full down positions. The ailerons were trimmed neutral, the rudder was trimmed 5˚ nose left, and the horizontal stabilizers were trimmed nose up within the green takeoff range on the stabilizer trim indicator.

The EGPWS and annunciator panel were recovered and sent to the TSB Laboratory in Ottawa for examination and information recovery. The left-hand oil pressure light was the only bulb illuminated at impact. There was no recoverable information from the EGPWS due to damage. Both engines and propellers were recovered for further examination.

Analysis

The teardown of the left engine revealed a burnt-through stator vane. The burnt-through stator vane created a one-per-revolution vibrational excitation and allowed excessive heat stress on the first-stage turbine wheel blades. This, combined with higher porosity in one of the blade castings, inadequate fatigue capability and robustness of the blade material, and a minor increase in the mean stress in the blade fir tree region due to blade platform contact, resulted in a high-cycle blade failure.

The separated portion of the failed blade damaged the remaining first-stage blades causing them to separate from the first-stage turbine wheel and pass through the remaining turbine wheels, damaging them in the process.

Although the engine was severely damaged, there was enough remaining air and fuel flow so that the engine continued to run, but it produced little or no power to drive the propeller. The discrepancies between the engine manufacturer's maintenance manual and fuel nozzle overhaul manual created a risk that cracked or failed fuel nozzles could be re-installed after overhaul. Currently, there is no requirement to perform a boroscope inspection of the TPE331-11U-612G's internal engine components in conjunction with the 450-hour fuel nozzle inspection, unless fuel nozzle plugging or adverse streaking is suspected.

Fuel nozzle testing for flow and streaking is not normally conducted at the same time and place as the nozzles are removed. In most cases, nozzles are removed and replaced with a spare set that have been tested previously. Plugging and/or adverse streaking would not likely be suspected until quite some time after the nozzles had been removed, which might preclude a boroscope inspection being carried out in conjunction with the fuel nozzle inspection. If there is no requirement for a boroscope inspection in conjunction with the 450-hour fuel nozzle inspection regardless of nozzle condition, there is an increased risk that premature internal engine damage will not be detected.

The engine had accumulated 2,948 hours since its last major overhaul. The next major inspection was not due until 3,500 hours. Failure of engine components 552 hours prior to the next inspection would be described as premature. Premature engine component failures have occurred in this engine type, but are rare. Unexpected and premature engine failures are known to occur.

To minimize the impact of engine failures and other major aircraft component malfunctions, aircraft manufacturers have developed type-specific flight crew procedures to reduce the risk of injury or damage resulting from these malfunctions. A first-stage turbine wheel blade in the left engine failed due to a combination of metallurgical issues and stator vane burn-through which created vibration and heat stress on the turbine blade. As a result of the blade failure, the left engine continued to operate but experienced a near-total loss of power at approximately 500 feet above ground level (agl) on final approach to Runway 26 at the Red Lake Airport.

A spectrum analysis of the cockpit voice recorder (CVR) data indicated that the turbine blade failure was sudden and that there were no prior cockpit indications of an impending engine malfunction. The engine power loss was unexpected, and the crew had only 56 seconds between the time the left engine malfunctioned and the time the aircraft struck the trees. The crew did not verbally call out the emergency, likely due to difficulty in identifying the precise nature of the problem.

The following factors likely contributed to the crew's difficulty in identifying the nature of the malfunction:

- The right engine was at a low power setting when the left engine power loss occurred, which would have made it difficult for the pilot flying to sense the yaw resulting from the malfunctioning engine;
- The left engine continued to run, which resulted in engine readings of 98 percent engine rpm, with likely normal

oil pressure, exhaust gas temperature, and fuel flow. The low torque indication in the cockpit would have provided some indication of the engine problem, but it was not noticed; and

• There was little time available to identify the nature of the malfunction.

Because the exact nature of the engine malfunction was not identified, the crew did not follow the standard operating procedures (SOPs) prescribed action of calling out the associated emergency procedure, which required them to stop and feather the propeller of the affected engine. This may have resulted from a belief that the NTS system would always activate in the event of a power loss and that NTS activation alone would provide adequate anti-drag protection from a windmilling propeller. Feathering the failed engine's propeller would have decreased the drag associated with it and likely would have allowed the crew to maintain control of the aircraft. Analysis of CVR information indicated that the crew had configured the aircraft for landing and, when they experienced the engine malfunction, they initially retracted the gear as though they were on an engine-out approach. They then re-selected the landing gear down before it could fully retract. It could not be determined if the company's non-precision engine-out procedure, which requires crews to re-configure the aircraft several times over a short distance, may have influenced these actions.

At 1828:43, the crew reduced the power on the right engine to approximately 91 percent torque, then made a further reduction to 54 percent torque (presumably to initiate a descent to the runway). Flight data recorder (FDR) information indicated that the aircraft slowed to 101 knots indicated airspeed (KIAS) and banked to the left after the second power reduction.

Flight test data indicate that with the aircraft in a high drag and asymmetric state, at this airspeed, the pilot flying would have had to input full aileron control deflection in an attempt to control the aircraft. Without further control input available, the pilot would have been unable to correct the aircraft's rolling motion or recover from a stall.

At 1829:01, in response to a pilot monitoring (PM) instruction to climb, the right engine power was increased to 98 percent torque. This increase in power exacerbated the aircraft's asymmetric state and resulted in the aircraft rolling left to 41° of bank. The aircraft's stall speed in this attitude, with full flap and the landing gear down, is approximately 98 KIAS. The aircraft's speed slowed to very near the stall speed; therefore, the loss of control was likely the result of a wing stall. There was insufficient altitude to recover.

The crew was unable to identify the nature of the engine malfunction, which prevented them from taking timely and appropriate action to control the aircraft. The nature of the engine malfunction resulted in the left propeller being at a low blade angle, which, together with the landing configuration of the aircraft, resulted in the aircraft being in an increasingly high drag and asymmetric state. When the aircraft's speed reduced below minimum control speed (VMC), the crew lost control at an altitude from which a recovery was not possible.

Findings as to causes and contributing factors

1. A first-stage turbine wheel blade in the left engine failed due to a combination of metallurgical issues and stator vane burn-through.

2. As a result of the blade failure, the left engine continued to operate but experienced a near-total loss of power at approximately 500 feet above ground level, on final approach to Runway 26 at the Red Lake Airport.

3. The crew was unable to identify the nature of the engine malfunction, which prevented them from taking timely and appropriate action to control the aircraft.

4. The nature of the engine malfunction resulted in the left propeller being at a very low blade angle, which, together with the landing configuration of the aircraft, resulted in the aircraft being in an increasingly high drag and asymmetric state. When the aircraft's speed reduced below minimum control speed (VMC), the crew lost control at an altitude from which a recovery was not possible.

Findings as to risk

1. If pilots believe that the negative torque sensing (NTS) system in the SA227 aircraft will activate in the event of any power loss or that NTS activation alone can provide adequate anti-drag protection in the event of an engine power loss, there is a risk that flight crews operating these aircraft types may not initiate the Engine Failures In Flight checklist in a timely manner.

2. If there is no requirement for a boroscope inspection of the TPE331-11U-612G's internal engine components in conjunction with the 450-hour fuel nozzle inspection, there is an increased risk that premature internal engine damage will not be detected.

3. If there are discrepancies between the fuel nozzle testing procedures described in the TPE331-11U-612G maintenance manual and the corresponding fuel nozzle overhaul manual, there is a risk that unserviceable fuel nozzles may be evaluated as serviceable and re-installed on aircraft.

Other findings

The SA227's negative torque sensing (NTS) system may not always activate in response to an engine failure. The nature of the engine failure and aircraft profile may affect whether or not NTS activation parameters are reached.

The Transportation Safety Board of Canada (TSB) issued Safety Advisory 825-A13C0150-D1-A1, Operation of Aircraft with Negative Torque Sensing Systems, dated 25 April 2014. This advisory indicated that the SA227AC propeller system incorporates a negative torque sensing (NTS) system, which provides cyclical anti-drag and negative torque protection for the engine if a negative torque condition is sensed. It is important to note that under certain conditions, such as an incomplete engine shutdown or certain aircraft configurations, NTS activation parameters may not be reached.

Other types of aircraft also use a similar NTS system. The investigation revealed that several SA227/SA226 training manuals provide descriptions of the NTS system that might cause pilots to interpret them to mean that the system would automatically provide anti-drag protection in the event of an engine failure or power loss.

The NTS system does provide partial anti-drag protection if negative torque is sensed, but not to the extent that is provided by a fully feathered propeller.

Misinterpretation by flight crews of the purpose or function of the NTS system in the event of an engine power loss may lead them to believe that the NTS system will always activate in the event of a power loss or that NTS activation alone will provide adequate anti-drag protection. As a result, flight crews may not initiate the Engine Failures In Flight checklist in a timely manner.

The Safety Advisory suggested that Transport Canada might wish to advise operators of these aircraft to review the NTS systems description in their training manuals and standard operating procedures (SOPs) for engine failures. The advisory further stated that particular attention should be directed to flight crews operating these aircraft types to initiate SOPs in a timely manner when an engine failure occurs.

(This report concludes the Transportation Safety Board's investigation into this occurrence. The Board authorized the release of this report on 11 March 2015. It was officially released on 14 April 2015.) ■

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Put the big boy through the mill

Early in May, GE Aviation began GE9X engine certification tests at its Peebles Test Operation in Ohio. The GE9X will power Boeing's new 777X aircraft.

The first round of GE9X certification tests are being conducted on the second GE9X production-configured powerplant built by GE. To prepare for the certification program, trials of the first full engine to test GE9X engine commenced in March 2016, generating critical data on the full engine system and aerodynamic performance, mechanical verification, and aero thermal system validation. Testing of the FETT engine concluded earlier this year with a series of preliminary natural-icing tests at GE Aviation's Peebles Test Operation in Ohio, where the GE9X ran more than 50 test points, accumulating 168 hours and 162 cycles.

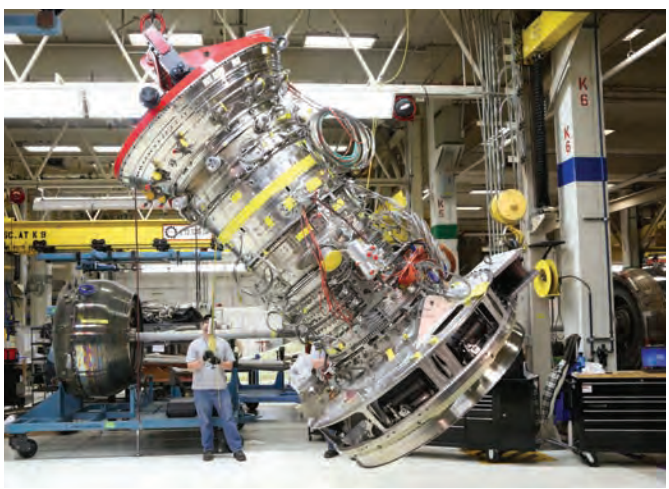
"Completing a full year's worth of validation efforts on the FETT engine gave us great confidence heading into the certification program with the second GE9X engine," said Ted Ingling, GE9X general manager at GE Aviation. "By incorporating all the learnings from the FETT engine, we start the GE9X certification program with a stable configuration and position ourselves to meet the schedule and performance expectations of our customers from Day One of service entry."

As the second GE9X engine begins testing at PTO, assembly of the third and fourth GE9X engines is well underway at GE Aviation's headquarters in Evendale, Ohio. The fourth GE9X engine is slated for installation and flight tests aboard GE's 747-400 Flying Test Bed flown out of GE's Mojave Desert facility in Victorville, California, before the end of this year.

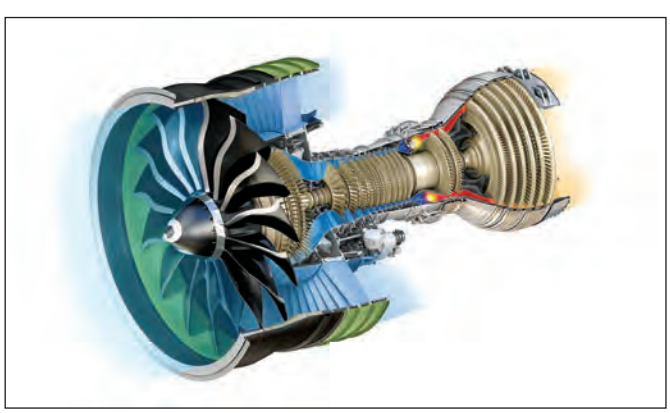
Maturation testing of the GE9X engine began about six years ago, progressing from component-level through the completed first full engine to test validation efforts. FETT brought all the GE9X technologies together to demonstrate their operability as a complete propulsion system.

In October 2016, GE completed the second phase of GE9X CMC (ceramic matrix composite) component testing in a GEnx demonstrator engine, accumulating 1,800 cycles while exposing the engine to harsh environmental conditions of dust and debris. The level of debris exposure was equivalent to about 3,000 take-off and landing operation cycles. For the second round of tests, the GEnx demonstrator engine utilized the same CMC combustor liners, HPT stage one shrouds and HPT stage two nozzles from the first round of tests run in September 2015 along with the addition of the HPT stage one CMC nozzles.

The use of lightweight, heat-resistant CMCs in the hot section of jet engines is a significant breakthrough in the aviation industry. CMCs consist of silicon carbide ceramic fibres and ceramic matrix and are enhanced with proprietary coatings. With one-third the density of metal alloys, these ultra-lightweight CMCs reduce an engine's weight, which improves fuel efficiency and durability. CMCs are also more heat resistant than metal alloys, allowing the diversion of less cooling air into an engine's hot section. By using this cooling air in the engine flow path, an engine runs more efficiently at higher temperature.



Above: The first engine to test (FETT) wraps up the extensive technology maturation program for the GE9X engine program, which began almost five years ago. Below: The fan blades of the GE9X engine use a lighter and more advanced composite material.



With almost 700 GE9X engines on order, the GE9X engine will be in the 100,000 pound thrust class and will have the largest front fan at 134 inches in diameter with a composite fan case and 16 fourth-generation carbon fibre composite fan blades. Other features include a next-generation 27:1 pressure-ratio 11-stage high-pressure compressor, a third-generation TAPS III combustor for high efficiency and low emissions, and CMC material in the combustor and turbine.

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