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The problem was the age of the aircraft

MID-CANADA Mod Center in Toronto recently completed the installation of a Universal Avionics InSight display system on an aging Textron Citation VII. The key challenge with this mod was the age of the aircraft. "Repair costs for legacy avionics on an aircraft of this age are typically quite high and some of the systems are no longer supported," said Bill Arsenault, president of Mid-Canada Mod Center. "The main goals here were to enhance safety through better situational awareness, and extend the usable life of the aircraft with a modern cockpit. This Citation VII had relatively few upgrade paths available, but having worked on older aircraft for many years, it was clear to us that the Universal Avionics InSight display system would meet our client's goals."

Ultimately MC2 teamed-up with sister company ADS and Universal Avionics to enhance the safety and usable life of the aircraft, marking the first Canadian installation of Universal Avionics' integrated flight deck. This is interesting not only because these older aircraft types can still be modernized, but AMEs may be seeing the same thing in their own mod-shops. The work included an extensive flight deck upgrade, inflight connectivity, plus additional certification to obtain Transport Canada approval of UA's FAA Supplemental Type Certificates. MC2's sister division, Avionics Design Services helped smooth the way for application submissions and developed an STC for a software upgrade.

With this completed installation and certification, the InSight display system is now considered a viable solution for all Citation VII aircraft with existing Honeywell and Collins Nav/Comm packages. ■

— John Campbell, Editor

Departments

Features

AirMaintenance Update
Unit 7, 11771 Horseshoe Way
Richmond BC V7A 4V4 Canada
phone: (604) 214-9824
fax: (604) 214-9825
email: chrissie@amumagazine.com
website: www.amumagazine.com

editor: John Campbell
art director: Cliff Vickstrom
publisher: Bill Carter
sales manager: Bill Carter
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Upcoming Events

Concorde Battery Virtual IA renewal series

Eight-Hour Certificate

Due to pandemic restrictions, Concorde Battery's IA renewal series has moved to a virtual format and will be accessed on the GoToWebinar platform. Held over three days, January 21-23, 2021, participants choose two of the three days to attend. Each day is comprised of four hours of training. At the end of this training, participants will leave with their eight-hour certificate. There is no charge for participation. A second virtual IA renewal series has also been scheduled for March 2021 with information to follow at a later date.

Speakers for the January 2021 series include experts in the field of aviation maintenance products. Participating companies include ACF-50, Champion, Cleveland Wheel & Brake, Concorde Battery Corp., Eagle Fuel Cells, G&N Engines, Goodrich De-Ice, Goodyear Tire, Hartzell Propeller, Lycoming, Rapco, Tempest and more. Presenting companies are subject to change but four hours of training will take place daily and each 50-minute session is FAA approved, which satisfies the recurrent training requirements.

For years Aviation Maintenance Technicians have gathered annually at Concorde Battery's event locations to renew their Inspection Authorization certificates in person. "Concorde was registering hundreds of AMTs arriving at the IA renewal series in specific geographic areas," says Chris Holder, Concorde Battery's Eastern US Sales Manager. "Broadcasting online will give us the ability to accommodate more participants throughout the country and continue Concorde Battery's support for IA Certificate Holders."

Online registration is required by accessing www.aircraft-battery.com and closes January 15, 2021. Once registrants are confirmed they will receive confirmation of enrolment and be notified via email with event access details in January 2021. At the end of their participation, attendees will be emailed their eight-hour certificate. For questions, please contact Chris Holder at **cholder@concordebattery.com**.

Airports, Aviation, Aerospace: Reducing Our Environmental Footprint

The aviation and aerospace industry is a significant contributor to global warming, generating as much as 4.9 percent of human-caused climate change. Indeed, there are a growing number of people advocating for more sustainable options including less air travel, and this could have a profound socioeconomic impact worldwide.

In an effort to address this critical issue, the British Columbia Aviation Council's Conference Committee decided to focus its Conference 2021—scheduled for May in Victoria—on the challenges generated by climate change. There are a number of ways that the aviation and aerospace industry can reduce its environmental impact and Conference 2020 helped to identify, and facilitate the important conversations around, these strategies. Conference 2021 will also introduce BCAC's new five-year strategic plan which focuses not only on the environment, but also on the industry's looming human resources crisis. Conference 2021 will probably begin with NAV CANADA's "Area Operations Consultation Meetings (AOCM)".

Directly following Conference 2021, the Inn at Laurel Point will host the "14th Annual Facility, Operations and Airport Managers Conference (FOAM Conference)", saving many attendees duplicate travel costs; this is especially important for those facing unexpected COVID-19-related expenses and shortfalls in their budgets. **www.bcaviationcouncil.org**

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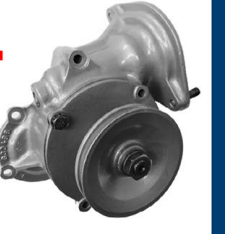

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STCs & new products

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Socket Roll has two new products: Socket Roll Metric Pro and Socket Roll SAE Pro designed with easy to read drive socket sizes for quick access. Both are made with MILSPEC elastic material that prevents premature wear and stretching while keeping tools dry and protected from harmful fluids. They roll out flat and have 21 socket sleeves, deep and short sizes, with additional sleeves for accessories. All Socket Roll products feature a "locking" stitch mechanism which locks each socket firmly in place and allows the socket to be inserted into the organizer in any direction. **www.socketroll.com**

RG-641 battery install is designed as drop-in

Concorde Battery has received FAA STC SR01067DE approving installation of RG-641 lead acid main battery on Enstrom 480/480B models. RG-641 has been designed as a drop-in replacement for the original equipment lead acid battery on the helicopter; no kit or hardware is required to convert. The 24-volt, 17Ah battery features proprietary PolyGuard separators, added protection against vibration, superior sustained starting and premium performance. STC SR01067DE and RG-641 are now available through Concorde's worldwide distribution network ready to ship Hazmat exempt via land, sea or air.
www.concordebattery.com

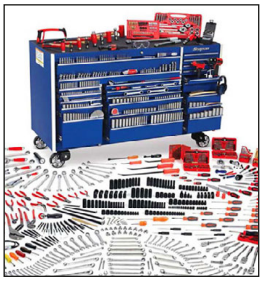
MU-2 STC awarded for Hartzell scimitar props

Intercontinental Jet Service Corp has obtained a Supplemental Type Certificate for Hartzell Propeller's scimitar four-blade aluminum prop installations on MU-2 twin-engine aircraft. Models covered include more than 260 aircraft built by Mitsubishi. The STC by IJSC, a Hartzell Propeller recommended service facility, replaces the previous Hartzell steel hub prop installations with lighter weight aluminum hubs and blades. The new installation saves 17 pounds per engine and delivers better performance. Available through IJSC, the completed kit includes installation, custom polished and larger aluminum spinner. **www.ijetservice.com**

Max-Viz 1400 and 1200 EVS receive approval

Astronics Corporation has announced the United States and Canada have approved its Max-Viz 1400 and 1200 Enhanced Vision systems for Airbus Helicopter's AS350 Écureuil. In cooperation with AVIO dg in Calgary, Canada, Astronics obtained the Supplemental Type Certificates for its Max-Viz 1400 and 1200 EVS from the U.S. Federal Aviation Administration and the Transport Canada Civil Aviation for approved models which are the Airbus Écureuil AS350B, AS350B1, AS350B2, AS350B3, AS350BA, and AS350BD. Astronics' Max-Viz 1200 and 1400 systems are lightweight, solid-state, low power, and feature an uncooled thermal camera.
www.Astronics.com

Tool set is designed for aviation pros



Snap-on's Aviation MRO Pro tool set comes with more than 500 tools specifically selected for aviation maintenance, repair and operation. Snap-on Industrial teamed up with aviation industry professionals to design this all-in-one set, which includes virtually everything you need as a professional technician to safely keep aircraft in top working order. The set includes a variety of hand, power, structure, torque, inspection and safety tools all housed in a 54-inch, 11-drawer roll cab, which comes with foam cutouts for tools for visual tool control.
www.snapon.com

McFarlane will now carry more Tempest products

McFarlane Aviation has expanded its distribution agreement with Tempest Aero Group allowing McFarlane to increase its product offerings to the full line of Tempest products: Marvel Schebler, Precision Airmotive, Alcor and Tempest Plus. For the past several years McFarlane has represented Tempest's Alcor brand of sensors and probes but the expansion will bring additional sparkplugs, vacuum pumps, carburetors, oil filters, sensors and more to the McFarlane storefront. **www.mcfarlaneaviation.com**

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

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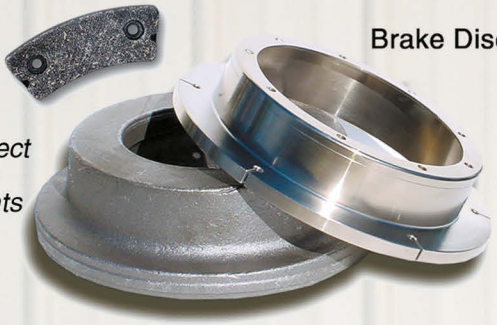

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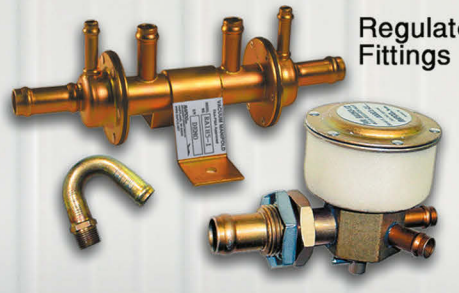

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BEECHCRAFT KING AIR 360 ENTERS INTO SERVICE

Textron Aviation has made delivery of its first Beechcraft King Air 360 turboprop to launch customer, California-based Stamoules Produce Company. While the King Air turboprop has been flying customers throughout the world for more than 50 years, Textron's King Air 360 offers the latest tech advancements in the cockpit, a redesigned cabin and enhancements to passenger comfort. "We were excited to learn of the new upgrades and features to an already exceptional aircraft, and I am even more excited to fly," said Katie Stefanopoulos, a family member, who will also serve as corporate pilot for the new aircraft.

EPISHUTTLES LAUNCHED TO FIGHT CORONA VIRUS

Keewatin Air now has operational certification from Transport Canada to deploy single-patient isolation and transport units called EpiShuttles in its Pilatus PC-12 planes. With the EpiShuttles in place, medivac services providers can perform patient monitoring and full intensive care of infected patients during air, sea, and land transport. With their EpiShuttles Keewatin can offer fast and safe transport, even from remote locations. The aircraft PC-12, is widely used in the north, where its short take-off and landing capabilities make it able to service the smallest and remote communities.

JAMCO WILL TEST WORLD'S FIRST HANDS-FREE LAVATORY

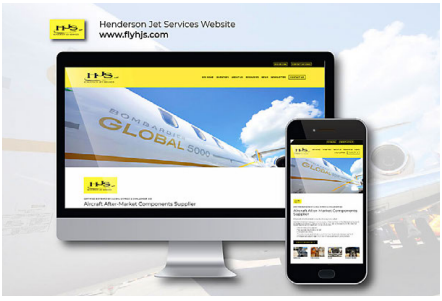
Jamco Corporation has introduced a new hands-free lavatory lock knob and door handle developed for passengers who do not wish to use their fingers or hands to touch the lavatory door. The hands-free lavatory lock knob and door handle can be installed overnight to existing lavatories without major modification. All Nippon Airways is the development partner for the hands-free product and is expected to be the first operator. In the wake of COVID-19, touchless, hygienic cabin interiors support passengers' need for safety during travel.

TEXTRON AVIATION TO EXPAND SERVICE OFFERINGS

Textron Aviation is expanding service offerings to provide customers with a new standard repair process for Cessna Citation CJ series aircraft main landing gear. When certified, this process will allow engineers to repair the MLG without having to replace it, improving cost-effectiveness of operation for customers. With initial testing taking place the company plans to subsequently apply the repairability solution across all CJ series aircraft starting in 2021. Textron has successfully completed static and cyclic testing of the Citation CJ3 MLG with up to five lifetimes (75,000 landings) of the gear's life limit to substantiate the repair safe-life.

HJS LAUNCHES BOMBARDIER AFTERMARKET WEBSITE

Henderson Jet Services, a certified supplier of Bombardier business jet aftermarket components, systems and engines, has announced the launch of the new company website, www.flyhjs.com, which was developed to provide Bombardier Global Express, Challenger 300, and Learjet OEMs, Operators, MROs, and Resellers comprehensive company product and service resources. Visitors



now have the ability to research HJS aftermarket component options, resources, and part inventory searches. The new HJS website includes educational content that addresses the value of top-tier aircraft sourcing, tear-down, component testing and full-cycle customer support.

VALLAIR DELIVERS AIRBUS A321 FREIGHTER CONVERSION

Vallair has delivered its pioneering Airbus A321 P2F (passenger to freighter) conversion to launch operator Qantas. The aircraft will be the only one phased into Qantas' fleet this year. Vallair says its A321 freighter variant is better for the environment due to its 20 percent reduction in fuel burn, enhanced performance across range, payload and volume with a capacity for 14 container positions in the upper deck and 10 more on the containerized lower cargo deck. It is anticipated that cargo specialists will require about 1,500 narrowbody converted aircraft over the next 10 years.

SATAIR PROVIDES METAL PRINTED FLYING SPARE PART

Satair has provided one of its airline customers in the US with what is believed to be the first certified metal printed flying spare part, an A320ceo component no longer procurable from the original supplier: specifically, A320ceo wingtip fences, which are installed in four different versions – starboard, port, upper and lower. The printing of the wingtip fence parts was carried out at the Reference Manufacturing shop in Airbus Filton, which was process qualified in 2019 and is now able to produce airworthy parts regularly. Four parts (full shipset for one aircraft) are printed simultaneously in a build job, which takes 26 hours.

ROLLS-ROYCE TO TEST SUSTAINABLE AVIATION FUEL

As part of its ongoing decarbonization strategy, Rolls-Royce will use 100 percent sustainable aviation fuel for the first time in engine ground tests, which aim to demonstrate that Rolls-Royce's current engines can operate with SAF as a full "drop-in" option, laying the groundwork for moving such fuels towards certification. At present, SAF is certified for blends of up to 50 percent with conventional jet fuel. The ground tests will involve a Trent engine which also incorporates ALECSys (Advanced Low Emissions Combustion System) lean-burn technology. ALECSys is part of the UltraFan engine demonstrator program. ■

Light Insight

By John Fogel

Leading aircraft manufacturers like Boeing are building LED lamps into their new designs for all external aircraft lighting because they last virtually forever.

This industry insider advises operators to consider the whole cost of ownership when choosing aircraft lighting.

MOST commercial airlines have seen an uptick in bookings over the 2020 holiday season but remain cautiously optimistic about rebounding to the full flights and revenues they reported prior to the COVID-19 pandemic. Keeping a close watch on expenses is key to maximizing operating efficiencies and continues to be an important driver for the industry. In our current economic environment, aircraft maintenance is moving to the forefront as operators look to reduce costs across the board and ensure the maximum return on every investment.

When it comes to aircraft lighting, beyond the initial price of any aircraft lamp, an important consideration in evaluating value is the total cost of ownership over the lamp's useful lifetime. This includes not only the initial price of the lamp itself, but also the cost of maintenance labour hours when it needs to be replaced, as well as the lost revenue from flight delays or the plane's downtime. This can vary from a couple of hours to days, depending on the type of plane and the type of lamp and

Above: LED cabin lights, which can be programmed to shift in brightness, warmth, and colour throughout the flight, have become common on new planes.

At right: 1. A light-emitting diode(LED) is a semiconductor light source that emits light when current flows through it.

2. Halogen lamps produce a continuous spectrum of light, from near ultraviolet too deep into the infrared.

3. Incandescent bulbs are manufactured in a wide range of sizes, light output, and voltage ratings, from 1.5 volts to about 300 volts.

creates a huge expense just to change out a light. Because lamps that fail more frequently can run up these unexpected expenses (even though they may be offered at discount prices), it makes economic sense to look for lamps that deliver the most in terms of performance and longevity.

There are four types of lamps commonly used for external aircraft lighting—and for different reasons. Here is what to consider when evaluating which lamp is best for your operation:

1. INCANDESCENT LAMPS contain a tungsten filament enclosed within an evacuated glass bulb, and are used for landing, taxi and identification lighting. While incandescent lamps may still be used by private pilots or in military aircraft—due primarily to restrictive rules and regulations—they are rarely used in commercial fleets today, and for good reason. Incandescent lamps don't offer the longevity that halogen or LED lights offer and do not maintain

With powerful lamps in the forward landing gear and wing roots lighting the way, an Airbus 350 accelerates for takeoff.

optimum candela or light output as well as the other types. The low cost of these lamps (while attractive) needs to be balanced against the need for more frequent lamp changes and the cost involved in doing so. The labour cost to change one lamp could run up to $140 an hour, not to mention the cost of a plane's downtime with pilots, crew and fuel figured in.

2. HALOGEN LAMPS can be used for almost all of an aircraft's exterior lighting, including landing lights, taxi lights, taillights and logo lights. These lamps consist of a tungsten filament sealed into a compact, transparent envelope filled with a mixture of an inert gas and a small amount of a halogen, such as iodine or bromine. Halogens currently are the most widely used lamps for commercial aircraft, as well as for business and general aviation, because of their proven cost-effectiveness, durability and reliability in terms of candela output and their long life. Halogen lamps can deliver up to, if not more than, 100 hours of lamp life, which reduces operating costs overall. Fewer lamp changes mean more flight hours. Another advantage is that they have won all necessary regulatory approvals and are readily available from OEM (original equipment manufacturer) parts catalogues.

3. XENON FLASHLAMPS, a standard in the market, are used primarily for wing tip and other identification lighting and may be the strobes or flashing lights on aircraft wing tips and tails. They produce light by passing electricity though ionized xenon gas at high pressure and are used on both

Xenon flashlamps are used primarily for wing tip and other identification lighting and may be the strobes or flashing lights on aircraft wing tips and tails.

The bright red light signals to all around that this is the left or port side.

Zenon circular flasthtube is an electric arc lamp that produces extremely intense, full spectrum white light with bands of UV-Visible-IR transmissions.

older and newer types of aircraft. The life of the xenon lamp depends on the number of flashes emitted. They typically last between five and ten million flashes, depending on the usage of the plane. Their costs are in range with halogen lamps and xenon flashlamps also are available through OEM parts catalogues. However, not all xenon flashlamps are manufactured the same. Be sure to check that the manufacturing process of the lamp is strictly controlled to ensure there is no exposure to moisture and foreign elements and that they are produced in clean room-like environments.

4. LED LAMPS are light emitting diodes, a semiconductor light source that emits light when an electric current passes through them. Leading aircraft manufacturers, including Boeing and Airbus, are building these types of lamps into their new designs for all external aircraft lighting because they last virtually forever. However, they may or may not fit into the lighting fixtures and housings of older aircraft. Often, they emit too much brightness on these planes, affecting visibility. For this reason and more, it's not likely many operators will retrofit their existing fleets with LED lighting, but they will be a big part of the future.

Of course, in choosing lamps for any type of aircraft, all products should meet or exceed the standards set by ANSI (American National Standards Institute), the FAA (Federal Aviation Administration) and/or are manufactured by an OEM and are approved for use by those organizations. Using other, possibly substandard lamps, can be dangerous by limiting the pilot's visibility on the ground and the plane's visibility in the air, which can result in huge legal and other liabilities. Lamps from qualified manufacturers are carefully tested in a range of environments and in all aircraft applications to ensure their performance, durability and longevity. Choosing the appropriate type of lamp for external lighting not only contributes to reducing maintenance costs and ensuring the maximum return on your investment, more importantly, it can ensure the safety of the pilot, crew and passengers. ■

(John Fogel, Halogen Product Manager at Amglo, has worked with the company for more than 10 years in product development, qualifying products with the FAA and building partnerships. For more information, visit **www.amglo.com**.*)*

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Back in the Skies

737 Max

ALAFCO

During the month of November the Federal Aviation Administration in the United States delivered a blueprint for the return of Boeing's 737 MAX to active duty. The world will pay close attention to what happens next.

IN **MID-NOVEMBER**, the U.S. Federal Aviation Administration (FAA) rescinded the order that halted commercial operations of Boeing 737-8s and 737-9s. The move will allow airlines that are under the FAA's jurisdiction, including those in the U.S., to take the steps necessary to resume service and Boeing to begin making deliveries.

Throughout the past 20 months, Boeing has worked closely with airlines, providing them with detailed recommendations regarding long-term storage and ensuring their input was part of the effort to safely return the airplanes to service, and an Airworthiness Directive issued by the FAA spells out the requirements that must be met before U.S. carriers can resume service.

"The FAA's directive is an important milestone," said Stan Deal, president and chief executive officer of Boeing Commercial Airplanes. "We will continue to

Right: New Boeing 737 Final Assembly line open in Renton, Washington.

work with regulators around the world and our customers to return the airplane back into service worldwide."

In addition to changes made to the airplane and pilot training, Boeing has taken three steps to strengthen its focus on safety and quality (**www.Boeing.com/737-max-updates**):

1. Organizational Alignment: More than 50,000 engineers have been brought together in a single organization that includes a new Product & Services Safety unit, unifying safety responsibilities across the company.

2. Cultural Focus: Engineers have been tasked to improve safety and quality. The company is identifying, diagnosing and resolving issues with a higher level of transparency and immediacy.

3. Process Enhancements: By adopting next-generation design processes, the company is enabling greater levels of first-time quality.

The FAA Directive includes installing software enhancements and completing wire separation modifications. These actions do not allow the MAX to return immediately to the skies. The FAA must approve 737 MAX pilot training program revisions for each U.S. airline operating the MAX and will retain its authority to issue airworthiness certificates and export certificates of airworthiness for all new 737 MAX aircraft manufactured since the FAA issued the grounding order.

Furthermore, airlines that have parked their MAX aircraft must take required maintenance steps to prepare them to fly again. The following are excerpts from the "Final Rule" in the FAA's Airworthiness Directive, specifying design changes that must be made before the 737 MAX returns to service:

The Final Rule

After careful consideration of the comments submitted and further review of the proposal, the FAA adopts this final rule. This final rule mandates corrective action that addresses an unsafe condition on the 737 MAX. This unsafe condition is the potential for a single erroneously high AOA sensor input received by the flight control system to result in repeated airplane nose-down trim of the horizontal stabilizer, which, in combination with multiple flight deck effects, could affect the flightcrew's ability to accomplish continued safe flight and landing.

As proposed in the Notice of Proposed Rule Making (NPRM), the corrective actions mandated by this AD include a complete revision of the airplane's flight control laws (software). The new flight control laws now require inputs from both AOA sensors in order to activate MCAS. They also compare the inputs from the two sensors, and if those inputs differ significantly (greater

Boeing Celebrates Rollout of First 737 MAX 9.

than 5.5 degrees for a specified period of time), will disable the Speed Trim System (STS), which includes Maneuvering Characteristics Augmentation System (MCAS), for the remainder of the flight and provide a corresponding indication of that deactivation on the flight deck.

The new flight control laws now permit only one activation of MCAS per sensed high-AOA event, and limit the magnitude of any MCAS command to move the horizontal stabilizer such that the resulting position of the stabilizer will preserve the flightcrew's ability to control the airplane's pitch by using only the control column.

This means the pilot will have sufficient control authority without the need to make electric or manual stabilizer trim inputs. The new flight control laws also include FCC integrity monitoring of each FCC's performance and cross-FCC monitoring, which detects and stops erroneous FCC-generated stabilizer trim commands (including MCAS).

This AD further mandates changes to the airplane's AFM to add and revise flightcrew procedures to facilitate the crew's ability to recognize and respond to undesired horizontal stabilizer movement and the effects of a potential AOA sensor failure.

This AD also mandates an AOA DISAGREE alert, which indicates certain AOA sensor failures or a significant calibration issue. The alert is implemented by revision of MDS software; as a result, certain stickers (known as INOP markers) will be removed.

Additionally, this AD mandates adequately separating certain airplane wiring, and conducting an AOA sensor system test and an operational readiness flight on each airplane before the airplane is reintroduced to service.

Public Comment

The FAA provided the public with an opportunity to comment on the proposed AD and while the majority of the comments were from individuals, organizations submitting comments included the Families of Ethiopian Airlines Flight 302; the civil aviation authorities of Turkey (Turkish DGCA) and the United Arab Emirates (UAE GCAA); the National Transportation Safety Board (NTSB); the National Air Traffic Controllers Association (NATCA); Flyers Rights; Aerospace Safety and Security, Inc.; the Aerospace Safety Research Institute, Inc.; Boeing; Airlines for America (A4A); the Ethiopian Airlines Group; the Joint European Max Operators Group (JEMOG); the British Airline Pilots Association (BALPA); the Allied Pilots Association; the Association of Flight Attendants-CWA (AFA-CWA); Air China; Ameco; Travelers United, Inc.; Southwest Airlines Pilot Association (SWAPA); and the Air Line Pilots Association, International (ALPA).

Several commenters stated that MCAS should not be retained as a function on the airplane, and other com-

Boeing 737 MAX Flight Deck Displays.

menters including the Families of Ethiopian Airlines Flight 302 had fundamental concerns with the basic design and availability of MCAS. More specifically, these comments focused on the availability of MCAS after failure, whether the airplane remained safe and compliant, and on the redundancy of the system and its inputs.

The FAA determined that the 737 MAX with the new MCAS implemented by the new FCC software, as proposed in the NPRM and required by paragraph (g) of this AD, meets FAA safety standards. The MCAS on the 737 MAX improves the pilot handling qualities (maneuvering characteristics) during non-normal flight conditions, specifically when the airplane is at high AOAs. During normal flight, the 737 MAX should never be at an AOA high enough to be within the range that MCAS would activate.

FAA regulations require that airplanes be designed and tested over the entire range of potential angles of attack, including high AOAs. FAA regulations also require column force to increase as AOA increases (14 CFR 25.143(g), 25.251(e), and 25.255).

In a 737 MAX, if a pilot is maneuvering the airplane with the flaps retracted and encounters a high AOA (outside of the normal flight envelope), MCAS will activate and command the stabilizer to move in the airplane nose-down direction, which changes the handling characteristics such that the pilot would need to pull with increasing force on the control column to maintain the current AOA or further increase the AOA. MCAS-commanded stabilizer movement results in

increased column forces such that the airplane meets FAA handling characteristics requirements for airplane operation at high AOAs. Existing FAA regulations (14 CFR 25.21, 25.671, and 25.672) allow for use of stability augmentation systems (such as MCAS) in showing compliance with FAA handling characteristics requirements. The 737 MAX airplane with MCAS operative is therefore compliant.

To be approved by the FAA, the proposed designs of transport category airplane flight control systems must comply with applicable 14 CFR part 25 regulations. The assessment of compliance must consider the airplane in the as-designed, fully operational configuration (no failures) and also, in accordance with 14 CFR 25.671 and 25.1309, in potential failure conditions. When assessing those failure conditions, the applicant must take into account both the probability of the failures and their airplane-level consequences. The outcome must show that the airplane is capable of continued safe

The Ethiopian Airlines aircraft that crashed in March 2019 had a flight pattern very similar to a Lion Air flight that went down in Indonesia in October killing all 189 people aboard.

flight and landing after single failures and any failure combination not shown to be extremely improbable (14 CFR 25.1309). For example, a twin-engine transport airplane complies with all regulations while both engines are operating, but if there is a single engine failure, the airplane must be capable of continued safe flight and landing with only the one remaining engine operating.

With MCAS inoperative, the Boeing 737 MAX is capable of continued safe flight and landing and is therefore compliant with 14 CFR 25.671 and 25.1309. If at high AOAs, with MCAS inoperative, MCAS will not move the stabilizer, and the resultant incremental change in column force will not be experienced by the pilot. In this situation, the pilot maintains control and can decrease the airplane's AOA by moving the column forward.

Through comprehensive analysis, simulation testing, and flight testing, the FAA determined that the airplane meets applicable 14 CFR part 25 standards, with MCAS operative and with failures, including failures that render MCAS inoperative. With MCAS inoperative after a failure, the 737 MAX is capable of continued safe flight and landing, as required by 14 CFR 25.671 and 25.1309.

If a system must be functional at all times to ensure continued safe flight and landing, the system must be available to function after a single failure. Conversely, if an inoperative system does not prevent continued safe flight and landing, then it is acceptable under FAA regulations for the system to not be available after a single failure; this is how MCAS is implemented on the 737 MAX.

In Conclusion

The design and certification of this aircraft included an unprecedented level of collaborative and independent reviews by aviation authorities around the world. Those regulators have indicated that Boeing's design changes, together with the changes to crew procedures and training enhancements, will give them the confidence to validate the aircraft as safe to fly in their respective countries and regions. Following the return to service, the FAA will continue to work closely with foreign civil aviation partners to evaluate any potential additional enhancements for the aircraft. ■

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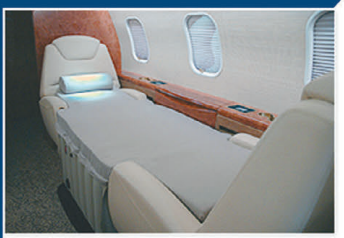

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PACIFIC

Pacific AME Association

AMEC/TEAC AGM Presidential Message

Hello, fellow AME's and members across Canada. I hope that you are all staying safe and surviving these very trying employment and economic realities. Aviation worldwide is really hurting and we are all feeling the brunt of it. Let us all hope that things begin to improve for 2021. I wanted to share some highlights of our 2020 Annual General Meeting held on Nov.4th 2020.

It was the first time that we did not meet in person in Ottawa, opting instead, because of the pandemic, to host a Virtual AGM via the internet. It was attended by representatives from each AME Association, Atlantic, Quebec, Ontario, Central, Western and Pacific. Each region gave a short report on activities and membership numbers. Unfortunately, it was not surprising to learn that membership has fallen by about 22 percent since early 2019. Obviously, this was not the direction we had hoped for in 2020—a reality driven by our COVID situation.

We did host our first ever National AMEC/TEAC Virtual Conference on Oct. 22 partnering with Hope Aero and the NTA. I would have to say that for a first time attempt it was a resounding success with over 270 attendees' from across Canada viewing and participating in some really top quality presentations. Thanks to all our sponsors and presenters. Look for more of these type of events in future, and many thanks to Louis Anderson who had the vision and tenacity to put it all together.

I am happy to report that our new AMEC/TEAC bylaws were passed replacing the old CFAMEA document. Many thanks to Steve Farnworth for championing this daunting task. Our budget for 2021 was passed and despite reduced revenue our finances are still in great shape. In terms of succession planning, my two-year term as President will be ending on Jan.1st 2021 and I am stepping down. I am pleased to report that Paul Carter, current Ontario President will be taking over the helm and carrying on the great work we have initiated with AMEC/TEAC. I am also delighted to report that Xavier Pallares, current Quebec President will continue as AMEC's VP.

Our annual meeting with Transport Canada is scheduled for the first week in December and will also be hosted virtually by them. As standard procedure, we will bring any concerns that the regions present to their attention. We will also be briefed with any new news from TC that is of interest to our members or pertinent to our trade.

In conclusion, let us continue to move forward with our plan to have a strong Canadian voice for all AME's through AMEC/TEAC and hopefully in the post pandemic days to come our industry will become stronger, our membership will grow, and our dedication to quality aviation maintenance will flourish. — Sam Longo **www.pamea.ca**

WESTERN

Western AME Association

Captain Judy Cameron Scholarship

The Northern Lights Aero Foundation and Air Canada are pleased to announce that the application process for the second annual Captain Judy Cameron Scholarship, established in honour of the airline's first female pilot with the goal of helping the next generation of women follow in her trailblazing footsteps, is now open. The scholarship is awarded in conjunction with the Northern Lights Aero Foundation.

Applications for the scholarship are open and will be accepted until November 30, 2020. It will be open to all women who are Canadian citizens who have been accepted or are enrolled in a post-secondary aviation flight program or aircraft repair and maintenance program. Those selected to receive a scholarship will be notified by January 18, 2021.

Aviation insurance for AMEs

Sound Insurance is proud to offer an exclusive Aviation program for Aircraft Maintenance Engineers. Together with Canadian AME Associations this program was developed with the needs of AME Contractors as our primary concern. Policies include full coverage at affordable premiums. The price is based on your annual sales, so you only pay for how much work you do. You are covered for claims occurring during the policy period, even if the work was done before the policy was purchased. There's no longer any reason for an AME contractor, new, experienced, or retired, to be without proper insurance.

Visit www.soundinsurance.ca/Programs/AME-insurance for more information. www.wamea.com

CENTRAL

Central AME Association

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 six similar associations across Canada who collectively support 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 is a not-for-profit organization run by a volunteer group of AME's. We elect members of our organization to be part of our Board of Directors. Members of CAMEA are comprised of AME's, AME apprentices, students, non-licensed persons working in the industry and corporate members. **www.camea.ca**

AME Association of Ontario

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

AMEC/TEAC Virtual Maintenance Conference

The first Virtual Maintenance Conference was held on Thursday October 22nd. Organizers and participants declared it a great success. On-line attendance fluctuated through the day with up to 240 people at a time. Participants came from coast to coast and everywhere in between.

The on-line conference was the brain-child of Louis Anderson from our AME Association of Ontario, who was also the principal organizer of the event. The Aircraft Maintenance Engineers of Canada/ Techniciens D'Entretien D'Aeronefs du Canada (AMEC/TEAC) teamed up with the National Training Association as anchors. Numerous sponsors contributed financially as well as making presentations. Originally conceived to replace the regional conferences and workshops which were cancelled by most of the six regional AME Associations due to the Covid-19 pandemic, the on-line version was also able to reach out to those who normally could not travel to a conference. It is anticipated that the virtual conference will continue to serve these individuals in future years.

The 18 live, 30-minute presentations were divided into eight morning and 10 afternoon presentations. These live presentations were augmented by up to two additional 30-minute presentations from each of the 18 presenting companies on the video archive website. The video archive site can be accessed from the main Conference page by all registered attendees until April 22, 2021.

As with any live event, which had contributions from across the continent, there were some glitches involving dropped videos and audio feeds. Overall, the system worked and most difficulties were overcome. A wide variety of topics were covered from soft skills such as mental health, insurance, hands on demonstrations and the latest technologies. Many topics were related and built on each other such as Stuart McAulay discussing "Mindful Leadership" being followed by Gord Dupont discussing stress. The event is over, but you can still register for a video archive membership until April 2021. Special pricing is available for AME Association members. Registration reductions are available for individuals who had their job affected by a Covid-19 related layoff/furlough. Use **https://www.ineventors.com/2020amecconf/** for a direct link to sign up.

Some AMOs have indicated that they will be using the video archive to supplement their recurrent training. National Training Association members will be incorporating sessions into their programs as well.

New AMEC/TEAC President

Congratulations to **Paul Carter** from the AME Association of Ontario. Paul was voted in as the new president of AMEC/TEAC at the recent Annual General Meeting. He will be taking over from Sam Longo on January 1st.

Submitted by Stephen Farnworth
For the Board of Directors
www.ame-ont.com

Atlantic AME Association

Objectives / By-laws

Objective

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.

By-Laws

All voting members of the Association must currently hold an AME license 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.

1. A representative of a Corporate member shall have the right to attend all meetings but no Corporate member shall be entitled to vote or hold office in the Association.
2. Membership is limited to AMEs, students and corporations in good standing with dues paid to date. Lapsed membership may be re-instated with the payment of annual dues.
3. The Association's President shall call executive meetings as are deemed necessary. Normal notice of meetings will be thirty days. Emergency meetings will be called as required.
4. Executive decisions can only be made with a quorum of 5 members of the executive, one of which must be the President or Vice-President.

ATLANTIC AME

5. An annual meeting of the general membership will be held normally, to coincide with the Atlantic Region Aircraft Maintenance Conference.
6. All committee chairmen will report to the general membership at the annual general meeting.
7. An election of executive officers will be held annually at the general meeting. In the event that an elected committee chairman resigns, for whatever reason prior to the expiry of his term, the President shall appoint another elected director to fill this position for the remainder of the resignee's term.
8. The executive committee will be comprised of a maximum of eight (8) and a minimum of six (6) directors who will manage the affairs of the Association.
9. Half of the executive will be elected at each annual general meeting. All nominations must be accompanied by one signature of a member in good standing. Elections will follow the nominations. Nomination forms must have the nominee's signature of acceptance or the acceptance can be verified by phone call by the nominator.
10. If a serving member of the executive is nominated to another position of the executive, he shall tender his resignation upon accepting the nomination.
11. Elections will be by secret ballot.
12. Members serving on the executive should be prepared to offer their services for two years, and attend executive and other meetings as required.
13. The president will not be a voting member, with the exception of a tie breaking vote.
14. An agenda will be required for the general meeting for discussion and action on items proposed during the year, and will be mailed thirty days in advance.
15. Membership fees (regular, student and corporate) will be established on an annual basis by the members at the AGM.
16. Any amendments to the AME Association Objectives and By-laws will be approved by the general membership at the AGM.

www.atlanticame.com

CENTRAL OHIO

Central Ohio PAMA

October 21st Board Meeting

The COPAMA Board met at the Nationwide Hangar to discuss current state of operations and future of the Central Ohio Professional Aviation Maintenance Association. With the onset of the COVID-19 Virus Pandemic resulting in the cancellation of the 2020 Ohio Aviation Maintenance Symposium and Central Ohio Aviation Golf Outing, they voted to suspend near term operations and scholarship application for the 2021 school year.

We do not think that the Maintenance Symposium will happen in March 2021 and will not pursue funding for vendor booths at the event. We would like to note that of the funds collected for last year's cancelled event, 15 of the 21 vendors contributed their booth fees as a donation to the COPAMA Scholarship Fund and we thank them for their generosity in these uncertain times.

Those proceeds totaled $2599.80. These contributions caused the Fund total of $26,795.81 to exceed the State of Ohio NPO limit of $25,000 so board members decided to issue a grant of $2,000.00 to Missionary Maintenance Services of Coshocton for support of their AMT apprenticeship program.

The Scholarship Fund currently has 10 students with awards outstanding over the last two years, waiting for them complete testing! At this point, testing sites are closed down due to COVID preventing them to finish. COPAMA will honor their awards within reason but will not seek applications for new scholarships at this time. The Grant Total including the pending scholarship awards and the grant to MMS is $167,534.00 over the 18 year life of the fund.

Board members and Officers will stay the same for now. We will revisit in spring holding the 2021 COAGO next September. The charter with the State of Ohio expires in April of 2023, so depending on the state of the industry, a final decision to continue COPAMA operations could be made in late 2022.

www.copama.org

SOCAL

PAMA SoCal Chapter

Who We Are

The purpose of SoCal PAMA is to promote a high degree of professionalism among aviation maintenance personnel; to foster and improve methods, skills, learning, and achievement in the field of Aviation Maintenance; to conduct local meetings and seminars; to publish, distribute, and disseminate news, technical bulletins, journals, and other appropriate publications dealing with the trade of Aviation Maintenance; to collaborate with other organizations in aviation in the queries of governmental agencies pertaining to maintenance rules and guidelines.

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From Concept to Implementation

A specialty materials company says it has developed superior anti-ice coating technology for the aerospace industry and offers case study numbers to back the claim.

Typical de-icing fluid is a mixture of propylene glycol and water heated between 160 and 180F.

A MANUFACTURER of de-icing systems recently approached New Jersey-based NEI Corporation—a specialty materials company—with the idea of combining an active de-icing system with a coating that easily sheds ice. Ice formation on the leading edge of an aircraft is a common aviation danger, playing a key role

in several catastrophic accidents over the years that have killed people and destroyed aircrafts.

All commercial aircraft have a built-in ice protection system, which could be either a thermal, thermal-mechanical, electro-mechanical, or pneumatic system. A common issue with de-icing devices is that they consume substantial power. Aircraft generally look to reduce power consumption, and with the advent of battery-powered aircraft, mechanisms or features that reduce power consumption are critically important. The aspect of reduced power is also relevant for battery powered drones.

Applying a passive anti-ice coating that functions synergistically with the active de-icing device is an attractive approach. The advantages are reduced power consumption, improved service life of mechanical components, lighter electronics, and extra protection in case of failure of active device.

The challenge presented to the engineers and scientists at NEI was to develop and demonstrate a coating that exhibits durable anti-ice performance and satisfactory wear and erosion resistance. More importantly, it needed to be practical for retrofitting in-service aircraft as well as be used by OEMs. In order to address the need, NEI developed its NANOMYTE SuperAiTM coating technology to have the following features:

- Durable anti-ice performance, suitable for permanent application
- Room temperature cure
- Easy application by spraying, dipping, or brushing
- Extremely lubricating surface
- Superior ice adhesion reduction factor
- Thin coating (<1 mil or 25 microns) providing a light weight solution

The development of the SuperAiTM coating started after numerous discussions with engineers at a major low-power ice protection system manufacturer. They brought to attention the two basic technical requirements for an anti-ice coating to be applied on their de-icing systems, i.e., lower ice adhesion and durable anti-ice performance.

NEI demonstrated both attributes

One of the common issues with de-icing devices is that they consume substantial power.

Thermal-electric deicing propeller systems use either heating wires or a layer of etched foil embedded inside rubber boots, which are attached to the inner part of the leading edge of each propeller blade.

Below: Passive coating applications (below) that function synergistically with the active de-icing device is an attractive approach to de-icing.

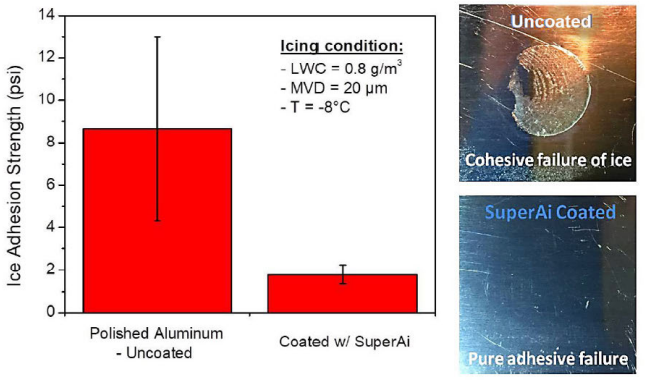


Figure 1: *Ice adhesion strength and locus of failure of SuperAi™ coated aluminum as compared to those of uncoated polished aluminum*

after extensive experiments in the company's laboratory and iterative testing at an icing wind tunnel facility with prototype de-icing devices. The ice adhesion measurements taken at NEI were corroborated by work done at the Penn State Adverse Environment Rotor Test Stand (AERTS) facility, which repeatedly showed an ice adhesion strength as low as ~1.8 psi for the SuperAi coated aluminum substrate – this represents an 80 percent reduction compared to an uncoated polished aluminum substrate.

Figure 1 (left) shows a pure adhesive failure when an ice column was pulled off the SuperAi coated substrate. In contrast, a cohesive failure of ice is seen for the uncoated aluminum substrate.

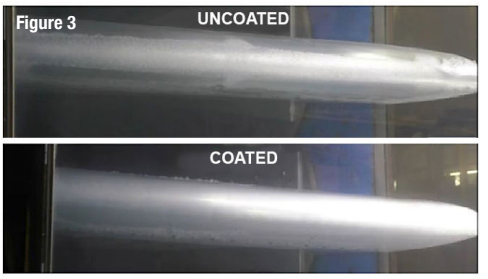
To demonstrate the enhanced de-icing efficiency of a de-icing device with the use of SuperAiTM, coated prototypes of electro-mechanical and thermal-mechanical expulsion de-icing systems were tested in an icing tunnel under simulated in-flight icing conditions at our collaborator's facility.

Figure 2 (page, right) shows the SuperAiTM coated leading edge being assembled with the thermal-mechanical expulsion de-icing system. NEI repeatedly demonstrated that improved de-icing efficiency, along with a 45-70 percent reduction in power consumption of the active de-icing systems, could be achieved with the use of the newly developed anti-ice coating Abrasion resistance is of great importance for the targeted application.

Figure 3 (page, right) features snapshots taken from the recording of icing tunnel test and show complete de-icing on the coated leading edge (bottom) and no de-icing on uncoated leading edge (top), at power consumption level 70 percent lower than that of the nominal power needed for a regular functional uncoated de-icing system.

Figure 4 (page, right) shows that the SuperAi coating was barely scratched at the wear track after 200 cycles of Taber abrasion. Note that the CS-10F Calibrase wheel used in the test is composed of a binder and abrasive particles, such as aluminum oxide and silicon carbide. The testing conditions simulate normal service abrasion and wear.

Further, the contact angle at the wear track was measured to be 103 degrees (vs. 105 degrees of fresh unabraded surface), indicating that the hydrophobicity of the surface was minimally affected by the abrasion. The ice adhesion measurement at the wear track showed that the



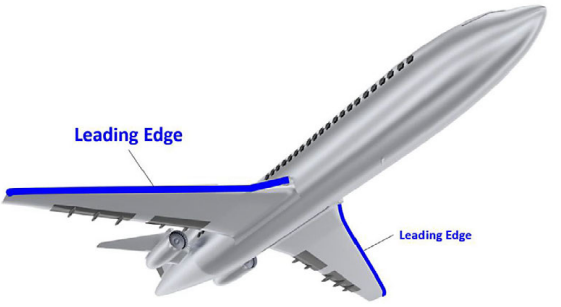


Figure 2 (left): *Installation of leading edge and thermal-mechanical expulsion de-icing system assembly.* **Figure 3 (right):** *Snapshots taken from recording of icing tunnel test showing complete de-icing on coated leading edge (bottom) and no de-icing on uncoated leading edge (top), at power consumption level 70% lower than that of the nominal power needed for a regular functional uncoated de-icing system.*

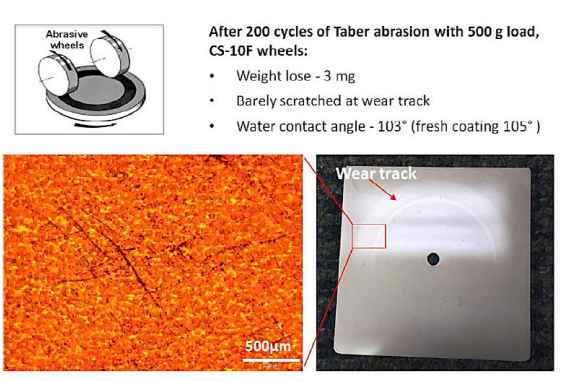


Figure 4: *Optical micrograph taken at the wear track after Taber test showing excellent abrasion resistance of the SuperAi™ coating.*

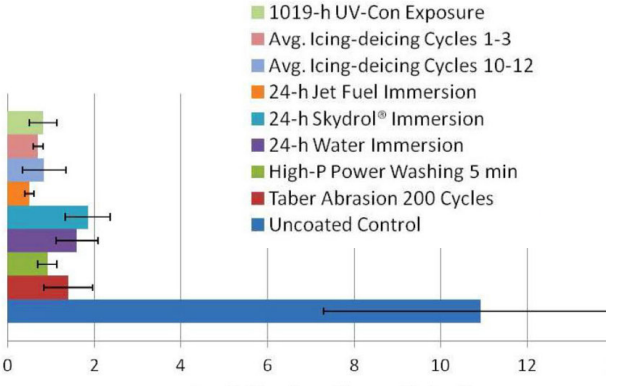


Figure 5: Ice Adhesion Strength (psi)

coating remained highly icephobic after 200 cycles of Taber abrasion (Figure 5).

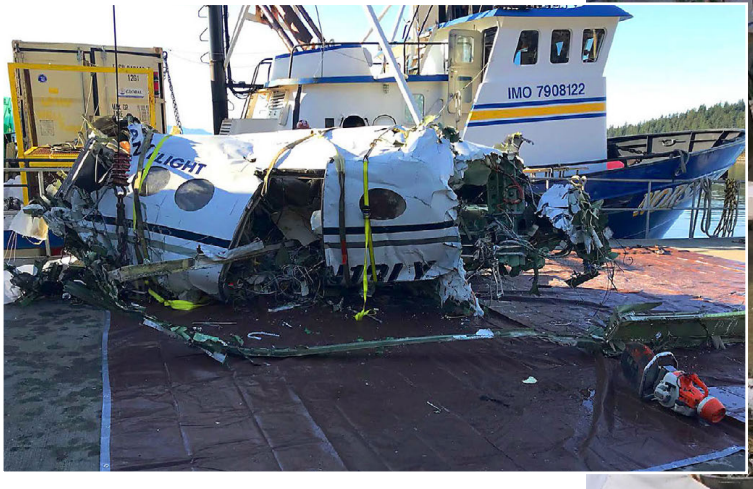
Other important aspects of an anti-ice coating for aircraft include its ability to resist rain erosion, chemical and solvent resistance, resistance to icing-deicing cycles, and weatherability. These aspects were investigated with various durability tests.

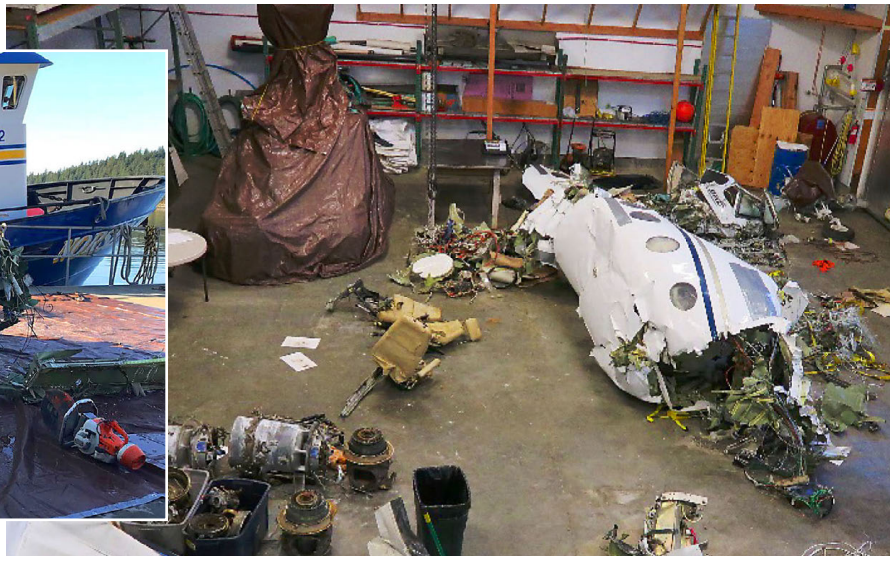
As can be seen in Figure 5, the SuperAiTM coating could survive repeated icing-deicing cycles. There was little change in ice adhesion after immersion in jet fuel, Skydrol (an aviation hydraulic fluid), and water for an extended period of time. Further, the ice adhesion strength was minimally affected by abrasion, high-pressure power wash, and UV-Con exposure.

In summary, NEI says it was able to address an important need in the industry, using a disciplined and focused product development effort. The case study presented here is representative of an application-driven coatings development effort undertaken to address a problem or an opportunity. ■

Sudden Impact

Investigators itemize the damage after pulling a downed Super King Air from icy Alaskan waters





Left: Unloading Wreckage in Juneau, Alaska.
Right: Accident airplane's debris at wreckage layout.

ON JANUARY 29, 2019, about 1811 Alaska standard time, a twin-engine, turbine-powered Raytheon Aircraft Company (formerly Beech Aircraft Corporation) B200 airplane, N13LY, is presumed destroyed after impacting the waters of Frederick Sound following a loss of control while on approach to Kake Airport (PAFE), Kake, Alaska. The airplane was being operated by Guardian Flight as an instrument flight rules (IFR) air ambulance flight under the provisions of 14 Code of Federal Regulations Part 91 when the accident occurred.

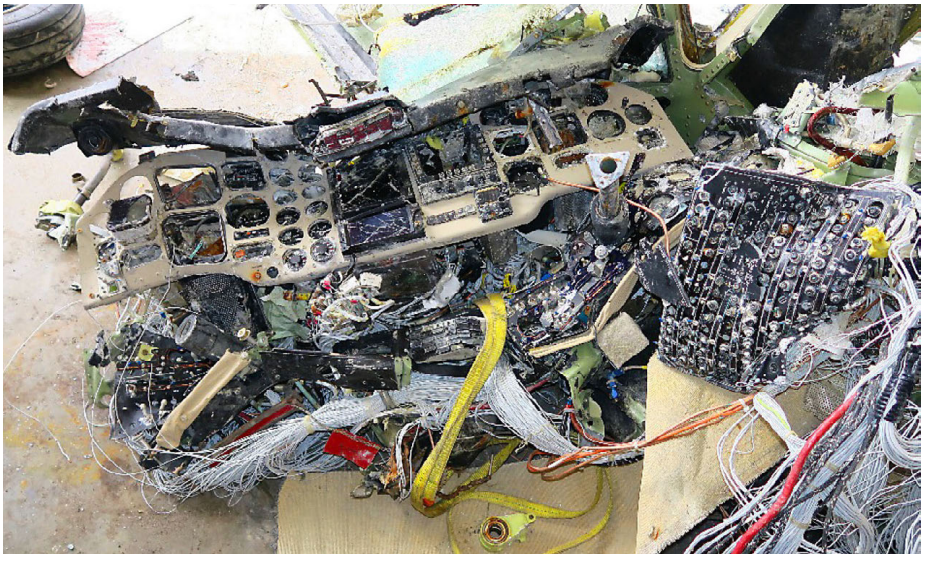
The airline transport pilot, flight paramedic, and flight nurse who was 27 weeks pregnant are presumed fatally injured. Visual meteorological conditions prevailed at the destination airport, and company flight following procedures were in effect. The flight departed Ted Stevens Anchorage International Airport (PANC), Anchorage, Alaska, about 1604 destined for PAFE.

The airplane impacted the ocean waters of Frederick Sound and was located on the ocean floor at a depth of about 500 ft. A cone shape debris field spanned about 1,650 ft on a bearing of 45°, with the lighter debris farther northeast due to the current. The aircraft impacted ocean waters and was heavily fragmented.

The instrument panel sustained impact damage and partially separated from the aircraft.

The following switch positions were noted:

- Ignition: Left – Arm, Right – Arm
- Ignition and Engine: Left – On, Right – On
- Avionics Master – Undetermined (loose)
- Left Gen: Undetermined (loose)
- Inverter – Off
- Engine Anti-ice: Left – On, Right – On
- Beacon – Undetermined (fractured)
- Strobe – Undetermined (fractured)
- Recognition – Undetermined
- Tail Flood – Undetermined (fractured & bent upward)
- No Smoke and FSB – On
- Pitot Mic – Normal
- Co-pilot Mic – Normal



stretched and the strands were separated near the outboard flap actuator assembly. Due to the impact damage to the flap actuator flex cable the flap actuator measurements was not deemed a reliable source of preimpact flap settings.

The right wing was heavily fragmented and appeared to sustain more impact damage than the left wing. The right wing structure was separated into multiple sections. The first major section included the inboard flap and aft spar section fragment from the wing root to the nacelle.

The next section of the right wing included the aft portion of the right engine nacelle and the right main landing gear

Above: Accident airplane's instrument panel. Right: Left engine power turbine vane ring. Bottom: Left engine propeller hub flange and beta ring.

The outboard left wing, which included the left aileron, remained attached to the left wing structure by the aileron and aileron trim control cables. The control cables were observed twisted numerous times at the wing structure fracture.

Most of the left aileron remained attached to the outboard left wing. An approximately 3.5' long section of the outboard end of the left aileron had separated and was observed with the wreckage. The aileron cables remained attached to the left aileron bellcrank and were continuous to the left wing root. The left aileron trim tab remained attached. The left aileron trim actuator was extended 1.8" which equates to approximately 5° tab down. The aileron trim cables remained attached to the trim actuator and were continuous to the left wing root.

The left inboard flap actuator was extended 2.55" which equates to about 0-10° extended. The flap actuator flex drive cable was fractured at the inboard flap actuator. The left outboard flap actuator was extended 2.95" which equates to about 10° extended. The flap actuator flex drive cable was partially separated,

along with about an 8' long section of the wing outboard of the nacelle. The outboard right flap was separated from the wing structure.

The remaining outboard right wing structure consisted of about a 10' x 3' section of the top wing skin with the right aileron bellcrank attached. The right aileron bellcrank was found fractured. One of the right aileron control cables was continuous from the fractured bellcrank to the wing root. The other right aileron control cable was cut by recovery personnel about 3" from the bellcrank; the remaining length of cable was continuous to the wing root.

The right wing forward spar, lower spar cap, had been cut by recovery personnel near the fusealge and was bent downward toward the right main landing gear; it continued through the bottom of the right engine nacelle and was about 15' long. An approximately 2' long secion of the right wing forward spar, top spar cap, located outboard of the right engine nacelle, remained attached to an approximately 7' long section of the center wing, forward spar, top spar cap, that was cut by recovery personnel near the fusealge. The right wing aft spar was fractured into multiple pieces outboard of the right engine nacelle.

The right inboard flap actuator was extended 2.10" which equates to 0° extended (fully retracted). The flap actuator flex drive cable attachment fitting was fractured and separated at the right inboard flap actuator. The outboard right flap actuator was extended 1.70" which also equates to fully retracted. The outboard right flap actuator flex drive cable remained attached to the outboard right flap actuator.

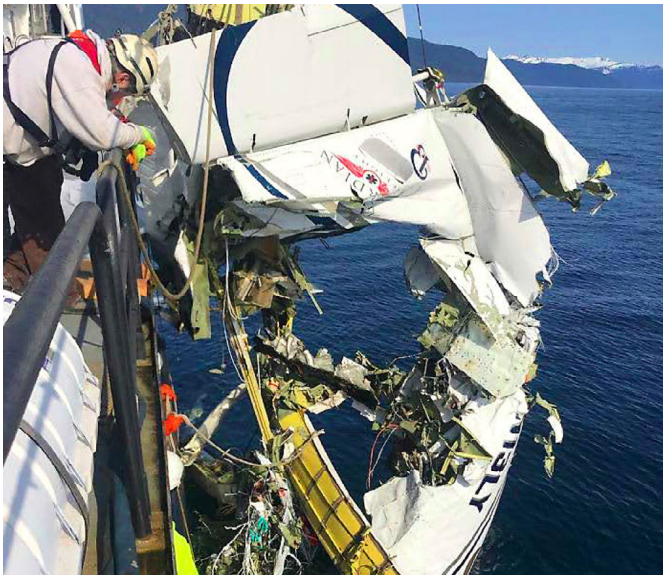
Above: The remains of the left engine.
Bottom: Left propeller.

The top portion of the tail, which included most of the right horizontal stabilizer, right elevator, and about a 3' section of the left elevator, was separated from the vertical stabilizer. About 2' of the outboard right elevator was not observed.

About a 4' long section of the left horizontal stabilizer leading edge skin and forward spar fragment were found separated from the structure. The remainder of the outboard left horizontal stabilizer, about a 6' long section, was bent downward. The remainder of the left elevator was not observed.

The vertical stabilizer separated and exhibited leading edge impact damage. The rudder remained attached to its attach points and was relatively undamaged.

The crew seats were recovered, both restraints were found unbuckled. One passenger seat was recovered and the re-



Above: NTSB IIC Brice Banning with Recovered CVR Onboard Recovery Vessel. Below: Recovery of Empennage.

straint was found unbuckled. The base of a second passenger seat was recovered; however, the seat back and restraint were not recovered. All recovered seats exhibited impact damage. One rear seat was not recovered.

The LH engine was received wrapped in plastic. Removal of the plastic, revealed the engine with parts of the airframe mount, some airframe accessories, wiring harnesses, and firewall still attached. The external surfaces of the engine were covered with environmental debris. The Gas Generator and Power Section modules data plates confirmed the engine S/N RX0633.

The propeller hub flange and beta ring were still attached to the reduction gearbox (RGB) gear-train. The RGB housings had dissolved. The gears were visible and covered with environmental debris, but were not damaged. The 1st and 2nd stage planet gears could be rotated. The No. 4 bearing oil nozzle tip had been partially removed due to rotational wear. The compressor rotor and the power turbine (PT) rotor / propeller shaft were seized.

The airframe component exhaust ducts were missing and ripped off at their flanges with some of the bolts still in place. The exhaust case was deformed, fractured and contained environmental debris. The Gas Generator Case (GGC) was mechanically deformed.

The Accessory Gearbox (AGB) housing had dissolved and most of the gears were not found. A portion of the inlet screen had rolled over on itself and a portion of the screen had been compressed inwards. The internal gas path of the inlet case was covered with environmental debris. Some compressor 1st stage blades found deformed without evidence of pre-impact Foreign Object Damage (FOD).

The Power Control and Reversing Linkages were fractured. The connecting rod between the CAM box to the FCU was no longer present, fractured pieces at either end were found. The CAM box was mechanically damaged and fractured. The Fuel Control Unit (FCU) with the fuel pump still attached were found hanging loose due to the complete dissolution of the AGB housing. The FCU and fuel pump showed mechanical damages. The Min and Max adjustment screws were found in place. The FCU showed mechanical damages resulting in the fracture in the condition lever and deformation in the lever controls.


Right propeller blades.

The Compressor Discharge Air (P3) pneumatic line was continuous from the Gas Generator Case (GGC) to the FCU, but showed mechanical damages due to impact. The lockwire at the P3 filter (downstream side) "B" nut was found broke, and the B" nut was found ¼ turn loose. The lockwire at the P3 filter (upstream side) "B" nut was missing, but the B" nut was tight. All other "B" nuts were secured with lockwire and tight. The P3 line was removed and found

contaminated with some environmental debris. The P3 air filter was found with environmental contamination similar to the debris found in the P3 line.

The Power Turbine Control (Py) pneumatic line was continuous from the FCU to the Propeller Governor (CSU) and torque limiter, but showed mechanical damages due to impact. All the "B" nuts were secured with lockwire and found tight. The Propeller Governor (CSU) was found hanging loose due to the complete dissolution of the front RGB housing. The CSU showed mechanical damages and the beta lever was not present. The Overspeed Governor (OSG) was not received with the engine. The Torque Limiter (TCU) was found hanging loose due to the complete dissolution of the front RGB housing. The TCU showed mechanical damages.

The RGB and AGB Chip Detectors were not received. The oil filter was clean and did not show signs of metal contamination. Both Ignition Plugs were still secured and tightened.

The Compressor Turbine disk downstream showed some rotational rubbing on the disk in the firtree region and under the blade platform. Some rotational contacts were also observed at the lip of disk center bore. The Compressor Turbine Shroud Segments presented a light rub, but exhibited normal operational wear. The Compressor Turbine Vane Ring was removed and found in good condition. It showed no signs of FOD. However, it was covered with environmental debris. The Combustion Chamber Liners were found to show mechanical damages from impact, but no evidence of any burning or overtemperature exposure was observed. Otherwise, they showed only operational wear. The Small Exit Duct was found in good condition.

The Power Turbine (PT) vane ring and the Inter Turbine Temperature (ITT) Probes, Busbar, and Harness were found in good condition. The PT vane ring was removed and presented on the upstream side rubbing on the inner wall, around the center button and on the rivets. The PT vane ring presented on the downstream side exhibited on the shroud housing deep circumferential groves from contact with the knife edges of the PT blades shroud tips. The PT vane ring inner and outer walls both showed circumferential rubbing contact from the PT blades firtree region and the edges of the shroud tips respectively. The 1st stage PT blades upstream showed rotational rubbing at the firtree region, the blade shrouded tips and the upstream side of the blade shroud tips. Due to access limitations, the 2nd stage PT blades were examined on the downstream side through the exhaust duct ports. The 2nd stage PT blades showed a rotational score at mid airfoil on some blades.

The RH engine was received wrapped in plastic. Removal of the plastic, revealed the engine with parts of the airframe mount, some airframe accessories, wiring harnesses, and firewall still attached. The external surfaces of the engine were covered with environmental debris. The Gas Generator and Power Section modules data plates confirmed the engine S/N RX0634.

The propeller hub flange and beta ring were still attached to the RGB gear-train. The RGB housings had dissolved. The gears were visible and covered with environmental debris, but were not damaged. The 1st and 2nd stage planet gears could be rotated. The No. 4 bearing oil nozzle tip displayed rotational wear. The compressor rotor and the power turbine (PT) rotor/propeller shaft were seized.

The left airframe component exhaust duct was missing and ripped off at its flange with some of the bolts still in place. The right airframe component exhaust duct was still attached, but was mechanically deformed. The exhaust case was mechanically deformed, fractured and contained environmental debris. The Gas Generator Case (GGC) was mechanically deformed, fractured.

The Accessory Gearbox (AGB) housing had dissolved and some of the gears were not found. The external scavenge pump was found hanging loose due to the complete dissolution of the AGB housing. A portion of the inlet screen had rolled over on itself, with a portion of the screen had been compressed inwards and punctured. The internal gas path of the inlet case was covered with environmental debris. Some compressor 1st stage blades found

deformed without evidence of Foreign Object Damage (FOD).

The Power Control and Reversing Linkages were fractured. The connecting rod between the CAM box to the Fuel Control Unit (FCU) was fractured at the end of the FCU and deformed. The CAM box was mechanically damaged and fractured. The FCU with the fuel pump still attached were found hanging loose due to the complete dissolution of the AGB housing. The FCU and fuel pump showed mechanical damages. The Min and Max adjustment screws were found in place. The FCU showed mechanical damages resulting in the deformation and fracture in the lever controls.

The Compressor Discharge Air (P3) pneumatic line was continuous from the Gas Generator Case (GGC) to the FCU, but showed mechanical damages due to impact. The lockwire at the P3 filter (downstream side) "B" nut was missing, and the B" nut was found 1/8 turn loose. The lockwire at the P3 filter (upstream side) "B" nut was found broke, and the B" nut was found 1/8 turn loose. All other ''B" nuts were secured with lockwire and tight. The P3 line was removed and found contaminated with some environmental debris. The P3 air filter which was found wet (water) showed no debris contamination.

The Power Turbine Control (Py) pneumatic line was continuous from the FCU to the Propeller Governor (CSU) and torque limiter, but showed mechanical damages due to impact. The lockwire at the firewall (GGC side) "B" nut was found broke, but the B" nut was tight. All the other ''B" nuts were secured with lockwire and found tight. The CSU was found hanging loose due to the complete dissolution of the front RGB housing. The CSU showed mechanical damages. The beta lever was fractured, with a section still attached. The Overspeed Governor (OSG) was not received with the engine. The Torque Limiter (TCU) was found hanging loose due to the complete dissolution of the front RGB housing. The TCU showed mechanical damages.

The RGB and AGB Chip Detectors were not received. The oil filter was clean and did not show signs of metal contamination. Both Ignition Plugs were secured and tightened. One of the leads was fractured. The exciter box was found still attached to the airframe mounting strut and was mechanically damaged with both ignition leads fractured at their respective boss.

The airplane was equipped with two 4-blade Hartzell propeller model HC-E4N-3G. Both propeller hubs fractured at the propeller shaft.

Summary

The engines displayed contact signatures to its internal components characteristic of the engines developing power at the time of impact. There were no indications of any pre-impact mechanical anomalies to any of the engines components that would have precluded normal engine operation. ■

(The preceding were excerpts from the National Transport Safety Board's examination summary of Accident Number ANC19FA012.)

Aviation Services

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Superbike-flavoured K-Racer IV now ready for competition

Kawasaki has unveiled a new Ninja H2R-powered unmanned helicopter.

IN ADDITION TO a powerful vertical lift rotor, the new UAV (unmanned aerial vehicle) from Kawasaki features two forward thrust rotors and a fixed wing for horizontal flight. It's powered by the same 998cc supercharged engine used by the company's Ninja H2R motorcycle. The track-only Ninja H2R is generally acknowledged to be the fastest and most powerful production motorcycle on the market. With a factory-spec 310 horsepower (326 with ram air) the H2R is said to output 50 percent more power than the fastest production motorcycles. The street-legal Ninja H2 variant outputs a "mere" 200 hp (210 with ram air).

According to Kawasaki Heavy Industries (the department of Kawasaki responsible for creating this aircraft) the two forward-facing rotors in combination with the fixed wing will give a significant amount of extra performance to the vehicle, allowing it to traverse larger distances at higher speeds. Although Kawasaki is not traditionally in the business of making unmanned aircraft, it has an impressive history both in making recreational sport motorcycles and high-performance aircraft for both civilian and military applications.

This newest aircraft, called the K-Racer IV, has already successfully completed test flights, and is likely built to compete with Yamaha unmanned helicopters that are built for agriculture applications. During the flight tests, the helicopter performed a vertical take-off, a flyby around the airfield, and a vertical landing. Notably, the K-Racer IV can be flown either remotely or autonomously, and both modes were tested during recent flights.

Although this aircraft may not directly lead to larger passenger autonomous aircraft, it shows that Kawasaki is investing a significant amount of R&D funds into autonomous flight tech. With Japan having shown great public interest in aerial mobility, and Kawasaki being one of the country's leading providers of traditional helicopters, Kawasaki may eventually lean in to creating autonomous passenger aircraft when the technology becomes more common. The K-Racer IV could sere as a strong foundation for those future VTOL aircraft.

Why it's important: As the aerial mobility industry advances, more and more large aviation industry players are investing in combinations of VTOL and fixed wing flight. The VTOL fixed wing combination, once totally unfamiliar, is now becoming a common marker for innovation amongst these companies. With Kawasaki in the mix, the coming age of VTOL aircraft inches closer to reality, and competition for aircraft manufacturing becomes a little more fierce. ■

(With files from TransportUp: The Aerial Mobility Newsletter)

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