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AMU

AirMaintenance UPDATE

The Magazine for Aircraft Maintenance Professionals

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The Engine's Actual Consumption

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Factors At Work

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UltraFan rolls onto Testbed

GO BIG OR GO HOME. The bigger the better. No replacement for displacement. Pick the cliche of your choice but they all boil down to one undeniable fact: when it comes to oversize objects nearly everyone finds a way to express interest and even admiration. Which is why Rolls-Royce now has the aviation industry's full attention as the British manufacturer continues progress on its massive UltraFan, an aircraft engine that is said to be the world's largest. Rolls-Royce announced in December that it has now finished building the first demonstrator for the UltraFan engine, which will eventually power airliners to be developed in the 2030s.

The demonstrator engine was transported from the build workshop and into Testbed 80 in Derby, UK where it was mounted in preparation for testing. Testbed 80, the world's largest and smartest testbed, was designed and built especially to accommodate the size and technical complexity of the UltraFan demonstrator. It was opened in 2020 and has already completed many hours of experimental engine testing. The first test of the demonstrator is expected to take place early this year and will be operated using 100 percent Sustainable Aviation Fuel.

The UltraFan demonstrator has a fan diameter of 140 inches and offers a factory-spec 25 percent fuel efficiency improvement compared with the first generation of Rolls-Royce's Trent engine. Its scalable technology from 25,000-110,000-pound thrust delivers the potential to further improve fuel efficiency of both narrowbody and widebody aircraft by up to 10 percent. ■

— John Campbell, Editor

Departments

Features

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Upcoming Events

NATA advises updated refuelling training

The **National Air Transportation Association** (NATA) released an update in early January to its industry-wide Safety 1st General Aviation Misfuelling Prevention Program — a free, online training resource for pilots, line service professionals, and other aircraft refuelling stakeholders.

"The new training refreshes the original content and addresses new misfuelling risks associated with unleaded avgas and the introduction of an additional grade of fuel at airports," said NATA's Managing Director of Safety and Training Steve Berry. "We encourage every individual involved throughout the aircraft refuelling process to complete the updated training, even those who have already participated in the original program."

NATA recognized the need for an industry-wide misfuelling prevention resource in 2015, developing the initial program to conform with standards from the Energy Institute and NATA's Safety 1st Operational Best Practices. Today, more than 13,000 stakeholders worldwide have received a certificate for successful completion of the first generation of training.

"Putting the wrong grade of fuel into an aircraft is proven to have tragic consequences. As the airport landscape evolves, NATA is proud to invest in and provide dynamic resources that continuously educate and train all stakeholders on the simple but critical elements required to prevent aircraft misfuellings," said NATA President and CEO Curt Castagna.

The free NATA Safety 1st General Aviation Misfuelling Prevention Program – along with videos, alerts, fact sheets, templates, operational best practices, and other valuable resources — are available at www.preventmisfueling.com. Visit to learn the latest in general aviation misfuelling prevention and earn the latest certificate. ✪

RCAF unveils Hornet Demo schedule

The 10-show 2023 schedule for the Royal Canadian Air Force CF-18 Hornet Demonstration Team was unveiled in mid-December 2022 and it again promises to be a cross-country series of events with demonstrations consisting of two separate show types. There will be tactical fighter support demonstrations highlighting the CF-18's ability to provide support to soldiers on combat operations and aerobatic demonstrations showcasing the CF-18's wide range of capabilities. Both demonstration styles will be flown with aircraft in an operational grey paint scheme. Tentatively, the schedule looks like this:

June 7	North Bay, Ontario	(Tactical)
June 10-11	Barrie Airshow	Barrie, Ontario (Tactical)
July 22	Boundary Bay Airshow	Delta, BC (Tactical)
July 29-30	Red Deer Airshow	Red Deer, Alberta (Tactical)
August 5-6	Alberta International Airshow	Edmonton, Alberta (Aerobatic)
August 11-13	Abbotsford International Airshow	Abbotsford, BC (Aerobatic)
August 26-27	Air Show Atlantic	Debert, Nova Scotia (Aerobatic)
September 2-4	Canadian International Air Show	Toronto, Ontario (Aerobatic)
September 8-10	Festival Aérien Airshow	Mirabel, Quebec (Aerobatic)
September 16-17	Aero Gatineau-Ottawa	Gatineau, Quebec (Tactical)

COMING EVENTS

Buckeye Air Fair
February 17-19, 2023
Buckeye, Arizona
www.buckeyeaz.gov

Stars & Stripes Air Show Spectacular
February 26, 2023
Laredo, Texas
www.wbcaairshow.org

Sun 'n Fun Aerospace Expo
March 28-April 2, 2023
Lakeland, Florida
www.flysnf.org

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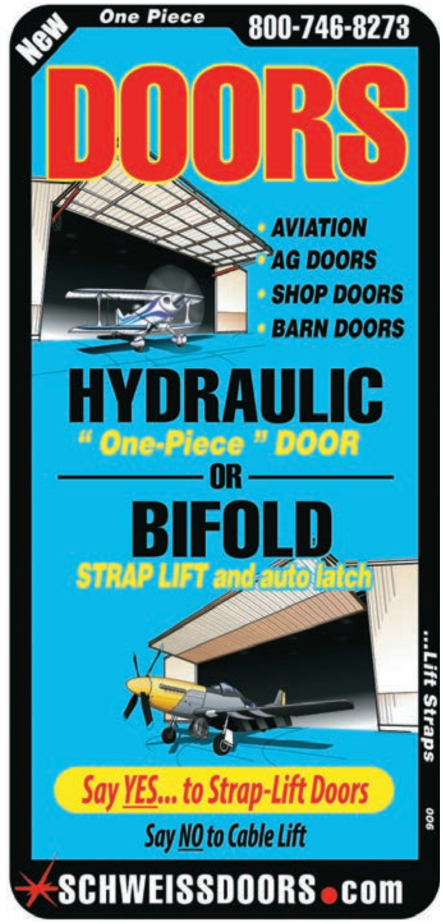

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STCs & new products

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Hartzell Propeller's three-blade aluminum Voyager props are now STC approved for Cessna 180 aircraft, powered by Continental 470-A (S/N 41000 and higher) -J, -R, and -S engines. This includes models 180, and models C – J with standard engines. The custom-designed 86-inch Voyager propeller provides premium performance offering the same or better cruise speeds, increased take-off acceleration, and an exceptional climb rate. It features swept scimitar aluminum blades and has a 2,400-hour, six-year TBO, and the longest propeller warranty in the business through first overhaul. **www.hartzellaviation.com**

Tank detects liquid levels

Saelig's Portatank Tank Level Indicator can detect liquid levels non-invasively through the outer walls of a storage tank without any permanent installation. It can measure liquid levels inside storage tanks with diameters of 1.5' to 50' and wall thickness of 0.004" – 0.8", which are made of most common materials such as steel, plastic, and aluminum. Portatank uses ultrasonics to provide non-invasive level measurement. The Portatank measures levels of all kinds of fluids, particularly hazardous liquids where the tank cannot be opened for safety reasons or where a float gauge cannot be installed. **www.saelig.com**

Compound cleans and protects

Strikehold is an anti-corrosion protectant, lubricant, and cleaner developed for the U.S. military. The compound protects aircraft used in some of the harshest working conditions in the world. It sprays on or applies wet and dries in place. A nano film coating protects aircraft components against the effects of corrosion and moisture while repelling corrosive airborne particles, dust, and dirt. The coating is not visible to the eye when it dries and can be reapplied as needed. The protectant is designed to waterproof components as well as dry out wet gear and water-sensitive parts. **www.strikehold.com**

GI275 is an all-in-one option

Southeast Aerospace has received an FAA Supplemental Type Certificate for installation of the Garmin GI 275 3.125-inch round display electronic flight instrument in Part 25 aircraft on an approved model list as an Electronic Standby Instrument. Utilizing the ESI version of the Garmin GI 275 electronic flight instrument, the GI 275 ESI AML STC offers a simple, all-in-one option to replace pre-existing, obsolete, higher-cost ESI and mechanical standby instruments. Lightweight and compact, the GI 275 is intentionally designed to take advantage of the common 3.125-inch flight instrument size, reducing installation time and preserving the existing aircraft panel. **www.seaerospace.com**

Passengers control the volume

Jamco Corporation's Personalized Sound Zone experience for commercial aircraft enables the embedded speakers located in each individual headrest to create a sound zone that surrounds each passenger's head area allowing only the individual passenger to hear audio without the use of headphones. The passenger will be able to control the volume and sound setting from the speakers. By using the patented technology, the sound is contained to the ultimate level and will not disturb neighbouring passengers. This is all possible without the use of headphones. At the same time, the passenger still can hear in-flight announcements. **www.jamco.co.jp**

Trailer holds two wheels

The **Wilcox GSE Tire Trailer** is designed to easily transport two main aircraft wheels. Tires can quickly be loaded onto the cart via the light weight, non-slip extruded ramp and secured internally. The rear ramp lifts up easily with side assisted gas shock and locks into place. Solid tires will ensure never a flat and are locked when cart is not in use with towbar integrated brakes. Trailers are available in steel or aluminum construction. **www.wilcoxgroundservices.com**

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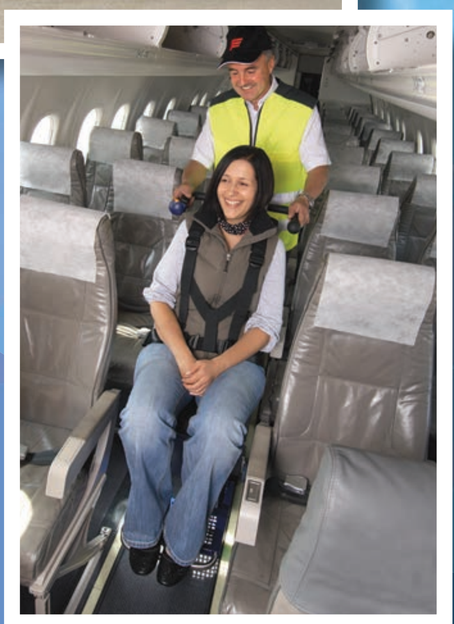

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PORTER HAS ORDERS FOR EMBRAER

Embraer's E195-E2 and E190-E2 have received Type Certification from Transport Canada Civil Aviation (TCCA), following certification from ANAC (Brazil), the FAA (USA), and EASA (Europe) in 2019 and 2018 respectively. The delivery of the first of 50 E195-E2 ordered by Toronto based Porter Airlines, which will also be the first E195-E2 to operate in North America, will take place at Embraer's headquarters in São José dos Campos, Brazil. Porter Airlines has orders with Embraer for up to 100 E195-E2 aircraft. In 2021 Porter ordered 30 Embraer E195-E2 jets, with purchase rights for a further 50 aircraft, worth US$5.82 billion.

CANADA PLANS MAJOR UPGRADE

The Canadian Press reports Canada is planning to spend $1.24 billion to upgrade its fleet of military search-and-rescue helicopters — about $200 million more than originally planned.

The sole-sourced deal to upgrade the military's Cormorant helicopters was announced in late December, 2022. The federal government has been planning to upgrade the Cormorant fleet for years, which will include modernizing its 13 existing helicopters and buying three new ones. The Cormorants are currently used to conduct search-and-rescue missions in BC, Newfoundland, and Nova Scotia.The addition of three more helicopters is expected to see the fleet expand to include operations out of Trenton, Ontario.

AUTOPILOT MODS IN THE WORKS

UK aircraft manufacturer Britten-Norman and US flight control systems developer Genesys Aerosystems are collaborating to certify the latest S-TEC 3100 autopilot system on Britten-Norman's range of Islander aircraft. The modification will be available as standard on all new aircraft as well as retrofit. The S-TEC 3100 gives pilots a list of workload-reducing and safety-enhancing capabilities that were previously unavailable on aftermarket autopilots. Genesys Aerosystems and Britten-Norman will work together on testing and installing the S-TEC 3100 at Britten-Norman's MRO facility at Solent Airport, Daedalus in December of this year. The modification for the Islander is due to be released in Spring 2023.

LAST 747 LEAVES THE FACTORY

The final Boeing 747 has now left the company's Everett, Washington widebody factory in advance of its delivery to Atlas Air in early 2023. The world's first twin-aisle airplane, the 747 has played a key role in Boeing's history. Production of the aircraft began in 1967 and spanned 54 years, during which a total of 1,574 airplanes were built. At 250 feet, the 747-8 is the longest commercial aircraft in service. The final airplane, a 747-8 Freighter, has a revenue payload of 133.1 tonnes, enough to transport 10,699 solid-gold bars or approximately 19 million ping-pong balls or golf balls. Production of new aircraft will move to the Boeing North Charleston facility to improve efficiency and costs.

NETJETS PLACES BIG ORDER

Bombardier has announced NetJets as the launch customer for its Global 8000 aircraft. The private jet company placed an order for four Global 8000s, valued at $312 million dollars and converted eight existing orders for Bombardier products. NetJets will build a 24-strong fleet of the Global 8000 aircraft and work with Bombardier to upgrade its entire in-service Global 7500 fleet to Global 8000 jets when they begin taking delivery of its new flagship aircraft. NetJets could subsequently grow its fleet—the world's largest and most diverse in private aircraft—through a series of options that could be exercised progressively over the coming years.

NEW AC SETUP FOR KING AIRS

Textron Aviation says an electrically driven air conditioning system will soon be a standard feature on all new production Beechcraft King Air 360 aircraft. This new feature provides cooled air throughout the cabin while the aircraft is on the ground and in flight. The new electric air conditioning system is built into the structure of the aircraft, and it does not impact any cabin space. The system can operate without the aircraft engines running by plugging into a ground power unit. The system offers an environmentally friendly solution by cooling the cabin without the use of the aircraft engines.

P&WC PROPOSES NEW ENGINE PAYMENT PLAN

Pratt & Whitney Canada will collaborate with American Express (Amex) to provide qualifying customers with a new option allowing them to extend payment terms, when buying a new or used P&WC engine. In the initial pilot phase, the Amex payment plan will be available to new and used engines sold outright or with an exchange as well as those under the company's P&WCSMART program. Engine exchanges — whereby the customer exchanges the used engine for a new, used/time-remaining or freshly overhauled engine — are popular because they require fewer logistics than an overhaul and reduce shop times.

VIRGIN WILL FLY ON COOKING OIL

The first ever net zero transatlantic flight will depart the UK this year, with Virgin Atlantic flying one of its Rolls-Royce Trent 1000-powered Boeing 787s from London Heathrow to New York's John F. Kennedy Airport using only sustainable aviation fuel. When fully replacing kerosene, SAF can slash lifecycle carbon emissions by more than 70 percent compared to conventional jet fuel. The SAF for the flight will be made primarily from waste oils and fats, such as used cooking oil. ■

Factors at Work

In 2019, the National Library of Medicine published a study entitled "Maintenance and Inspection as Risk Factors in Helicopter Accidents: Analysis and Recommendations." The following are key selections from that White Paper.

IN THIS WORK ["**Maintenance and Inspection as Risk Factors in Helicopter Accidents: Analysis and Recommendations**"], we [the authors) establish that maintenance and inspection are a risk factor in helicopter accidents. Between 2005 and 2015, flawed maintenance and inspection were causal factors in 14% to 21% of helicopter accidents in the U.S. civil fleet. For these maintenance-related accidents, we examined the incubation time from when the maintenance error was committed to the time when it resulted in an accident. We found a significant clustering of maintenance accidents within a short number of flight-hours after maintenance was performed.

Of these accidents, 31% of these accidents occurred within the first 10 flight-hours. This is reminiscent of infant mortality in reliability engineering, and we characterized it as maintenance error infant mortality. The last quartile of maintenance-related accidents occurred after 60 flight-hours following maintenance and inspection.

We then examined the "physics of failures" underlying maintenance-related accidents and analyzed the prevalence of different types of maintenance errors in helicopter accidents. We found, for instance, that the improper or incomplete (re) assembly or installation of a part category accounted for the majority of maintenance errors with 57% of such cases, and within this category, the incorrect torquing of the B-nut and incomplete assembly of critical linkages were the most prevalent maintenance errors.

We also found that within the failure to perform a required preventive maintenance and inspection task category, the majority of the maintenance programs were not executed in compliance with federal regulations, nor with the manufacturer maintenance plan. Maintenance-related accidents are particularly hurtful for the rotorcraft community, and they can be eliminated. This is a reachable objective when technical competence meets organizational proficiency and the collective will of all the stakeholders in this community.

Opposite, left: Lift generation is not contingent on the forward motion of the helicopter.

Opposite, right: Helicopter accident rates vary by number of main rotor blades, by engine type, and by number of engines.

This page, right: The B-nut was involved in 33% of the cases of incorrect torquing or incomplete assembly of nuts, bolts, cutter pins, or safety wires.

Below: Helicopters are indispensable for many civilian and military applications.

A FEW WORDS ABOUT ROTORCRAFT

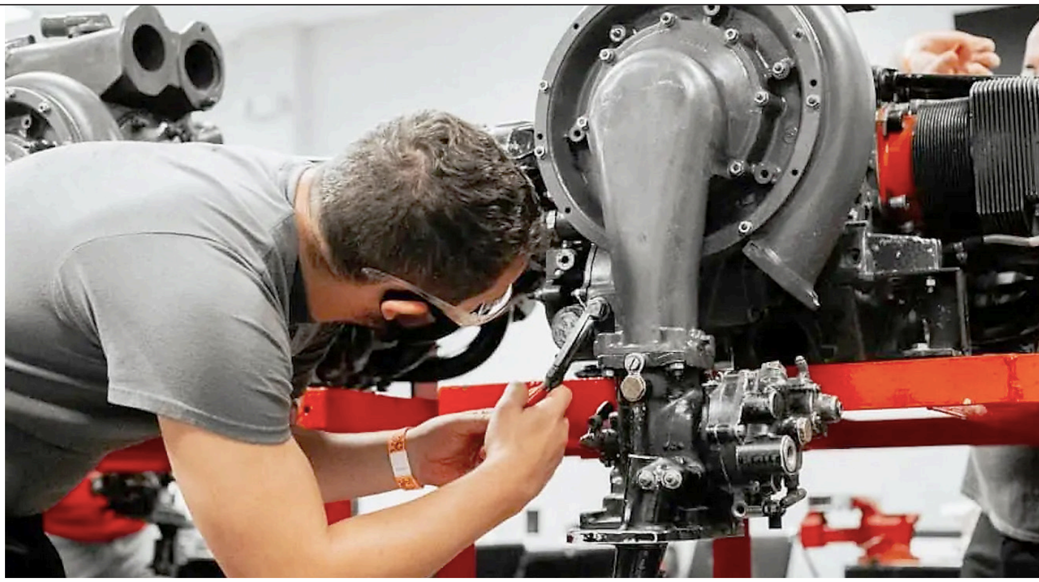
The fundamental feature of a helicopter's design, a rotating wing, decouples the vehicle airspeed from that experienced by the airfoil or blade element on its main rotor. As a result, unlike the situation with fixed-wing aircraft, lift generation is not contingent on the forward motion of the vehicle. The consequence of this is that several new flight regimes are enabled by this particular design choice, including hovering, vertical flight, and translational flight in directions (e.g., backward, and sideways) that are beyond the flight envelope of fixed wings. These flight regimes have made the helicopter indispensable for many civilian and military applications, from medical evacuation to law enforcement and close air support to mention a few.

By the same token however, rotating the wing raises a host of design and operational challenges and complexities, including issues related to vibrations and wear-out of a variety of components on the helicopter. The consequence of this is that maintenance and inspection are particularly crucial for helicopters for their continued airworthiness.

In a previous work, we examined trends, rates, and factors associated with helicopters accidents. We controlled for number of main rotor blades, engine type (turboshaft versus reciprocating), and number of engines (single versus twin). The key findings of that study are briefly summarized below:

1. At an aggregate level, we found that the fatal accident rate of U.S. civil helicopters has averaged 0.7 fatal accidents per 100,000 flight-hours since 2005, and no statistically significant improvement has occurred since then. Similarly, we found that the total accident rate has averaged about 4.8 accidents per 100,000 flight-hours;

2. Helicopters have a 17.3 times or 1,730% the risk of fatal accidents of passenger cars in the U.S. (based on the size of the respective fleets). This is a staggering result and it provides a



Above: Incorrect torquing or incomplete assembly of nuts, bolts, cutter pins, or safety wires accounts for a significant number of maintenance issues.

benchmark for appreciating the safety record of helicopters;

3. Helicopter accident rates vary by number of main rotor blades, by engine type, and by number of engines (when controlling for each of the other factors). For instance, the 2-bladed (2B) reciprocating helicopters have an accident rate 1.31 times that of the 2B turboshaft. This risk ratio increases to 1.56 when comparing the 3B reciprocating with the 3B turboshaft helicopters;

THREE SALIENT FINDINGS

1. There is a clear and significant clustering of helicopter accidents immediately following maintenance and inspection. For example, about 21% of all accidents occur in the first ten hours of flight following maintenance and inspection, the majority of which occurs within the first couple of hours (the 95% confidence interval covers roughly the 18% to 24% range);

2. There is a clear, decreasing pattern of accidents following maintenance and inspection. That is, the likelihood of a helicopter to experience an accident decreases with flight hours after maintenance and inspection. This is reminiscent of infant mortality in reliability engineering. The accident trend then levels off around 70 hours.

3. There is a sharp drop in accidents after 100 hours. This is simply an indication of the prevalence of the 100-hour inspection of helicopters … All the accidents after 100 hours are helicopters operating under one of the progressive inspections regime. It is likely that a majority of helicopters in the U.S. civil fleet subscribe to this regime (unfortunately, no official data is available to confirm or improve this estimate).

HELICOPTER MAINTENANCE ERROR CLASSIFICATION

A commonly used error classification scheme is the Human Factors Analysis and Classification System, or HFACS, developed in a series of articles by Shappel and Wiegmann and based on Reason's human error classification.

The HFACS framework consists of four levels, from the high-level "organizational influences", to "unsafe supervisions" and "preconditions for unsafe acts", and down to "unsafe acts" classified as "errors" and "violations".

Each level is further divided into finer-grained categories, for example "errors" are broken down into "decision errors", "skill-based errors", and "perceptual errors", which arise when sensory input is degraded. Decision errors are "[thinking] errors represent [intentional], goal-intended behavior that proceeds as designed, yet the plan proves inadequate or inappropriate for the situation".

Skill-based errors, sometimes described as technique errors, or "doing error", occur with little or no conscious thought. The classification is reminiscent of the defense-in-depth safety principle and the notion of the safety value chain, individuals at the sharp-end of safety, e.g., operators, and others at the blunt-end of safety, e.g., management. An extension of the HFACS framework was also proposed to cover maintenance-related mishaps in naval aviation and beyond. The levels were specialized to "maintainers condition", "working conditions" and "maintainer acts", but little else changed from the original version.

In our sample, the majority of the maintenance errors were skill errors (77%) and very few decision errors (12%). We found no perceptual errors, and the accident narrative was not descriptive enough to assign a particular error type for the remaining errors (11%).

We did not adopt or further pursue the HFACS framework in our work for two reasons. First, except in rare cases, there was no discussion of organizational influences or the pre-conditions for unsafe acts in the accident reports (Level 1 and 3 in HFACS). Furthermore, in the vast majority of cases, poor inspection was at fault (Level 2).

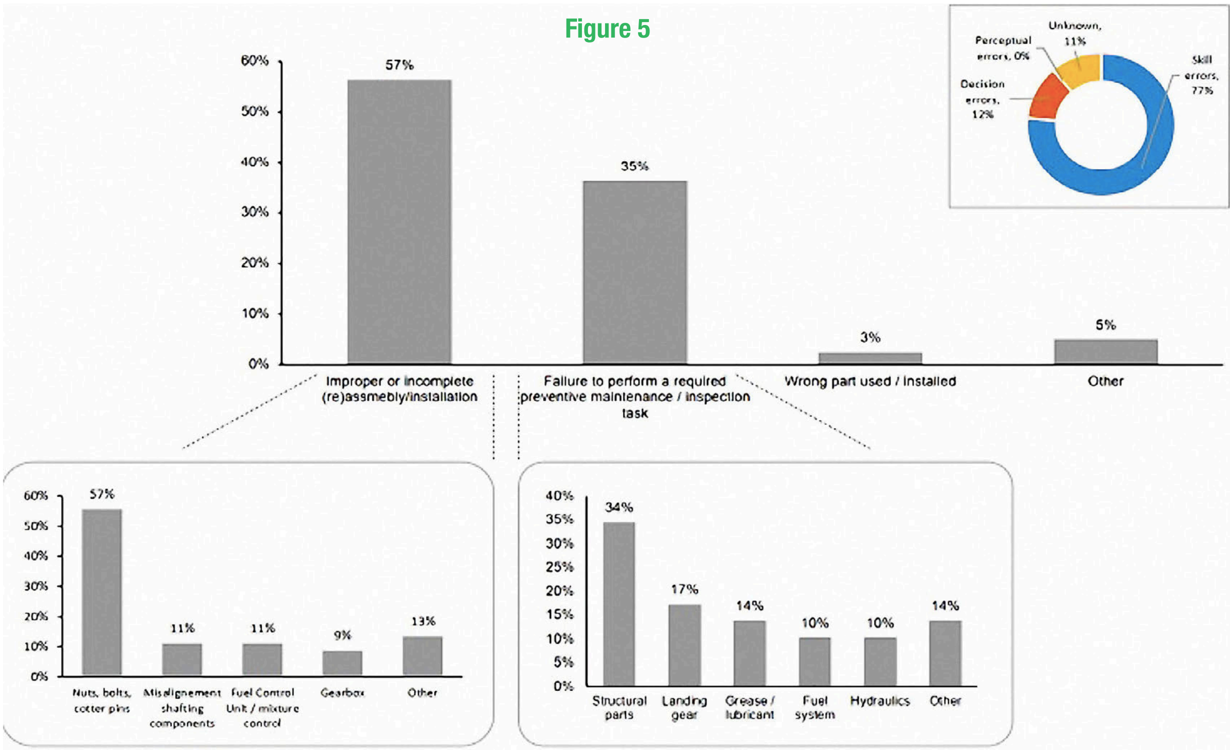


Figure 5

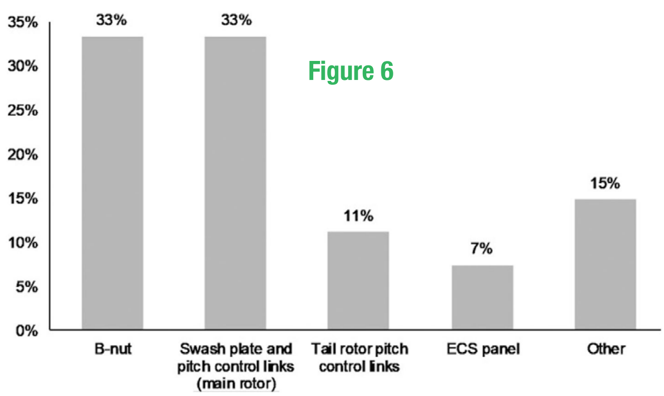


Figure 6

Second, more importantly, we found repeated patterns of maintenance errors (by function and location on a helicopter), which the HFACS unsafe acts classification was blind to. The results are shown in **Figure 5**. At the top level, we have:

1. Improper or incomplete (re)assembly or installation of a part. This accounted for the majority of maintenance errors with 57% of such cases;

2. Failure to perform a required preventive maintenance and inspection task: 35%;

3. Use or installation of the wrong part: 3%;

Other. This category accounted for situations we either could not resolve or for which there was only a single occurrence of a maintenance error.

We further decomposed these categories when enough data was available in the accident reports. For example, the following sub-categories clearly emerged under the Improper or incomplete (re)assembly or installation of a part. We found for example that:

1.1 Incorrect torquing or incomplete assembly of nuts, bolts, cutter pins, or safety wires was the most prevalent sub-category in (1), accounting for 57% of the maintenance errors under this category (1);

1.2 Misalignment of shafting components after maintenance accounted for 11% of this category;

1.3 The incorrect assembly of the fuel control unit and mixture control accounted for another 11% of this category;

1.4 The incorrect assembly of the gearbox accounted for 9% of the maintenance errors in this category.

A further sub-classification of (1.1) yielded the following results (**see Figure 6**):

1.1.1 The B-nut was involved in 33% of the cases of incorrect torquing or incomplete assembly of nuts, bolts, cutter pins, or safety wires;

1.1.2 The swash plate and pitch control links (main rotor) were also involved in 33% of these cases;

1.1.3 The tail rotor pitch control links were involved in 11% of these cases.

We further decomposed the second category, Failure to perform a required preventive maintenance and inspection

Above: The fundamental feature of a helicopter's design, a rotating wing, decouples the vehicle airspeed from that experienced by the airfoil or blade element on its main rotor.

There are perhaps around 50,000 maintenance and inspections interventions on U.S. civil helicopters per year.

task, with the parts to which the preventive maintenance was meant to be applied and for which there was enough data. The results show:

2.1 A prevalence of structural parts (rotor blades, structural tubing, engine outer combustion case, upper sheave, etc.) not properly inspected or maintained, 34%. It is important to clarify that this means that the maintenance program was not executed in compliance with federal regulations, nor with the manufacturer maintenance plan or service bulletins. In some of these cases, the parts were overflown past their service life by several hundred hours;

2.2 The landing gear was surprisingly involved in 17% cases of maintenance errors in this category. In this sub-category, the maintenance error led to ground resonance, and the consequence was dire: as one (un)lucky pilot was quoted in the accident report, "in a matter of seconds, the helicopter shook itself apart";

2.3 The non-application of grease or lubricant when required was involved in 14% of the cases in this category. The failure mechanism in these cases typically involved thermal damage, which led to structural failure.

There are roughly 12,000 helicopters in the U.S. fleet, their average flight-hours per year is about 300 hours (these are not uniformly distributed across different types of helicopters). Assuming 90% of helicopters operate under the 100-

There is a clear and significant clustering of helicopter accidents immediately following maintenance and inspection.

hour and annual inspection regime, this results in 12,000×0.9 (300/100+1)=43,200 maintenance and inspection interventions per year.

Furthermore, assuming that each of the remaining helicopters operating under the progressive maintenance regimes (AAIP or CAMP) have 6 maintenance and inspections interventions per year each, this would result in an additional 7,200 interventions. As a result, it is reasonable to assume that there are perhaps around 50,000 maintenance and inspections interventions on U.S. civil helicopters per year. With the 20 to 30 helicopter maintenance accidents per year noted previously, this give an average reliability of the maintenance and inspection intervention of 99.94% to 99.96%, or 4 to 6 in 10,000 intervention lead to an accident.

That helicopter maintenance and inspection are highly reliable is related to this estimate. It is nevertheless worthwhile to reflect on whether this is a good reliability achievement to be content with or not. If banks for example had a similar reliability per transaction, the result would likely be financial mayhem and riots.

One research paper benchmarked approaches to safety in different high-risk industries, and found a typical value of 10–5 to 10–6 of unreliability per unit of exposure in a healthcare context (blood transfusion and anesthesiology) and in civil aviation (per departure) for example. This represents about 2 to 3 orders of magnitude better reliability than that of helicopter maintenance and inspection. The rotorcraft community deserves and can do better. ■

("Maintenance and Inspection as Risk Factors in helicopter accidents: Analysis and Recommendations" was produced by Joseph Homer Saleh, Archana Tikayat Ray, Katherine S. Zhang and Jared S. Churchwell.)

The Engine's Actual Consumption

By Ekaterina Vuorinen

"One flight equals one cycle." This has been the traditional method for measuring Mean Time Between Scheduled Repairs. But there is an alternative for Increasing Engine On Wing Time.

Above: The core business of Neos is leisure flights with a fleet that consists of six Boeing 787-9, five 737-800 and four 737-8 aircraft.

Left: The simple measurement used in old-fashioned lifing methods is based on a worst-case scenario.

ROLLS-ROYCE'S new approach to aircraft engine product lifecycle management (PLM) is revolutionary. To understand how the company's Blue Data Thread digitalization program works imagine a thin blue thread connecting every Rolls-Royce powered aircraft, every airline operation, every maintenance shop and every factory. That thread is humming with data. Information flows in both directions making the whole operating chain smarter. It starts at the aircraft and it starts at the airline too as a seamless automated plugin to airline operations.

In practice, let's consider the real-world example of Neos Air, which is a small airline established in 2001 as part of a larger holding of the Italian travel operator, Alpitour Group. The core business of Neos is leisure flights with a fleet that consists of six Boeing 787-9, five 737-800 and four 737-8 aircraft.

NEW AIRCRAFT AND ENGINES NEED A NEW APPROACH

Neos's 787 Dreamliners are powered by Rolls-Royce Trent engines and, as part of the engine management plan implemented by the OEM to increase MTBSR (Mean Time Between Scheduled Repairs), they introduced a method called DAC (Direct Accumulation Count) of cycles for aircraft engine management. The purpose is to increase cyclic life by analytically determining how much of that life is consumed during each flight. The rationale behind it is that, during each flight, under typical conditions, the engine will consume a fraction of a full cycle. By accurately measuring that consumption it is possible to better determine the remaining safe life for the part rather than having to rely on rigid time driven calculations of remaining life.

That more realistic measurement of actual wear for the parts and engines makes it possible to keep them on wing longer. The simple measurement used in old-fashioned lifing methods, is based on a worst-case scenario which might see parts removed well before their actual wear would justify that. In order to achieve optimum effectiveness, methodology such as that requires lots of information to be provided to Rolls-Royce, some of which will be coming from Neos's MRO software Aircraft Maintenance and Engineering System (AMOS) that the airline has been using since 2004.

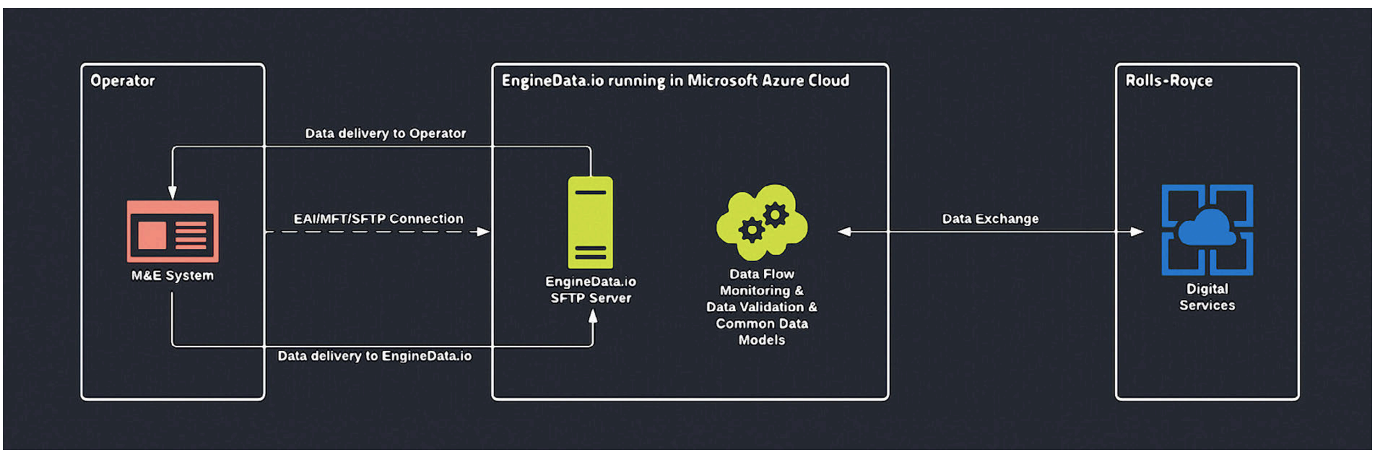
When Neos Air took delivery of its Rolls-Royce Trent powered 787s, in order to be able to measure the life and calculate the life expectancy of life-limited parts in each engine, Rolls-Royce first needed to build up a profile of Neos's operation (phase one). For that they used data coming from the 787 with ACARS messaging using a downlink from the aircraft. A second set of telemetric data that was generated by each engine during the flight and downloaded by the maintenance crew after the aircraft had landed.

Boeing 737-86N.

data exchange platform. This data is then available to Rolls-Royce who, in turn, provides data on the exact level of life consumed and remaining for each life-limited part.

BLUE DATA THREAD

QOCO works with Rolls-Royce to support service delivery and to provide data capture and management components in



Neos collects data from AMOS and then delivers it to EngineData.io data exchange platform. This data is then available to Rolls-Royce.

The process continued for some months until Rolls-Royce had built a profile of Neos's ways of using the engines. In phase two, the airline was able to declare that the DAC system was the executive method of lifing for these engines. In order to do so, it was necessary to go through several steps of approval which included interfaces with AMOS, Neos Air, and Rolls-Royce, through a third-party service provider which is QOCO, a data management specialist firm based in Finland.

QOCO had already worked on previous customer projects to deliver a data exchange solution between the operator's M&E system and Rolls-Royce digital services. Neos collects data from AMOS and then delivers it to QOCO's EngineData.io

the OEM's Blue Data Thread as part of the digitalization of Rolls-Royce TotalCare. How the vendor usually works with an airline is that, during on-site visits, QOCO undertakes a project with the operator to thoroughly understand the processes and people behind the operator data and then sets-up the data exchange. When COVID-19 arrived, on-site visits were not possible and remote collaboration tools (such as Microsoft Teams) became the norm. The Neos Air implementation was the first one to be managed completely remotely, with no on-site presence for QOCO.

The first step was to have an implementation project for the data exchange in which QOCO worked with the airline

through the different phases such as discovery, definition, implementation and roll-out. They configured and deployed the required data pipelines between the airline and the EngineData.io platform.

Once the implementation phase was over, the next step was to go live with the data exchange and complete the handover to QOCO's continuous services for data monitoring. The service also includes data quality controls that will notice if, for instance, there is a missing flight for one aircraft, and will trigger the system to contact the airline through Rolls-Royce to resolve any data issues. As the system is constantly reviewing the data, it will notice if there are any issues that require action.

With data exchange capabilities, Rolls-Royce can keep track of their assets used by different airlines and keep a digital copy of the engine. It is a huge benefit for the airline as they can keep the engine running safely on the wing for a longer time, enabling them to optimize operations.

This has a particular impact with life limited parts (LLPs); the traditional approach is that the manufacturer, who doesn't know how the airline will operate the engines, has to assume the worst which means that life limits are usually set according to worst operating conditions. With the data exchange, Rolls-Royce receives IoT (Internet of Things) data directly from the engines; QOCO provides the complementing data from the maintenance system which completes the picture.

With that complete data set, Rolls-Royce is able to extend the use life of LLPs which, in turn, further supports longer safe operating times on wing for the engine. It also reduces unscheduled maintenance events. This more detailed and comprehensive picture of how the airline is operating the engine can also feed into a predictive maintenance process.

REGULATORY AND INTERNAL APPROVALS

From QOCO's point of view, approval is threefold. Rolls-Royce provides technical clearance to use the DAC system. Then the airline needs to approach the local aviation authority to get their approval. Finally, of course, there will be internal approvals at the airline. All three need to be in place. QOCO

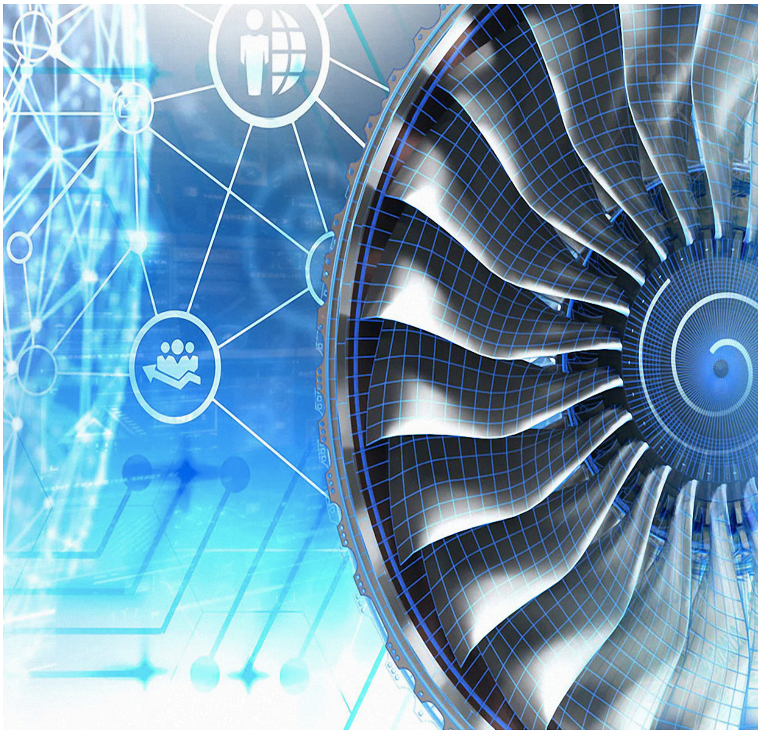
Rolls-Royce needed to build up a profile of Neos's operation and for that they used data coming from the 787 aircraft.

will support and provide documentation, but more often than not, further support is not necessary.

The system itself, the way in which Rolls-Royce proves the information is already approved by EASA. Rolls-Royce holds the EASA type certificate for the engine which means that EASA has approved this maintenance and engine management process so Neos simply had to amend its continuous airworthiness management process. By adding this particular process to measure the life of LLPs, the benefit gained was to avoid the removal of an engine due to life expiration of LLPs based on cycles flown rather than life used. That was and is a huge benefit that Neos has derived together with, of course, the only other way they could have reached the same goal would have been by making a repetitive and frequent manual inputs to and extracts from AMOS of the necessary data.

With this automatic routine of the data being sent automatically from AMOS, and sent to the right place, as well as Neos also automatically putting that data into their own systems, the airline is able to avoid manual inputs and instructions which, in turn, removes the possibility of human error, leaving employees free to work on other projects and tasks.

The process has been approved by the Italian LAA without constraints due to EASA certification. Fortunately, approval of a dedicated AMP (Aircraft Maintenance Program) revision was less of a problem than it might have been due to the change being already EASA approved.



Rolls-Royce's Blue Data Thread program connects every airline operation, every maintenance shop and every factory.


Neos's 787 Dreamliners are powered by Rolls-Royce Trent engines.

THE SYSTEM IN PRACTICE

Integrated within the AMP (Aircraft Maintenance Program), LLP life is controlled with fractional data, i.e., data referring to that fraction of a flight consuming the LLP. Sending that data to the system allows users, in just a few months, to measure performances of all parts of the engine and how much of a component's life has been consumed during any particular flight. For Neos, this is not the only system to which they are sending data.

In a very similar way, the airline is also sharing the same sort of data with Boeing for other maintenance related reasons such as reliability and AHM (Aircraft Health Monitoring). Using AMOS data is helping to improve operations. Once the data exchange structure is up and running, it works. AMOS was switched on at Neos in 2004 and has never gone down; it's very reliable.

In the time Neos has been using QOCO, there have been a couple of changes in the way AMOS gets data from the database with the aim to have an optimized way for achieving that. QOCO is continually improving the data transfer method so that the system is continuously monitoring and fine tuning. QOCO works with Rolls-Royce's Blue Data Thread program using agreed data from different aspects of aircraft maintenance.

FUTURE PLANS AND NEXT STEPS

The process of measuring and recording life used and remaining on LLPs does not yet cover all of the LLPs in an aircraft engine with Neos; so, there will be a progressive inclusion of other LLPs into the system and away from the traditional method of "one flight equals one cycle." That will be reflected in a corresponding growing number of components that can continue safely on wing based on actual condition and not just cycles flown. ■

Pacific AME Association

Corporate Members

Our corporate members are important to us. From supporting / sponsoring the Association's workshops to donating boardrooms for our meetings and training, we appreciate their hard work and dedication to furthering the industry.

Corporate benefits

Work shop and meetings during the year on topics of interest to AMEs.
Opportunity to meet and exchange ideas at our functions.
A representative of a corporate member has the right to attend and speak at all membership meetings, but is not entitled to vote or to hold office in the Association.
Corporate Members are entitled to advertise that they are members of AME Association.
Opportunity for employment networking at our workshops.
Free advertising of your company on our website.
Free job postings on our website.
Two corporate members able to attend our workshops.
www.amec-teac.ca/pacific

Western AME Association

We'll be back soon

The WAMEA website is currently undergoing maintenance and will be back soon!
For any inquiries, the usual communication methods are still in place:
Email: **info@wamea.com** or **president@wamea.com**
Phone: **587-713-WAME (9263)**

While the WAMEA website is undergoing maintenance, please take the opportunity to peruse the National AME Association website for your professional interests at:
http://www.amec-teac.ca

Thank you for your patience,
Greg Andersen
President
Western AME Association

www.wamea.com

Central AME Association

26th Annual Aviation Symposium 2023

The 26th Annual Aviation Symposium is on March 2-3, 2023

Symposium Schedule

Thursday March 2, 2023
0745 to 0900 Registration & Continental Breakfast in Trade show area
0900 to 1530 Speakers & Presentations / Trade Show Open
1530 to 1630 Skills competition
1630 to 1830 Banquet Reception/Cocktails On-site in the TYC Event Centre
1830 to 2100 Banquet in TYC

Speakers Thursday, March 2
Key Note Speaker: Kendra Kincade - President of Elevate Aviation
Pending Special 1-Day Course
(Pre-registration required, limited capacity)
Amy-Tsai Lamourex - RCAF
Dean Barrett - Transport Canada
Kathryn Atamanchuk - University of Manitoba
Kim Burton - Textron Aviation

Friday March 3, 2023
0745 to 0900 Registration & Continental Breakfast in Trade show area
0900 to 1630 Speakers & Presentations / Trade Show Open until 1400
(Booth tear down @ 1400)

Speakers Friday, March 3
Pending Special 1-Day Course (Pre-registration required, limited capacity)
Bill Grassick
Mark Girdner/ John Thomas - Michelin North America
Ray McNabb - Transport Canada
Terry Slobodian - Royal Aviation Museum of Western Canada

Event Venue:
Canad Inns Destination Centre Polo Park
1405 St Matthews Ave
Winnipeg, Manitoba
www.camea.ca

AME Association of Ontario

#613 - 7360 Bramalea Road, Mississauga, Ontario L5S 1W9
tel: 1-905-673-5681 email: association@ame-ont.com website: www.ame-ont.com

AME Shortage

At several of the meetings between our association, the colleges and Transport Canada, the subject of an AME shortage was a prominent topic. Concern was expressed that there may not be sufficient people to replace retiring AMEs, not to mention the forecast increased demand for aviation maintenance personnel.

The colleges in Canada are producing about 3,500 graduates per year, unfortunately only half of these have accreditation. Due to confidentiality and privacy concerns the colleges are unable to track their graduates. So there is no ability for us to find out whether these graduates make it into an aircraft maintenance job or why they may have changed to another career path.

Transport Canada has provided some statistics about AME licencing. From 2011 to 2021, the average number of new AME licenses issued was 446. The total active number of AMEs living in Canada as of November 2022 was 15,525. The average age of these AMEs is 49. Continuing with the current trend, they expect that in 2030 there will be 425 AMEs retiring per year (based on an age 65 retirement). This would work out to be a growth factor of less than one-tenth of one percent.

Numerous suggestions have been made to improve the situation. Increasing the college enrolments would, of course, increase the number of graduates, but would quality suffer? Another suggestion is to improve the system of accreditation which would channel more graduates into remaining in the aircraft maintenance field. Of course improving the starting salaries would also help.

Should insufficient AMEs and skilled workers be available, especially to the airlines and larger aircraft maintenance facilities, we might expect that they will be pressuring the regulators to allow for in-house trained and qualified persons to perform and certify maintenance. Quality and safety oversight will suffer. Your opinions and suggestions are best channeled through your regional AME Association. Join and participate with us as we try to keep the public safe.

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

Quebec AME Association

Association des Techniciens/Techniciennes d'Entretien d'Aéronefs du Québec

C.P. 34510, 3131 Côte-Vertu; CSP Place Vertu, Saint-Laurent, Qc, H4R 2P4
email: info@ame-tea.com website: www.ame-tea.com

Nous sommes l'Association des Techniciens et Techniciennes d'Entretien d'Aéronefs du Québec et nous sommes fiers de pouvoir servir et promouvoir la communauté des TEA du Québec. Membre de l'AMEC/TEAC, nous travaillons avec les différentes associations de TEA à travers le Canada sur différents dossiers, dont certains directement avec Transports Canada.

L'Association des TEA du Québec promeut la sécurité des personnes affectées par les métiers de la maintenance aéronautique, favorise des pratiques sûres sur le lieu de travail et reconnaît que la sécurité est la pierre angulaire de l'industrie aéronautique.

Faire partie d'une association régionale de TEA amène certains avantages. Outre l'accès à des rabais intéressants pour les TEA, vous recevrez plusieurs magazines dédiés au monde de l'aéronautique directement à la maison. C'est aussi un excellent moyen pour les TEA de participer à cette communauté.

Nous avons récemment été actifs à différents niveaux et avons eu le plaisir de participer à la journée Portes-Ouvertes de l'École nationale d'aérotechnique de St-Hubert le 19 novembre et avons eu la chance d'y rencontrer nombre de futurs étudiants souvent accompagnés de leurs parents. De plus, le 20 et 21 novembre derniers, les 6 associations régionales de TEA du Canada se sont rassemblées à Ottawa en présentiel pour la première fois depuis l'assouplissement de certaines restrictions relatives à la Covid-19. Nous y avons également rencontré les représentants du département de la Navigabilité opérationnelle de Transports Canada pour notre réunion annuelle avec eux. Nos membres recevront sous peu un compte-rendu complet de cette rencontre.

Finalement, nous prévoyons organiser notre assemblée générale au début de 2023. Les membres seront informés par courriel relativement à cette rencontre.

Vous pouvez en apprendre plus à notre sujet à l'adresse suivante :
www.ame-tea.com email: info@ame-tea.com

The association's mission is to represent all AMEs in Quebec regardless of the company or the contracts on which they work. Regardless of the type of aircraft on which the AME works, he/she will be welcome. We will simply recognize ourselves as a holder of an AME Transport Canada M1/2, E or S license with an attachment in Quebec.

Renewal: Annual Membership

Licenced Aircraft Maintenance Engineer:	$45
Apprentice/ Student/ Retiree:	$30

Here is how you can renew

Make an Interac transfer to the following email address:
info@ame-tea.com
Security Question: what is our career? Answer: AME
Or send a cheque payable to AME ASSOCIATION QUEBEC to the following address:

Aircraft Maintenance Engineers Association of Quebec
C.P. 34510, 3131 Côte-Vertu
CSP Place Vertu, Saint-Laurent, Qc , H4R 2P4

Learn more about us at :
www.ame-tea.com email: info@ame-tea.com

Atlantic AME Association

Mark your calendar
ARAMC 2023 is set to be held at the :
Delta St. John's, Newfoundland on **May 3-5, 2023**.
Info to follow as it becomes available.

Potential phishing scam alert
To our members: It's been brought to our attention that there could be Phishing emails circulating that appear to be coming from the Association President, Bob Pardy. Please be vigilant and do not open if it appears suspicious.

www.atlanticame.com

SoCal PAMA Chapter

Now Hiring: How Millennials Can Save an Industry
By Lindsay Nixon

There are few things that we are reminded of as frequently as the opinion that the millennial generation (those between the ages of 25 and 42 years old in 2023) is inherently different than those who came before them. When a group of managers was asked to describe millennials in one word, the responses received were unflattering (to put it mildly).

What you may be surprised to hear is that the same adjectives used to describe millennials today are the same adjectives used to describe the younger generation in 1990. "Lazy, entitled, selfish, shallow... [who] have trouble making decisions" is a quote taken from the Time article "The Next Generation" in the summer of 1990.

Life Magazine, in 1968, had a similar article using the same descriptors with the up-and-coming generation of that era. The true issue may not be generational, after all. The difference may be that as we age, we choose to take on additional responsibilities and zoom our lens out to view a larger picture. In doing so, we tend to shift our career focus from personal priorities (do peace, equality, or civil rights ring any bells?) to organizational priorities – a natural progression of sorts.

For employers, this is fantastic news; common ground exists. Many ideals most important to the young generation of today are the same ideals we held dear in our younger years – meaningful work, social justice, diversity, and the importance of education. In fact, the millennial generation has repeatedly shown the rest of us that they are more focused on personal and career growth and less focused on marriage and family – something never-before-seen in the workforce-entering generation.

In our industry specifically, we have no time to waste in welcoming this generation into our organizations. While the aviation industry loses mechanics and pilots daily to retirement and burn out, the logical place to recruit these replacements is in the generation that everyone loves to hate: millennials. Truth be told, we need them more than they need us – and it's our responsibility to begin advocating and recruiting this generation to join our industry before it's too late. Below are my five steps to creating a millennial-friendly workplace:

1. Evaluate your mission. By injecting a personal feel into your brand – community outreach, charity work, and living your company values – you will not only define your company, but also attract talent that places importance on giving back (which has its own set of perks).
2. Review your benefits. Money isn't everything, so review what you're offering. You may find that you attract better talent with better benefits, vacation time, tuition reimbursement or flex scheduling.
3. Be prepared for departure. In aviation specifically, we all know that the supply of career opportunities is in excess of talent. It's your responsibility as the employer to create an environment that entices your employees to stay, instead of going to your competition.
4. Embrace technology. The inevitable result of the computer age, the faster you are able to incorporate technology into your organization, the more efficient and millennial-friendly your workplace will become.
5. Last but not least, listen. Truly listening to your employees and evaluating their feedback seems simple enough, but to this generation it means even more. Improving processes and promoting growth of your organization are two byproducts of simply opening your ears to hear the good, the bad, and the ugly of your company's day to day from those on the front lines (or at least, those closer to them than you).

The aviation industry doesn't have the luxury of being selective. We need to overcome our workforce shortage with optimism and resourcefulness, not stereotypical judgement. The fact is that things are projected to get worse before they get better. By adapting your workplace to welcome millennials with open arms and minds will only help you weather the storm.

www.socalpama.org

Central Ohio PAMA

2023 Scholarship Awards

At our November Board of Directors meeting, we awarded $8,250 to six students at the Columbus State Community College Aviation Maintenance Technology at Bolton Field for 2023. This will reimburse each $1,375 for their completed FAA written computer exams and their oral and practical exams performed by Designated Maintenance Examiners.

2022 Board of Directors Meeting and 2023 Officers

On Wednesday November 30, the Board met at the home of Treasurer Earl Redmond to establish plans for 2023 and install new members to the Board. We also discussed future plans for the Association and elect new officers.

Four members of the Board, Jeff Gruber, Gene Sprang, Earl Redmond and Lowell Dowler, were up for re-election. Gene and Lowell will remain on the board for a two year period.

Jeff Gruber had previously left the board for a position with the FAA in Cincinnati and Christopher Deem of CSCC Aviation Maintenance Technology became a full member after filling in as interim for Jeff.

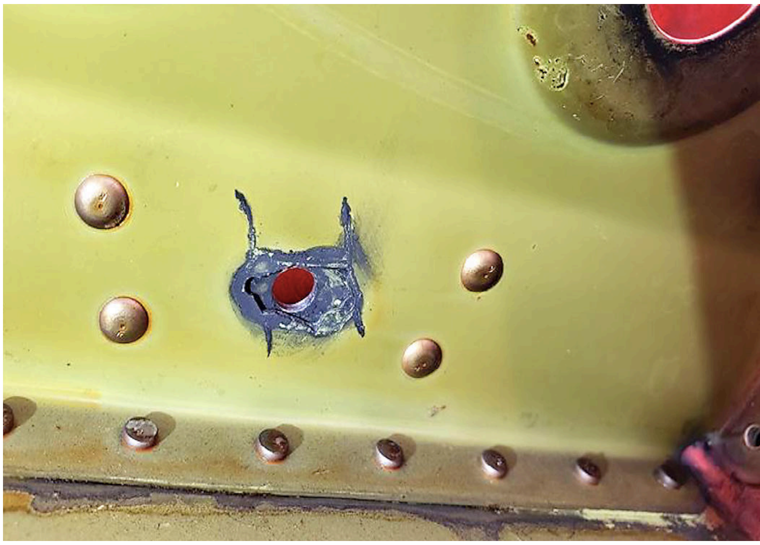
Earl Redmond leaves the board due to health reasons and we thank him for his long service as board member since 2010 and Treasurer since 2012. We wish him and his wife Carol good luck in the future as he continues his recovery.

Bill Otte, Regional Manager for Duncan Aviation has joined the board and Lowell Dowler will take over the Treasurers postion vacated by Earl's leaving. Thank you Bill for your willingness to volunteer and your future input on decisions we make.

www.copama.org

★ TRANSPORT CANADA ★ Reports and Comments

The following are selections of Canadian Aviation Service Difficulty Reports originally published as "Feedback" by Transport Canada.



Right: Pilatus PC-12. Underside of rudder rib 6 with missing anchor nut.

REPORT: PILATUS PC-12

Loose Anchor Nut – Rudder Hinge Attachment Bolt

Subject:

During a maintenance check, the rudder was removed to inspect for play at the hinge point, and a Structural Repair Manual (SRM) repair was carried out by installing a bushing. During the rudder re-installation, when mounting the top rudder attach point bolt, a rattling noise was heard of something that had dislodged and fallen inside the rudder. Upon further investigation, it was noted that the anchor nut to which the bolt must be attached had fallen inside the rudder. After the anchor nut was retrieved, it was noted that the anchor nut was still riveted to the broken piece of rudder rib 6.

Transport Canada Comments:

The SRM repair mentioned by the submitter is Rudder Upper Hinge Fitting Repair RM06299 (Installation of an aluminum bushing). This repair has the operator increasing the top bolt hole to a larger size to accommodate a bushing, adding strength and preventing play-inducing wear.

Pilatus offers another repair, Rudder Upper Hinge Attachment Repair RM05387 (Replacement of the nutplate with a self-locking nut and washer). This repair replaces the anchor nut with a self-locking nut and washer. This repair also adds an inspection panel to access the lower portion of rudder rib 6.

Play in the rudder attachment fittings is checked while performing Pilatus Task: Rudder Inspection Check - 12-B-55-40-00-00A-313A-A. Operators are asked to keep this defect discovery in mind when finding play in the rudder upper hinge fittings of PC-12 aircraft.

REPORT: BELL 505

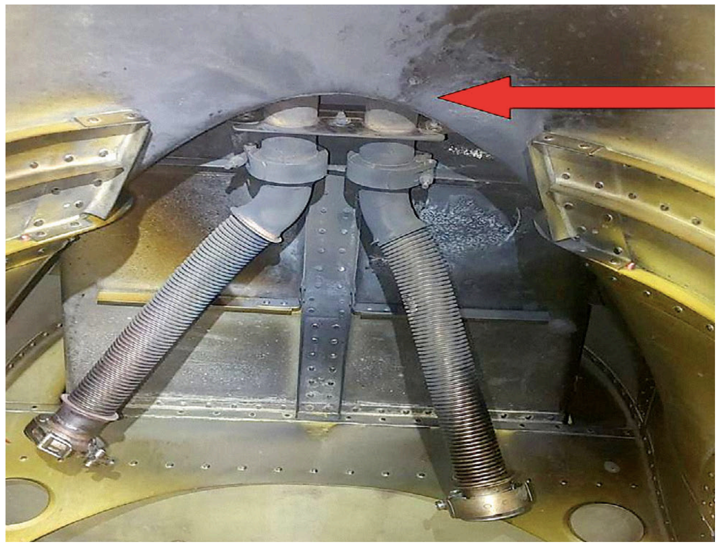
Fractured Main Rotor Hub Bearing Roller

Subject:

Feathering bearing, part number (P/N) 206-011-118-001, was removed from a main rotor hub of a Bell model 505 helicopter. The main rotor hub has not been disassembled since new. Total time is 197.2 hours since new. The feathering bearing was found damaged upon removal. Bell Helicopter has been notified.


Below: Bell 505.
Fractured roller in bearing.

Below: Beech B300. Approximate location of weld failure.



Transport Canada Comments:

Bell investigated this service difficulty and indicated that it may have been possible for the bearing to have been inadvertently damaged during the assembly of the main rotor hub. Although the roller was found fractured, an inspection of the rollers mating surface on the main rotor yoke showed no damage.

Transport Canada Civil Aviation encourages owners, operators, and maintainers to submit a Service Difficulty Report if a fractured bearing roller is discovered during inspection of any helicopter model with a similar designed main rotor hub.

REPORT: BEECH B300

Air Intake Anti-Ice Lip –
Weld Assembly Engine Air Inlet Cracked

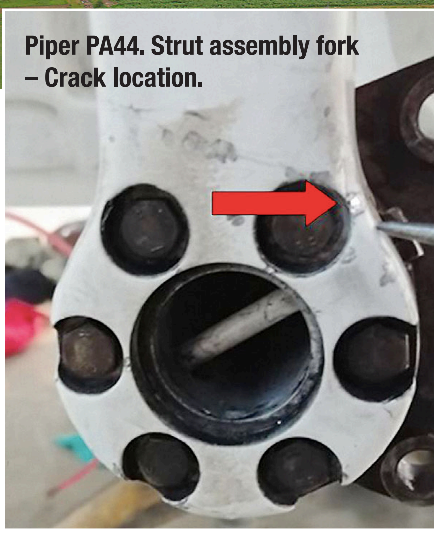
Subject:

During regular maintenance, maintenance personnel noticed that the bottom of the engine was covered with soot. Further investigation revealed that the lower cowl inlet duct was completely broken, shooting hot bleed air directly on engine oil lines and engine wiring. Wiring was inspected, no damage was found, and the oil lines were replaced proactively. This Service Difficulty Report (SDR) is the result of investigation following a recent event. Refer to SDRs 20221019001 and 20221026010.

Transport Canada Comments:

Similar failures have also been reported on other King Air models (not limited to King Air 300 Series aircraft) that utilize an inlet de-ice lip heated by exhaust gas from a collector in the exhaust stack. Failures include weld failure of the inlet/outlet tubes as depicted below, anti-ice flex hose failure, or connection points failure. Flight crews may be unaware that the air intake anti-ice lip heating function is degraded or completely unavailable since there are no shutoff, caution, or temperature indications for this system.

Operators and maintainers are reminded to remain vigilant when inspecting the surrounding areas. Soot is an obvious sign of exhaust gas leakage which should warrant a closer look to determine the exact cause.



Piper PA44. Strut assembly fork – Crack location.

Above: Bell-Textron 429. Bearing, MS14101-5A, installed in the tail rotor directional control idler assembly.

REPORT: PIPER PA44 180

Main Landing Gear Strut Assembly – Fork and Piston

Subject:

During an inspection of the gear down-lock switch on the right-hand (R/H) MLG, an aircraft maintenance engineer (AME) found, by chance, a crack on the lower strut assembly inboard of the axle, where the brake torque plate bolts attach. The crack is slightly above the bolt at the 1 o'clock position, and it is where the strut joins the axle. The location of the crack is in a significant load bearing area.

Transport Canada Comments:

Piper Aircraft published service letter (SL) 1263 due to MLG piston tube fatigue cracking. Shortly thereafter, an accident (National Transport Safety Board report WPR21LA117) involving the separation of a R/H MLG occurred. The root cause was identified as failure of the landing gear strut piston tube due to fatigue cracking from corrosion pitting.

It was noted in a subsequent Service Difficulty Report (SDR) 20210806009, that Piper has produced a replacement strut assembly, part number (P/N) 67037-006 (also referenced in the above SL), which appears to have a notable design improvement in the affected area of the lower fork.

Transport Canada Civil Aviation (TCCA) recommends compliance with SL 1263. Additionally, paying special attention to the area of the fork identified in this SDR is also recommended. High cycle aircraft, such as those used in a flight training role, may be particularly susceptible.

REPORT: BELL-TEXTRON CANADA 429

Worn Directional Control Idler Bearing

Subject:

The following was reported to Bell upon the 800-hour inspection. Excessive wear was found on the bearing of the directional control idler.

Transport Canada Comments:

The worn bearing, part number (P/N) MS14101-5A, is a component of the tail rotor directional control idler assembly, P/N 429-001-721-105. Several Service Difficulty Re-

Pratt & Whitney.
Dislodged piece of check valve.

ports (SDRs) were received describing a worn bearing, P/N MS14101-5A, in the idler assembly. Bell investigated these reports and published Operation Safety Notice (OSN) 429-19-04 to highlight the importance of completing the scheduled detailed inspection of the bearing.

In addition to publishing the OSN, Bell has indicated the possibility of a future design change to replace the existing bearing. Transport Canada Civil Aviation (TCCA) will monitor this service difficulty and reminds operators and maintainers to continue submitting a report for each reportable service difficulty.

REPORT: PRATT & WHITNEY – USA PW1524G3

Fuel Check Valves

Subject:

A fuel imbalance was experienced in flight. The following log entry was submitted by the aircrew: During the whole flight, we had fuel imbalance. The maximum was a 200kg difference. The low side was always on the right-hand side. The system balanced fuel three times within 45 minutes. On the ground, the fuel imbalance was still 160kg less on the right-hand side and the fuel flow was the same on both engines. The removal of the engine feed/isolation check valve revealed that the check valve was not properly installed.

Transport Canada Comments:

Several Service Difficulty Reports (SDRs) have been received reporting "Fuel Imbalance" master caution messages during flight. Maintenance inspections found dislodged fuel check valves, which prevent backflow of fuel from wing tanks to centre tanks, as well as permit engine fuel cross-feeding when electrical boost pumps are in operation.

Furthermore, it was discovered that the retaining wire, which holds the check valve in its correct position, is of an insufficient diameter allowing the check valve to become dislodged and, consequently, allowing fuel to bypass the check valve.

Transport Canada Civil Aviation would like to make operators and maintainers aware of Airbus Canada Service Letter CS-SL-28-20-004, which provides instructions for the replacement and installation of an improved retaining wire part number P/N 2183023-101. ■

Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

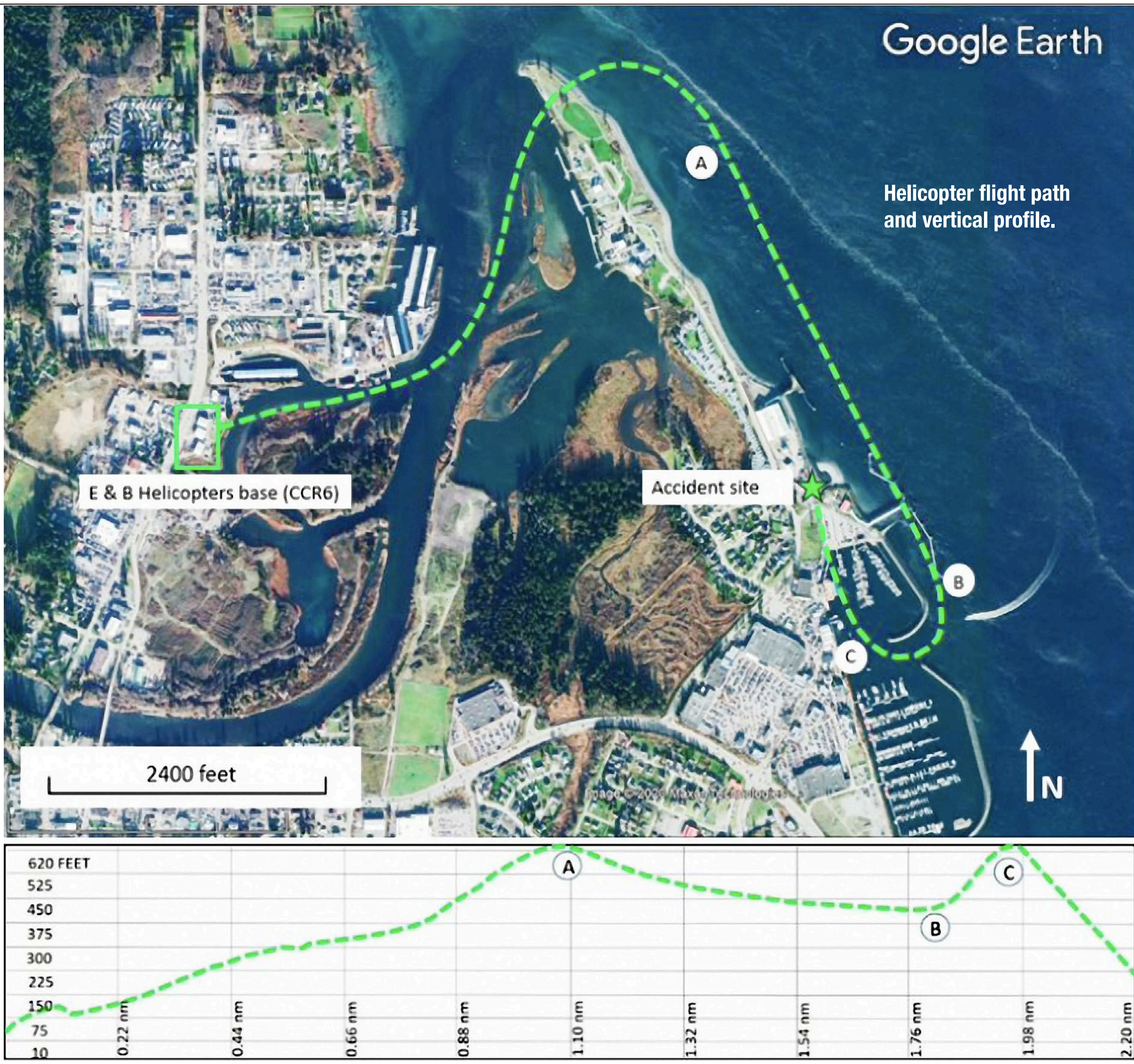
Deformed in Flight

A combination of factors leads to failed autorotation.

A typical Bell 206B. Not the occurence aircraft.

ON **24 September 2019**, the E & B Helicopters Ltd. Bell 206B helicopter (registration C-GEBY, serial number 3375) was conducting a visual flight rules flight from the operator's base at Campbell River (E & B Heli) Heliport (CCR6) in Campbell River, British Columbia, to Moat Lake, British Columbia, with only the pilot on board. Shortly after departure, while flying southeast along the coastline, the helicopter briefly levelled off at 615 feet above sea level, then began a descent. When the helicopter was at 417 feet above sea level, it entered a right-hand climbing turn toward land and, following the turn, it began to descend again. During this descent, at 1103 Pacific Daylight Time, control of the helicopter was lost when it was about 200 feet above ground level and the helicopter fell to the ground, striking a building and 2 vehicles. The pilot was fatally injured. No one on the ground was injured. The helicopter was destroyed by the impact forces and a post-impact fire.

The investigation found that an engine power anomaly likely occurred while the helicopter was in cruise flight and, as a result, the pilot reversed course and entered a descent consistent with an autorotation. Following the occurrence, a visual and microscopic examination of the main rotor blades revealed several indications of structural failure in flight. At some point during the flight, both main rotor blades became deformed. Although indications of fatigue were present post-occurrence on a small portion of the trailing edge of one of the main rotor blades, the extent to which this fatigue contributed to the deformation could not be determined. The investiga-



Helicopter flight path and vertical profile.

tion also found that in the last moments of the flight, likely as a result of the deformed blades, the main rotor rpm decreased to a point that could not sustain autorotational flight, and the helicopter fell vertically and impacted the ground.

The investigation also revealed that the engine fuel system didn't have the appropriate accumulators and double check valve for the Bell 206 helicopter. During the installation of the engine, the company maintenance control system was ineffective at ensuring that the engine installation complied with the manufacturer's recommendations, including having the correct accumulator and double check valve configuration for the Bell 206. If maintenance procedures don't include a thorough review of all related instructions and bulletins, there is a risk that an aircraft will be released into service in a non-airworthy configuration.

The investigation examined the air operator's safety culture. Safety culture within a company can be summarized as "how we do things around here." The pilot was the company's owner, accountable executive, and operations manager, and direction on how the maintenance department was to respond to a partial loss of engine power that occurred a week before the occurrence came from him. The investigation revealed that many operational and maintenance-related decisions were being made based on a single opinion, rather than a process of validation by a hierarchy of independent and skilled supervisors.

Several opportunities to improve the safety of the flight had been missed. If company management routinely deviates from regulatory requirements, there's an increased risk that an unsupportive safety culture will develop, affecting the entire organization.

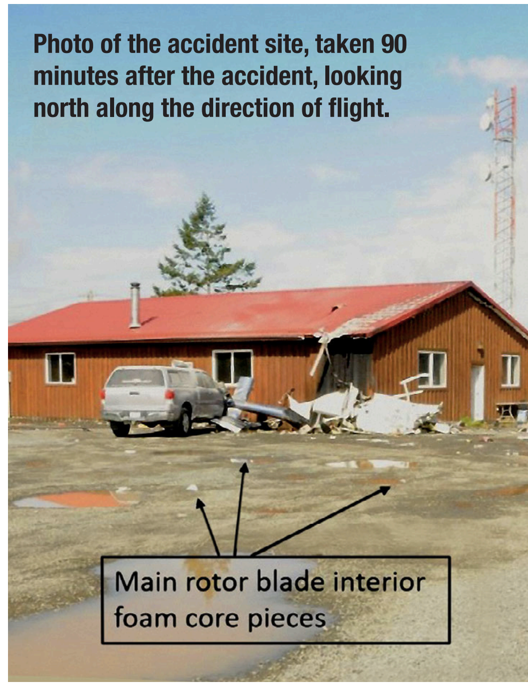


Photo of the accident site, taken 90 minutes after the accident, looking north along the direction of flight.

The investigation examined the certification process of composite main rotor blades. A structural fatigue test, completed as part of the primary structural element threat assessment, is intended to ensure the continuing airworthiness of a structural component, the failure of which could be catastrophic. A dynamic load assessment helps determine the maximum damage size to be introduced into the structural fatigue test specimen.

The investigation determined that no dynamic assessment was carried out for the certification of the model of Van Horn composite blades installed on the occurrence helicopter. If data from a dynamic assessment is not available, the fatigue test may not discover structural responses associated with this damage. If a structural fatigue test does not include quantitative assessments and simulated damage that is of probable sizes and at critical locations as determined from a dynamic load assessment, the resulting airworthiness limitations may not be adequate to prevent failures or excessive structural deformations.

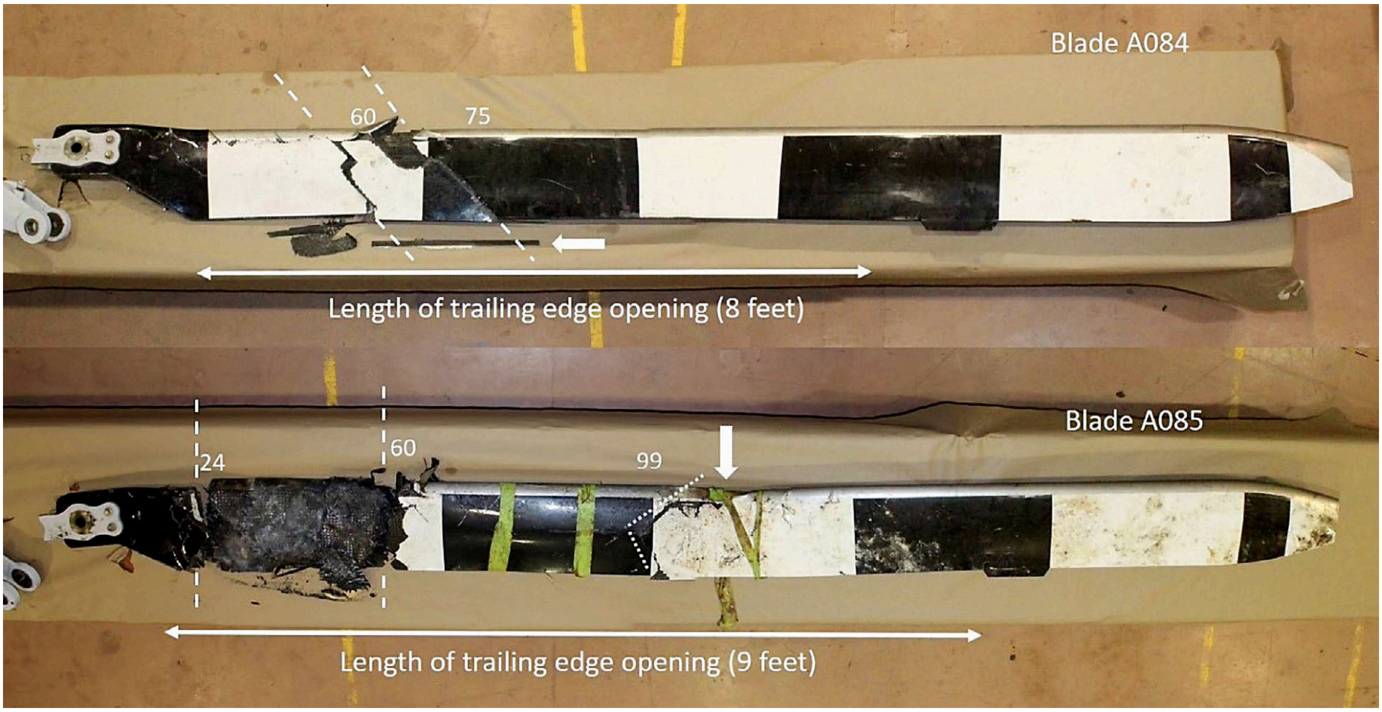
The Van Horn composite blades are certificated on the basis of the "no-growth" method. This method is used to show that "the structure, with damage present, is able to withstand repeated loads of variable magnitude without de-

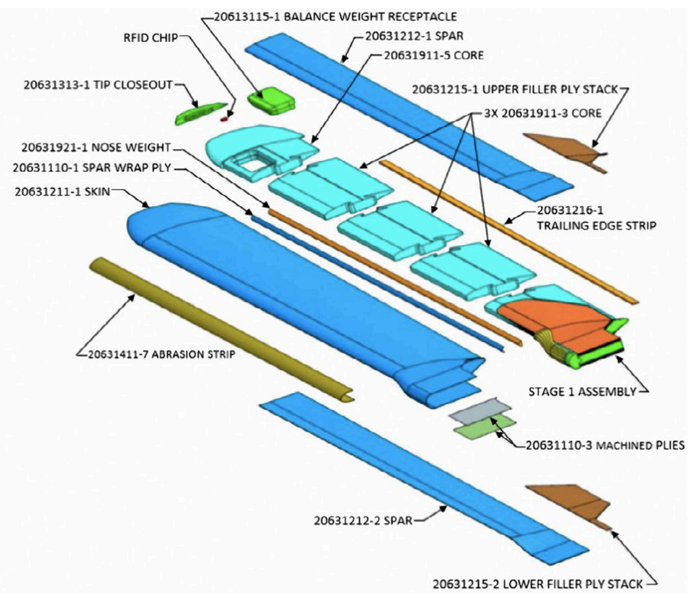
tectable damage growth within a specified replacement time."

However, Van Horn's quality assurance process has no established inspection for internal defects following production, or criteria for the permissible size of internal defects. Therefore, it is possible that an unknown intrinsic flaw could exist following production that might exceed a predefined damage limit and would affect the structural integrity of the helicopter blades. If helicopter main rotor blade manufacturing processes do not include internal inspections for defects or criteria for permissible defects, there is a risk that defects that affect structural integrity will not be identified.

Aircraft information

The occurrence helicopter was purchased from an operator in South America in 2016, and imported into Canada in 2017. Documents related to importation into Canada were completed in March 2019. The helicopter underwent extensive maintenance between 2017 and 2019, including the installation of a replacement turboshaft engine (Rolls-Royce M250-C20B) on 25 February 2019. This engine had previously been installed on a Hughes 369 helicopter and then on a Bell 206B3 helicopter before being purchased by E & B Helicopters Ltd.





Above: Overall view of both main rotor blades.

Left: Sub-assemblies of the Van Horn Aviation, LLC composite main rotor blade.

Opposite, right: Main rotor blade upper and lower skins sectioned by the TSB for examination.

As part of the process to obtain a Canadian certificate of airworthiness, a work order package was created to track all defects, maintenance required, and component parts removed or installed on the helicopter. This package also included scheduled and unscheduled inspections as required by both the airframe and engine manufacturers. A maintenance entry dated 25 February 2019 indicated that all airworthiness directives applicable to the occurrence helicopter were complied with up to 18 February 2019.

By late March 2019, the occurrence helicopter began to be flown regularly and, according to the aircraft journey log, had accumulated approximately 140 flight hours before the accident. However, a review of flight tracking data following the accident revealed that several flights had not been logged in the aircraft journey log, so the exact time in service can only be estimated. From the time the engine was installed until the accident flight, there were no defects or maintenance activities related to engine power issues recorded in the aircraft journey log.

Previous power reduction event

On 18 September 2019, during a flight conducted by the occurrence pilot, the occurrence helicopter experienced a reduction (droop) in main rotor rpm (about 20%). The pilot took immediate action by lowering the collective and "beeping-up" the droop compensator.

This defect rendered the helicopter unserviceable and was reported to E & B Helicopters Ltd. maintenance staff; however, contrary to the company operations manual, the maintenance control manual, and the CARs, it had not been recorded by the pilot in the aircraft journey log.

Company maintenance checked all fuel and air lines to and from the fuel system components and then performed an engine ground run and leak check. No defects were found. This maintenance activity was also not recorded in the aircraft journey log, under the direction of the pilot and contrary to the CARs.

Following this maintenance activity, a 12-minute test flight was conducted, and no loss of power or main rotor rpm droop was experienced. This test flight was not recorded in the aircraft journey log, nor were any defects deferred, once again under the direction of the pilot and contrary to the CARs.

Following the main rotor rpm droop incident, company

A-Lower skin	Solid black arrows - symmetrical fracture arrest lines or tidal marks
B-Upper skin	Dashed black arrows - direction of failure at station 60
C-Upper spar	White rectangle - area of discoloration on trailing edge strip
D-Lower spar	
E-Upper filler ply stack	
F-Trailing edge strip	

maintenance contacted the helicopter manufacturer and it was determined that the fuel accumulator/double check valve configuration was not correct for the helicopter. The proper parts were ordered to correct the configuration, and shipping records showed that the parts had been delivered on the day of the accident. However, they had not been installed at the time of the occurrence.

The pilot was aware of the situation, and other company pilots had been verbally cautioned by the chief pilot about an unresolved issue with the fuel system components; they were told not to fly the occurrence helicopter because it was still unserviceable.

The helicopter was equipped with Van Horn Aviation, LLC (Van Horn) composite main rotor and tail rotor blades. The main rotor blades were installed per Supplemental Type Certificate (STC) SH16-46 issued by TC on the basis of approval by the U.S. Federal Aviation Administration (FAA). The blades were manufactured in March 2017 and were purchased and installed new on the helicopter in January 2019.

The Van Horn composite main rotor blade is dimensionally (span and chord) the same as the Bell aluminum blade. The blades are of a monocoque construction with carbon/epoxy skin material without a traditional D-spar. The D-spar is replaced by various layers of carbon/epoxy material (laminate stacks) on the upper and lower skins (Figure 3). Flight characteristics of the blades are similar enough that no changes to the performance section of the Bell 206B rotorcraft flight manual were required.

In the summer of 2020, a newer version of the main rotor blade was approved by the FAA and replaced the original part number. The main difference between the 2 versions is that the newer blade has a different carbon fibre ply count and orientation. According to Van Horn, the "[p]ly adjustment along with changes to the mass distribution provides a softer ride […]."

In total, 152 blades (or 76 sets) of the original main rotor blade had been sold before the newer main rotor blades were approved. The last original blades were manufactured in April 2018. It is not known how many original blade sets are in operation in Canada; however, it is estimated that there are 6. The Van Horn composite tail rotor blades were installed on the helicopter per TC's STC SH10-22 in 2011.

Examination of the engine and engine systems

The engine was sent to an approved maintenance and overhaul facility in Vancouver, BC, to be examined in detail because damage signatures indicative of slow rotation at impact had been seen during the TSB's initial examination of the engine. Teardown examination of the engine with the assistance of the manufacturer's representative, and with the TSB in attendance, confirmed that the engine's rotational speed had substantially decelerated when the helicopter impacted the ground. Aluminum shavings from crushing rotational contact between the compressor impeller and diffuser scroll had been blown back to the turbine section, but were not melted as they normally would be by the high operating temperatures found in the combustor section. This is consistent with an engine that has flamed out.

The fuel components from the engine and airframe were sent to a maintenance facility in Winnipeg, Manitoba, for bench testing and follow-up disassembly and examination. A TSB investigator was in attendance. Even though the fuel control unit, governor, fuel pump, engine compressor discharge air pressure filters, and fuel check valves were damaged in the impact and post-impact fire, their condition was acceptable to be tested. These components performed satisfactorily on test bench and were subsequently disassembled. The only discrepancy noted was that the configuration of the accumulators and check valve components of the Bendix fuel control system was not appropriate for installation on a Bell 206 series helicopter.

Visual examination

Staff at the TSB Engineering Laboratory in Ottawa, Ontario, conducted an examination of the main rotor blades with the manufacturer present. The examination identified that the damage to both blades featured characteristics of different failure mechanisms, namely fibre breakage, ply separation, delamination, and debonding.

Findings as to causes and contributing factors

An engine power anomaly likely occurred while the helicopter was in cruise flight and, as a result, the pilot reversed course and entered a descent consistent with an autorotation.

At some point during the flight, the main rotors became deformed. Although indications of fatigue were present post-occurrence, the extent to which this fatigue contributed to the deformation could not be determined. In the last moments of the flight, likely as a result of the deformed blades, the main rotor rpm decreased to a point that could not sustain autorotational flight, and the helicopter fell vertically and impacted the ground. ■

(These were excerpts from the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 23 November 2022. It was officially released on 08 December 2022.)

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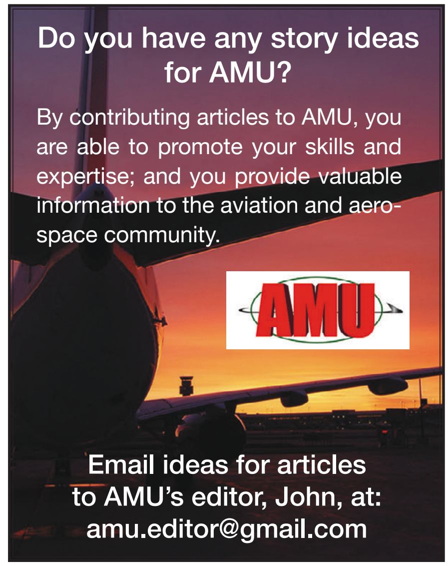

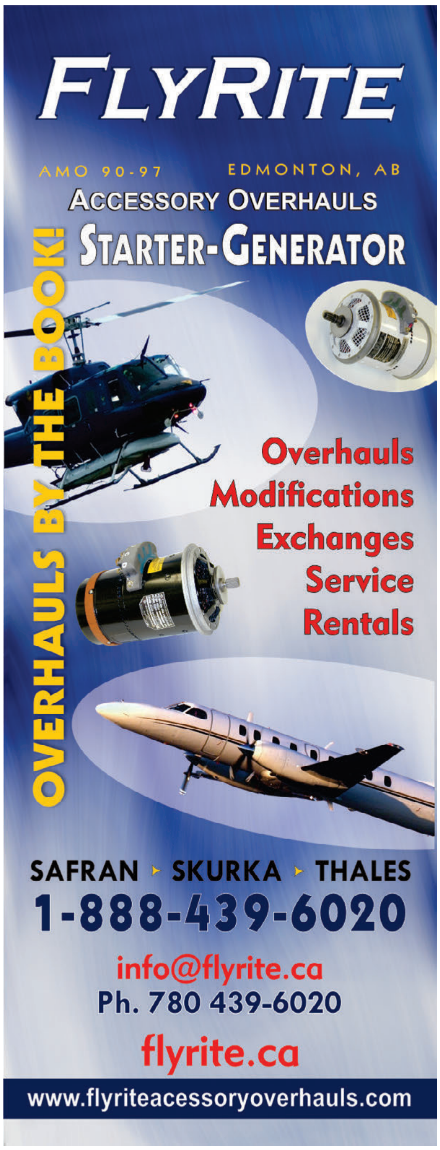

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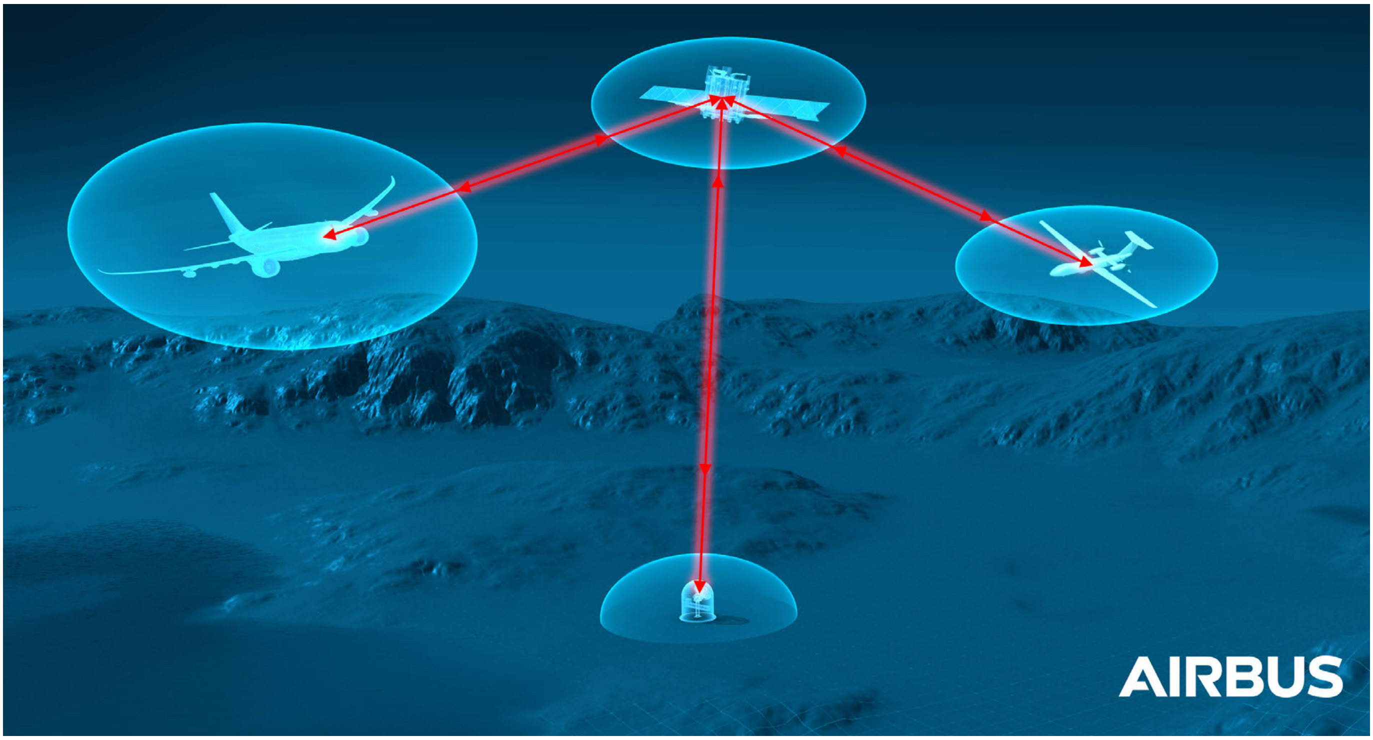
Bursting open the Bandwidth Bottleneck

Have Airbus and friends found the solution for data traffic in the quantum age?



AIRBUS AND VDL GROUP have signed a partnership agreement for the development and manufacturing of a laser communication terminal for aircraft, known as UltraAir. Based on the development led by Airbus and the Netherlands Organisation for Applied Scientific Research (TNO), the two companies will now prepare a demonstration of a prototype and a first flight test in 2024.

As of 2024, Airbus and VDL Group – a Dutch high-tech industrial supplier – will further industrialize the prototype in order to make it ready for integration with a hosting aircraft. VDL brings design for production to the partnership and will manufacture critical systems. A flight test of this industrialized prototype is planned in 2025 on an aircraft.

UltraAir will enable the exchange of large amounts of data using laser beams in a network of ground stations and satellites in geostationary orbit at 36,000 kilometres above the Earth. With technology including a highly stable and precise optical mechatronic system, this laser terminal will pave the way for data transmission rates that could reach several gigabits-per-second while providing anti-jamming and low probability of interception.

In this way, UltraAir will allow military aircraft and UAVs (Unmanned Aerial Vehicles) to connect within a multidomain combat cloud thanks to laser-based satellite constellations such as Airbus' SpaceDataHighway. This is a key milestone in the roadmap of Airbus' overall strategy to drive laser communications further, which will bring forward the benefits of this technology as a key differentiator for providing multi-domain combat collaboration for government and defence customers. In the longer term, UltraAir could also be implemented on commercial aircraft to allow airline passengers to establish high-speed data connections.

Regarded as the solution for data traffic in the quantum age, laser communication technologies are the next revolution in satellite communications (satcom). As satellite bandwidth demand is growing, the traditional satcom radio-frequency bands are experiencing bottlenecks. Laser communication brings 1,000 times more data, 10 times faster than the current network. Laser links also have the benefit of avoiding interference and detection, as compared to already-crowded radio frequencies they are extremely difficult to intercept due to a much narrower beam. Thus, laser terminals can be lighter, consume less power and offer even better security than radio.

Co-financed by Airbus and VDL Group, the UltraAir project is also supported by the ESA ScyLight (Secure and Laser Communication Technology) programme and by the "NxtGen Hightech" programme, as part of the Dutch Growth Fund, led by TNO and a large group of Dutch companies. ■

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