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Publication Mail Agreement No. 0041039024
and Return Undeliverable Canadian Addresses to
Alpha Publishing Group (2004) Inc.
Unit 7, 11771 Horseshoe Way, Richmond, BC, V7A 4V4
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April - May 2022
Volume 20/Issue 6

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Ukraine crisis will spark shortages

THE NUMEROUS WAYS the escalating hostilities between Russia and Ukraine have already impacted the global business aviation community, and likely ramifications as the crisis evolves in the weeks and months ahead, were the subject of a timely National Business Aviation Association News Hour webinar held March 4. The webinar, moderated by NBAA President and CEO Ed Bolen, was sponsored by UAS International Trip Support.

John Tuten, chief pilot for Honeywell and chair of the NBAA International Operations Committee, noted the early-March closure of Russian airspace had impacted roughly half of all routes between the U.S. to India and the Asia-Pacific. "In some instances it's adding five hours of flight time" to divert around the closures, he said.

Given the level of international sanctions against Russia, Ron Epstein, senior equity analyst for Bank of America, said he expected supply chain shortages, particularly as Russia is among the largest global suppliers of titanium and other materials used in aircraft production. "If you're doing business with these folks, you have to be really careful given how the sanction environment is changing, quite literally, almost by the hour," he said.

International sanctions against Russia also will affect aircraft transactions. "If you buy an aircraft that was owned by a blocked entity, the government's going to seize it and start a forfeiture procedure," cautioned Jonathan Epstein, partner at Holland & Knight LLP. "You better have documented that you did [your due] diligence and were a buyer in good faith." ■

(With NBAA files)

— John Campbell, Editor

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AirMaintenance Update
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publisher: Bill Carter
sales manager: Bill Carter
Advertising inquiries: (604) 214-9824

production manager: Chrissie Harvey
circulation: Anne Gervin
cover photo: Bounder32h - Dreamstime.com

Published by Alpha Publishing Group (2004) Inc.

Publication Mail Agreement Number 0041039024 and Return Undeliverable Canadian Addresses to:
Alpha Publishing Group (2004) Inc.
Unit 7, 11771 Horseshoe Way
Richmond BC V7A 4V4 Canada

Subscription Rates: 1 Year: $40 2 Years: $60
AirMaintenance Update is published 6X annually.

Corporate Member of:

HAC Helicopter Association International NBAA

Publications Mail Registration No. 0007198278 **ISSN 1703-2318**

Upcoming Events

COPA NATIONAL FLY-IN AND AVIATION EXHIBITION

Discover the charm of the Saint-Jean-sur-Richelieu, Quebec region while participating in a variety of open-air activities at the 2022 COPA National Fly-In and Aviation Exhibition. The meeting point is conveniently located just an hour's drive from the Ottawa and Montreal airports. Visitors will have the opportunity to discover exciting exhibitions, socialize, eat, learn in a variety of workshops and attend the gala dinner at the end of the weekend! With over 500 delegates on site, sponsorship is a great way to get your brand name in front of your target audience. The event is scheduled to run June 23-25, 2022.

CANADIAN COUNCIL FOR SUSTAINABLE AVIATION FUELS LAUNCHED

Canadian aviation industry leaders are joining forces to create the Canadian Council for Sustainable Aviation Fuels, whose mission is to accelerate the deployment of sustainable aviation fuels in Canada to ensure that the Canadian aviation sector remains competitive as it transitions to a net-zero future.

Sustainable aviation fuels can reduce greenhouse gas emissions by up to 80 percent and can be used now without significant modifications to aircraft or supply infrastructure. Their use will allow for rapid results in achieving carbon neutrality in the sector.

Created by a consortium of 60 airlines operating in Canada and comprised of key stakeholders in the Canadian aviation ecosystem including suppliers, aerospace manufacturers, airports, finance, and academia, the Council will aim to facilitate the production and supply of affordable, low-carbon, made-in-Canada SAF. The C-SAF will also act as the voice of its members with governments and stakeholders to develop an ambitious strategy and roadmap for a profitable and sustainable SAF market in Canada.

"Decarbonizing Canadian aviation requires collaboration between industry, governments, scientists and airlines. The C-SAF provides a space for a common dialogue to facilitate the exchange of ideas to reduce GHG emissions from aviation and we strongly believe that with everyone working together, change can happen faster," said Geoff Tauvette, Executive Director of the C-SAF. ✪

COMING EVENTS

Aéro Montréal
International Aerospace Week
April 4-7, 2022
Montreal, Quebec
www.aeromontreal.ca

Atlantic Region Aircraft
Maintenance Conference
April 20-22, 2022
Halifax, Nova Scotia
www.atlanticame.com

Alberta Aviation Council Conference
April 22-24
Calgary, Alberta
Aac2022conference.eventbrite.ca

MRO Americas
April 26-28, 2022
Dallas, Texas
www.mroamericas.aviationweek.com

Space Coast International Air Show
May 21-22, 2022
Titusville, Florida
www.valiantaircommand.com

World War II Weekend:
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June 3-5, 2022
Reading, Pennsylvania
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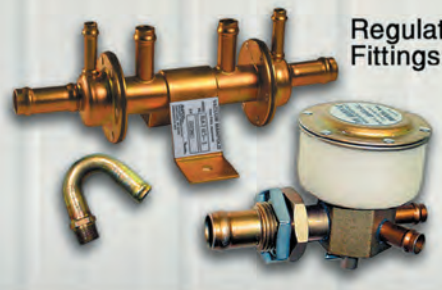

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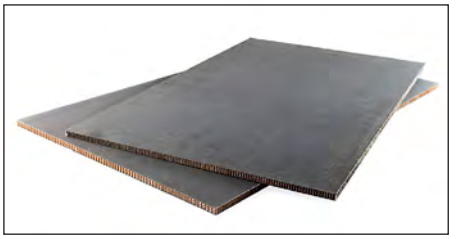
Inlet filter improves cleaning

Precision aerospace manufacturing company **Aerometals** has announced Federal Aviation Administration concurrence for a new flat filter inlet barrier filter design for the AS350 and H130 airframe series with both single and dual hydraulic configuration. The new design will be offered as a new filter assembly as well as an upgrade to existing filter assemblies. Benefits of the new flat design include an increased service interval from 100 to 150 hours, improved cleaning and oiling, a two-pound reduction in weight along with simplified pre-flight and inclement weather inspection. **www.aerometals.aero**

T-RX tester receives CE certification

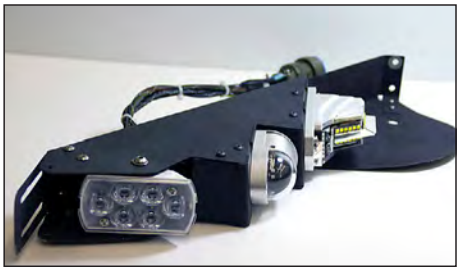
Ottawa-based **CCX Technologies'** T-RX Avionics radio tester is now compliant with European regulations and can display the CE Mark. The T-RX evaluates most avionics radio systems with more than 100 different tests. Easy to use, rugged and portable, it replaces the functionality of outdated avionics testers with a single compact unit. Even as new standards and test requirements emerge, upgrading the T-RX's capabilities is done via mobile phone or tablet software upgrades. The T-RX allows maintainers to print and include test reports into their customer work orders. **www.ccxtechnologies.com**

Floor panels can be cut on-site



SATAIR has launched its first Airbus semi-finished floor panel solution that can be cut on-site leading to a reduction of downtime during repairs and fits application across all passenger, aisle and galley areas. The Airbus semi-finished floor panels are said to be more robust without the compromise of additional weight and can be installed across the majority of Airbus aircraft platforms including A320, A330, A340, A350, and A380. The solution can be installed in line with the Airbus Structural Repair Manual and Aircraft Maintenance Manual. **www.satair.com**

LED assembly is five times brighter



KADEX's new LED wing tip light assembly designed for the Beechcraft King Air 350 aircraft is now STC-approved. The assembly is five times brighter than bulbs, with a 70 percent reduction in power consumption, and is a form, fit and function drop-in replacement that comes with a five-year warranty. Canadian-based aircraft parts distributor KADEX Aero Supply has chosen PWI in Wichita, Kansas to be a worldwide, in-stock distributor for this product. **www.kadexaero.com**

FAA-PMA approves oxygen mask kit

AMERON recently achieved FAA-PMA approval on its Eros mask overhaul kit, which is used for the overhaul of OEM Zodiac Aerospace's MF20 series full face quick donning masks. The M422B340 kit consists of 13 parts, which are eligible to be installed on Airbus A300, A310, A340, A380 and Boeing 727, 737, 747, 757, 767, DC-10, MD-10, MD-11 series of aircraft. **www.amerongloba.com**

Folding stair is easily deployed

Worldwide Aircraft Services has obtained FAA certification for the installation of a folding stair in the main entrance of the Embraer EMB 135/145 aircraft. The installation maintains the 'side hinged' jetway door and installs a folding stair and track system for stowage of the stair immediately aft of the existing jetway door. This modification eliminates the requirement for added ground support needed for passenger loading and unloading. The folding stair can be easily deployed internally or externally by the flight crew. **www.worldwide-aircraft.com**

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

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FAA APPROVES FASTFIN

Washington State based BLR Aerospace has received FAA approval of its H125 FastFin System incorporating the H125 Arriel 2D engine power upgrade certified by Airbus Helicopter in October 2021. The increase in directional control that BLR's FastFin System provides combined with the additional engine power now available is said to result in useful load increases up to 485 pounds, while the OGE hover ceiling at maximum take-off weight is higher by 2,750 feet (up to 13,900 feet vs 11,150 feet previously). EASA certification is in progress along with certifications with several other Civil Aviation Authorities around the world.

EMBRAER AIMS AT AIR FREIGHT MARKET

Embraer entered the air freight market in early March with the launch of the E190F and E195F Passenger to Freight Conversions (P2F). The E-Jets freighters are designed to meet the changing demands of e-commerce and modern trade that require fast deliveries and decentralized operations. The full freighter conversion is available for all pre-owned E190 and E195 aircraft, with entry into service expected in early 2024. The E-Jet Freighter will have over 50 percent more volume capacity, three times the range of large cargo turboprops, and up to 30 percent lower operating costs than narrowbodies.

COVID-RELATED RISE IN AIR ACCIDENTS

The Transportation Safety Board of Canada has released a summary of preliminary transportation occurrence statistics from 2021, which points to an increase in the number of accidents/incidents for the aviation sector over the previous year. TSB says this increase was likely influenced by the easing of COVID-19 restrictions for the transportation industry, which resulted in fewer pandemic related disruptions in service than in 2020. The number of aviation accidents (190) reported to the TSB in 2021 was 12 percent higher than in 2020 (170), but about 11 percent lower than the five-year average of 214.

DUTCH SEE POTENTIAL FOR E-AIRCRAFT

It is feasible to electrify small-scale aviation in the Netherlands on short distances. The first nine-passenger electric aircraft could be certified and available on the short-haul market by 2026, bringing more sustainable aviation an important step further. This is the outcome of a study by NACO/Royal Haskoning-DHV and Royal NLR commissioned by the country's Ministry of Infrastructure and Water Management. The study was recently presented to the House of Representatives and mentions several important challenges including developing batteries, certifying new aircraft and scaling up production to meet demand.

CANADA JETLINES ROLLS OUT FIRST AIRCRAFT

Canada Jetlines reported that its first aircraft, an Airbus 320, landed at the Kitchener/Waterloo airport on February 26. The aircraft was flown from Shannon, Ireland where it recently underwent

painting and interior refurbishing. The flight was operated by Captain Randy Howe (Canada Jetlines' Chief Pilot) and Captain Colin Forrest, both pilots having recently completed their Canada Jetlines' A320 pilot training and simulator check ride monitored by Transport Canada. "This is a very special day for Canada Jetlines," said Eddy Doyle, CEO of Canada Jetlines. "I am very proud of the hard work completed by the entire Canada Jetlines team which made this day possible.

PHENOM 300 IS BEST-SELLER AGAIN

Embraer notched a milestone in February as the Phenom 300 series became the world's best-selling light jet for the 10th consecutive year and the most delivered twinjet of 2021, according to numbers released by the General Aviation Manufacturers Association. Embraer delivered 56 Phenom 300 series light jets in 2021. The series has had the largest annual delivery rate with 50-plus jets being delivered on average since entering the market in December 2009. To date, the series has accrued more than 640 deliveries. The Phenom 300 series is in operation in 39 countries and has accumulated nearly one million, five hundred thousand flight hours.

LARGE FREIGHT DOOR IS WORLD FIRST

Following more than 36 months of planning, design, retrofitting and safety testing, Air Inuit's custom-modified Dash8-300 aircraft received its Supplemental Type Certificate from Transport Canada on February 3rd. The aircraft has been customized to feature a large freighter door. Equipping a Dash8-300 with a

custom-built large freighter door is a world first. A crucial part of Air Inuit's mission serving Northern Quebec is the delivery of essential goods and oversized materials. In the absence of road access, Air Inuit provides a vital link ensuring cargo ranging from food to indispensable tools such as ATV's and snowmobiles can be delivered reliably and affordably.

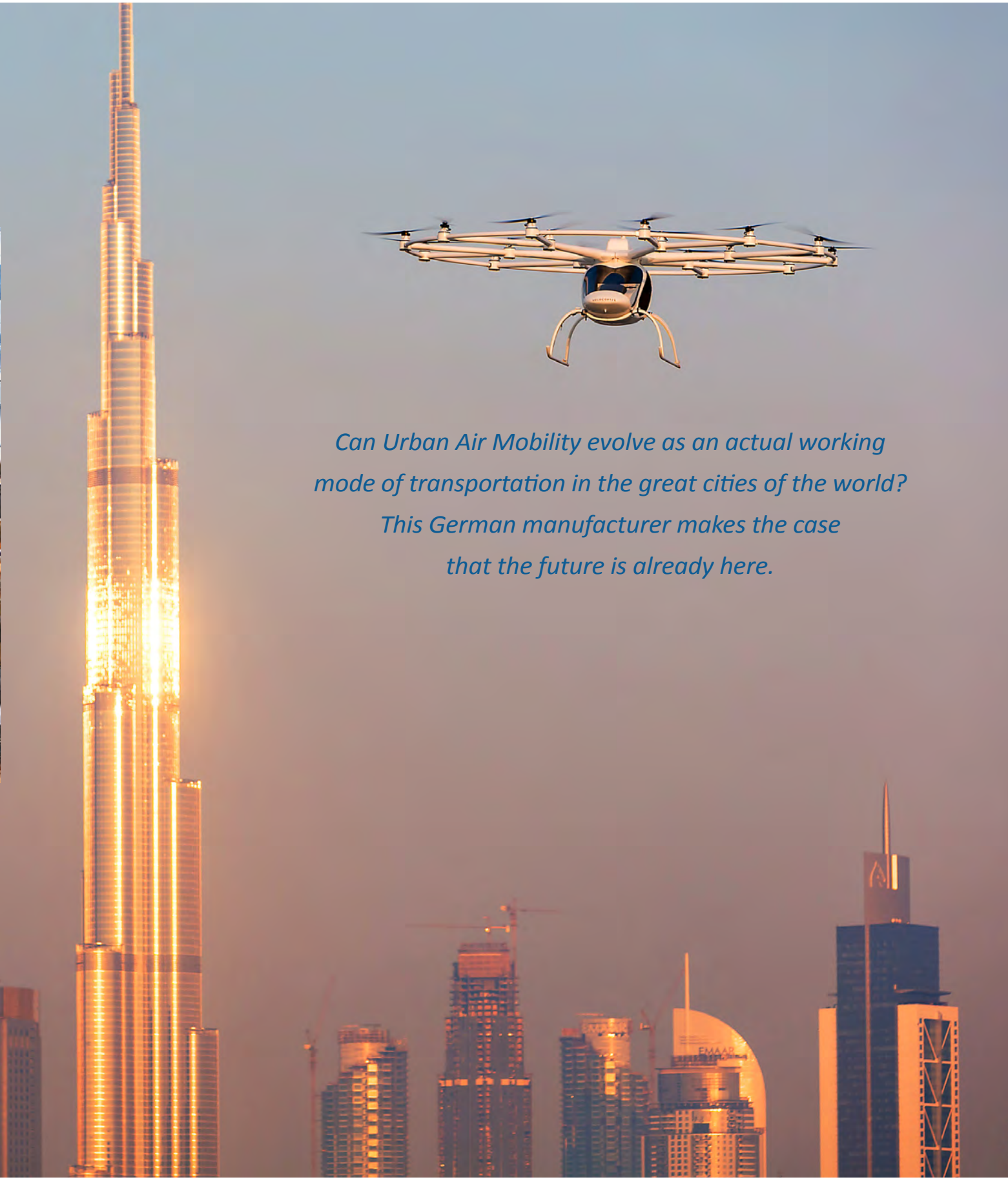
PARTNERSHIP WILL STUDY SOLUTIONS

Embraer, Widerøe and Rolls-Royce have announced plans to study a conceptual zero-emission regional aircraft. The 12-month cooperation study will address passenger requirements and seek to accelerate the knowledge of the technologies necessary for this transition. Such technologies will allow national governments to continue to support passenger mobility while reusing most of the existing infrastructure in a more sustainable way. Among other topics, the study will cover a wide range of applications for new propulsion technologies to examine a range of potential solutions – including all-electric, hydrogen fuel cell or hydrogen fueled gas turbine powered aircraft. ■

VTOL Revolution

Above: Atlantia, Aeroporti di Roma, and Volocopter announce partnership to bring electric air taxis to Italy. Right: VC200 flies over Dubai in 2017.

VOLOCOPTER IS A GERMAN company in the business of developing electric vertical takeoff and landing (VTOL) aircraft—a term that still rings with the implausibility of a Jetsonian future. Yet, Volocopter insists it will start a commercial air taxi business in the next two years despite the many regulatory hurdles in its path. The future-vision of this company—to establish an Urban Air Mobility (UAM) network—gained some urgency in March during an interview with the Korea Herald when Volocopter's head of Southeast Asia operations Hon Lung Chu declared, "At this point, it is no longer a question of if electric air taxi services will come to cities around the world, but when."



Can Urban Air Mobility evolve as an actual working mode of transportation in the great cities of the world? This German manufacturer makes the case that the future is already here.

UAM Flight Korea.

Volocopter prepares serial production of eVTOL aircraft with DG Flugzeugbau acquisition.

According to Chu, the 10-year-old company is on track to launch commercial services at the 2024 Paris Olympics and is committed to launching in Singapore in the next two years. Even so, Volocopter still requires certifications from the European Union Aviation Safety Agency and the Federal Aviation Administration. Much work remains to be done, but with a current market valuation of $1.7 billion, it seems the company has come far in its quest to standardize and gain industry acceptance of UAM as a legitimate alternative to traditional air travel.

Following are excerpts from Volcopter's white paper entitled Pioneering the Urban Air Taxi Revolution, in which the company addresses the manifold technical, regulatory, and social challenges it has faced in developing its aircraft.

THE CASE FOR URBAN AIR TRANSPORTATION

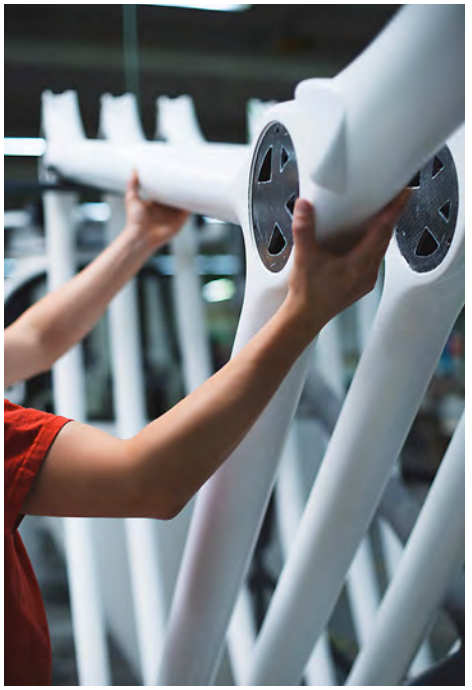
In developing the Volocopter we take safety into account for every aspect of the design. We believe that safety and simplicity are closely correlated. Thus, the simpler the architecture, the more likely that the aircraft will gain certification. Specifically, the Volocopter has 18 motors fitted with fixed-pitch rotors, which have only one degree of freedom: the rpm at which they operate. There are no tilting components in this highly-redundant propulsion system, which is extremely robust vis-à-vis individual motor failure. In other words, the Volocopter can safely end its mission even after multiple motor failures. This essentially enables the vehicle to meet the safety standards specified by EASA. Similar levels of redundancy are designed into the Volocopter flight control system and its onboard data networks. The Volocopter is one of the few eVTOLs actually designed to meet all the safety requirements for operating in urban air taxi missions.

Many different eVTOL architectures have been proposed. In our view, the more complex a system becomes, the more difficult and expensive it will be to show that the system will have the required low failure probability required for certification, i.e. a failure probability of one in a billion flight hours for critical systems functions. There are some interesting architectures with tilting wings, tilting rotors and variable pitch propellers. These can all be made to work and are as such amazing technologies. However, designing them in a way that demonstrates the required low failure probability is likely to be difficult.

As an example, imagine how difficult it would be to show continued safe flight operations if a tilt rotor were to become jammed halfway through a tilt. Even something as basic as a retractable landing gear or an electric wheel brake can be extremely hard to certify, because malfunction can typically lead to a loss of the aircraft.

The next key design driver for any urban air taxi is the noise signature. One of the reasons that helicopter flights over many cities are strictly limited today is because of the "noise pollution" that they cause. If air taxis are to be accepted by the people living and working in the cities they fly in, they will need to be designed and operated in a way that strictly limits the noise level audible on the ground. Plus, the generated noise should be subjectively non-disturbing. Certain frequencies are perceived as more disturbing than others, regardless of the actual decibel levels of the noise. Consider the high-pitch sound of a legacy helicopter tail rotor as an example.

In Uber's Elevate white paper, noise is identified as one of the major differentiators and vehicle design drivers. Further studies by Porsche Consulting, Roland Berger, and McKinsey support this analysis. Due to the laws of physics, air taxis with low disc loading and low rotor tip speed produce less



Volocopter showcases its VoloCity at the CoMotionLA event.

Volocopter secures position and certification to launch serial production of eVTOL aircraft.

noise than those with higher disc loading and faster rotor tip speeds. The rotor tip speed and number of rotor blades defines the frequency signature and in combination with the disc loading defines the overall noise level of the rotor.

In simplified terms, this means that an air taxi that has a small rotor surface relative to its weight is likely to be very loud. This is because the weight of the aircraft will need to be carried by accelerating air up to very high speeds using a very small rotor surface. On the other hand, an air taxi with a rather large rotor surface relative to its weight will have a better noise signature, as it can deliver the required lift by accelerating the air with less speed over a larger surface. In addition, keeping rotor tip speeds low is another key to improving the noise signature.

To visualize this relationship between disc loading, tip speed and noise, consider the following two applications for lifting the weight of one person. The slow-moving large rotors of the human powered multicopter can hardly be heard, while the "jet pack" solution with its small, fast-spinning rotors generates a lot of noise.

The above holds true in the critical vertical take-off and landing phase, where the distance to people on the ground is smallest. In cruise flight at sufficient speed, generating lift using wings may be an efficient way to reduce noise signature, although vertical noise emissions by conventional propellers may negate part of this advantage.

When looking at the urban air taxi mission, the most critical phases in terms of noise emission are take-off and landing. It is in these phases that the aircraft has the greatest impact on the surrounding area and people. Aircraft like the Volocopter with a large rotor area and low disc loading will be more likely to comply with strict noise regulations and be granted access to densely populated areas. It is important to note that a large rotor disc area can be achieved by using a few large rotors or numerous smaller rotors.

Slower tip speeds can be achieved by using a large number of small rotors, which in turn reduces noise coming from the rotor tips. In addition, a large number of smaller rotors is perceived to be quieter than one larger rotor. This is because various weak noise sources spread noise over a broad frequency spectrum, which is less disturbing to the human ear than one prominent noise source.

RANGE AND SPEED

One of the most hotly-debated questions about urban air taxis focuses on the required range of an eVTOL for the urban air taxi mission. Compared to conventional aircraft, urban air taxis fly very short distances and thus only require a limited range to offer useful capabilities. Uber's Elevate paper suggests that urban air taxis will mainly be useful to so-called "mega commuters," people who commute more than 160 km per day, therefore making a minimum useful range for these commuters half of that distance (80 km). The paper also suggests that there would be no opportunity to re-charge the batteries between flights, which means that the air taxi would have to fly the return trip (160 km) without recharging. The authors assert that for shorter range commutes, the ground infrastructure requirements would be too cumbersome for practical purposes.

Volocopter takes a different view. The Elevate paper focuses on a very specific use case (mega commuters) in a limited number of geographic areas. However, there are a multitude of urban air taxi use cases that exist globally. In our view, many timesaving routes can be operated efficiently and economically with limited infrastructure at a much shorter range. Examples include connecting key geographic locations, like

Volocopter's Volocopter 2X at EAA AirVenture Oshkosh in 2021.

airports, shopping malls, business districts, train stations and hotels. Consequently, urban air taxis can be used for purposes other than the daily commute use case, e. g. to shuttle passengers between a business district and an airport, or between a shopping mall and a major hotel, etc. In fact, studies suggest that the inner-city air taxi mission represents the highest demand and thus business potential.

Volocopter's in-house analysis found that most megacities have an urban area spanning less than 30 km around the geographic centre, while most of the major airports serving these cities are within 30 km of the city centre. More specifically, 70 percent of the analyzed megacities have a major airport within 20 km of the city centre (e. g. Melbourne or Mumbai), while 93 percent have a major airport within 30 km of the city centre (e. g. Houston or Guangzhou).

Looking at a practical example, we could imagine implementing an airport shuttle between John F. Kennedy International Airport (JFK) and Midtown Manhattan, which is a notoriously cumbersome route to travel by road or by rail. The distance through the air is less than 30 km and can be covered by an air taxi in 20–25 minutes, whereas according to cellphone data 90 percent of ground trips take longer than 60 minutes and roughly 50 percent of trips take longer than 90 minutes. This represents a huge potential for time saving! In addition, this trip could already be implemented under current regulations utilizing existing helicopter routes.

From the above analysis, we at Volocopter have determined the range requirement for our Volocopter air taxi to be somewhere between 30 and 35 km. This will enable the Volocopter to offer inner-city taxi and airport shuttle services in more than 90 percent of megacities.

The corollary consideration to range is time saving. Ultimately, in order to serve as a viable mass-market transportation solution, air taxis must save customers time compared to a road trip. In short, speed is important. Even without traffic jams, it is rare to travel within megacities at an average speed of more than 50 km/h. It is even rarer to find a direct straight-line connection between two major locations inside such a city. This means that using ground transport, a 30 km trip will take from 35 minutes to more than 120 minutes if there are traffic jams or no efficient routing.

With a Volocopter traveling at an average speed of 80 to 100 km/h, a 35 km trip would take 18 to 22 minutes. This represents a time saving of at least 50 percent! Faster speeds may further reduce travel times. However, when air taxis are operating at low altitudes over densely populated areas there will be limitations on the speed for the following reasons:

- Noise: Faster aircraft will generate more noise.
- Collision-avoidance: It is reasonable to assume that other aircraft and drones will be operating in the same airspace (e. g. camera drones, parcel delivery drones, helicopters providing emergency medical services, etc.). It is paramount to ensure these aircraft share the airspace safely. Detecting and avoiding other aircraft will be more difficult with increasing speed. This is because the required detection range increases linearly with higher speed (e. g. imagine spotting a parcel drone that is only one km away).
- Bird strike damage: Flying birds are an important consideration in low- altitude airspace. Lower speeds will be necessary to enable timely detection and avoid collisions. In addition, potential damage caused by birds striking an aircraft increases quadratically with the aircraft speed. Hence, limiting speed will be one way of avoiding "armouring" air taxis (which comes at a high weight expense).

COST OF ENERGY

The most obvious cost component of an electrically powered air taxi is the cost of electrical energy consumed to carry out the flight. While the actual cost of electrical energy may vary from one geographic region to another, it is safe to say that a more energy-efficient design will lead to lower operating costs. If we take the need for vertical take-off and landing as a prerequisite, a large part of the energy will be consumed during these energy-intensive phases in which the air taxi needs to hover and maneuver at low air speed. During this phase, all lift needs to be generated by the propulsion system.

Volocopter Aircraft Flying in Bruchsal, Germany.

These flight phases will be especially challenging for air taxis that are optimized for larger passenger capacity and range. A larger number of passengers will contribute to a higher take-off weight, while the bigger battery for longer range will also add considerable weight. The high weight will require a large amount of thrust, and power, to maintain flight. Unfortunately, the level of required power in vertical take-off increases more than linearly with the take-off weight (momentum theory), while a smaller rotor area also leads to a significant increase in power requirements.

The following example illustrates how significant this is. A typical transformative eVTOL design may have a power requirement ranging from 500 to 1,000 kW for take-off and landing. If we assume just three minutes for take-off and landing per flight, this results in energy consumption of 25 to 50 kWh – just for take-off and landing! This is equivalent to the full battery charge of an electric car (e. g. Tesla Model 3 SR with 50 kWh battery) consumed in just three minutes.

Most available battery technologies cannot reliably deliver this level of power within the weight and size limits of the aircraft design (i.e. it would require a very large, heavy battery). To illustrate once more, the 50 kWh required for an eVTOL would require more than 200 kg of battery chemistry. This does not include the cruise phase of the flight nor does it take into account the package weight of the battery (assuming an optimistic 250 Wh/kg on cell-level).

The Volocopter, on the other hand, can complete a full 30 km urban air taxi mission including take-off, landing and cruise phase with a similar amount of energy thanks to its very high energy efficiency in the low-speed phases of flight. As a result, the energy and battery contribution to the overall operating costs will be relatively low for the Volocopter. The conclusion that multicopter concepts are preferable for short- to mid-range missions is generally supported by the NASA study "Observation from Exploration of VTOL Urban Air Mobility Designs" published by Wayne Johnson and Christopher Silva.

CONCLUSION

Urban air taxis need to meet clearly delineated design and certification requirements to be effectively used for their intended purpose. The Volocopter is specifically designed for urban air taxi missions and offers a great combination of characteristics needed to fulfill all key air taxi requirements, in our humble opinion.

The Volocopter is designed to comply with the specific airworthiness requirements for intra-city commercial air transport and serves as an industry bench- mark for low noise emissions. Hence, it may go where other, more noisy aircraft, cannot go. With a range of more than 30 km, it can service the all-important airport route in 93 percent of the world's largest cities. A cruise speed of 80–100 km/h enables the Volocopter to offer significant time savings compared to ground transport, without the practical drawbacks of higher-speed aircraft. With its two-seat configuration, the Volocopter will be able to service the vast majority of urban air taxi missions.

The Volocopter design allows for comfortable, safe embarking and disembarking along with a comfortable environment for passengers. Its design simplicity and efficient use of batteries enable the Volocopter to be operated at a low operating cost. This allows the air taxi service to be deployed at scale within competitive price levels. The Volocopter is thus destined to pioneer the emerging Urban Air Mobility revolution, offering an additional mode of transport to people in cities around the world. ■

(From Volcopter's white paper, "Pioneering the Urban Air Taxi Revolution")

World Air Cargo FORECAST: 2020-2039

Boeing recently published its biennial forecast for the air cargo business in which the company concludes there are multiple factors now in play that will greatly expand the world's freighter airplane fleet. These are excerpts from the Boeing report.

AS THE NEW decade began, the air cargo market was poised to benefit from improvement in the world economy. This followed a weak 2019, in which the effects of tariffs, tepid world economic growth and weakened industrial production resulted in air cargo traffic decreasing by three percent. As COVID-19 quickly spread to all corners of the world, the impact from the loss of long-haul passenger belly capacity from widebody fleets created a significant air cargo capacity shortfall. Passenger belly cargo capacity typically accounts for 54 percent of the world air cargo capacity. Freighter operators have responded by operating above normal utilization levels to fill the lower cargo hold shortfall.

In addition, the urgent need to meet demands for transporting medical supplies to all regions in response to COVID-19 created a unique and unprecedented environment. The decline in air cargo capacity plus urgent demand for medical supplies led to a spike in yields to high double digit levels in second quarter 2020. With these market conditions, freighter operators have been in a unique position to meet market demands that require a high level of speed, reliability and security, as only air cargo can do.

With high air cargo yields and greatly reduced long-haul international networks, conditions have been favourable for many airlines to use some of their passenger widebody fleets

Increasingly, passenger jets are being pressed into dedicated freight carrying roles.

2020 saw the rise of operators packing cargo into the cabins of passenger aircraft amid the downturn in passenger activity. COVID and the rise of e-commerce are factors in the growth of the preighter trend.

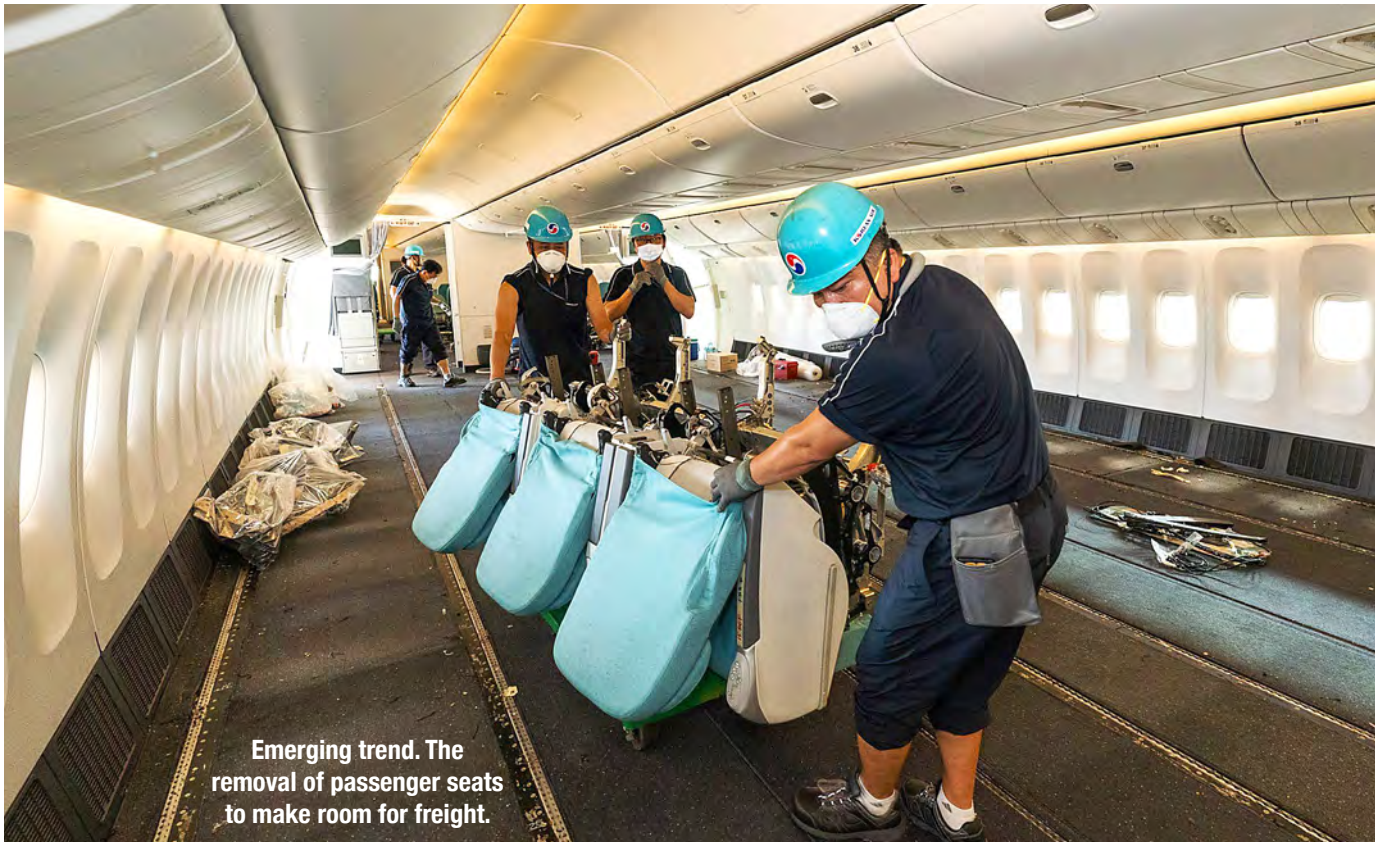
for cargo-only operations to generate much-needed cash flow. These "preighters" have taken up some of the capacity shortfall and, even in some cases, have generated quarterly profits for carriers despite minimal passenger operations. As of the end of September 2020, nearly 200 airlines had operated 2,500 passenger airplanes exclusively for cargo operations.

Through September 2020, air cargo traffic was down 12 percent, rivalling declines in past recessions. In a normal year, this would translate to poor financial performance for air cargo operators. However, in 2020 almost a quarter of air cargo capacity had been lost. As a result of the constrained air cargo capacity, yields were up over 40 percent and overall air cargo industry revenues were up 16 percent.

The 2020-2039 World Air Cargo Forecast incorporates the near-term disruption to air cargo markets but does not assume the current dynamics of constrained widebody passenger belly capacity will continue into the long term. Long-haul widebody passenger traffic will return in the coming years, and air cargo will then reflect market dynamics much closer to what we have seen in the years prior to the COVID-19 disruption.

In contrast to disrupted passenger markets, the higher-than-market average growth seen in express markets over the last decade has increased during the COVID-19 pandemic. E-commerce, which was already growing at double-digit rates prior to the pandemic, has accelerated its impact on the air cargo market. Express carriers have fared well as a result of the market turmoil in 2020. Through the end of September 2020, they had increased their traffic by 14 percent. All-cargo carriers, at six percent, are the only other air cargo business model to show growth. This forecast incorporates this continued structural growth and surge in demand that we have observed because of COVID-19.

Another consideration of structural shifts affecting air cargo growth, and a topic of intense debate in recent years, is the trajectory of globalization on global supply chains. Geopolitical tensions and trade disputes have percolated and increased in many major economies around the world. Air cargo is highly sensitive to global industrial production output and worldwide manufacturing supply chains. However, even prior to the COVID-19 pandemic, some shifting of supply chains was already occurring. China, the location of choice for many Western manufacturing companies during the past 20 years, had slowly lost its low-labour-cost advantage relative to other developing countries. As a consequence, some manufacturing has moved away from China to other Asia-Pacific countries in the past few years. However, the movement of supply chains, depending on the complexity of the product, can take years to implement.



Emerging trend. The removal of passenger seats to make room for freight.

The magnitude of air cargo imports from China to the United States, for example, is nine times that of the next Asia-Pacific country. This further highlights the current dominance of China as a manufacturing source and supplier. Early indications show trends toward diversification of supply chains, rather than onshoring, to lessen risk. Developments in other modes of freight transport may affect air cargo industry growth. The maritime industry, which transports almost 90 percent of world merchandise trade, has experienced significant market disruption over the past decade. Several years of overcapacity and weakening trade led to collapsing yields. Ultra-large container ships (those vessels with more than 15,000 20-foot equivalent units of capacity) introduced by the major shipping operators contributed to the overcapacity as trade slowed.

In the past five years, the industry has seen consolidation of players, reduced capacity growth and firming yields. While normally the maritime sector is not a competitor to air cargo, the changing nature of container shipping may benefit the air cargo sector. Container ship operator capacity discipline, plus manufacturers seeking to de-risk their supply base and disperse manufacturing sites into lower-cost Asia-Pacific regions, may lead to the increased use of air cargo.

IMPORTANCE OF MAIN DECK FREIGHTERS

In addition to the long-term trend of dedicated freighters carrying more than 50 percent of global air cargo traffic despite growing widebody passenger fleets, the COVID-19 pandemic has highlighted the importance of main deck freighters in our global air transportation system. While increasingly capable passenger widebody airplanes have helped the air cargo industry grow during the past decade, dedicated freighters are anticipated to continue to comprise at least 50 percent of the world air cargo traffic carried.

There are several key reasons for freighter preference in air cargo flows:

1) Most passenger belly capacity does not serve key cargo trade routes;
2) twin-aisle passenger schedules often do not meet shipper timing needs;
3) freight forwarders prefer palletized capacity, which is not available on singleaisle aircraft;
4) passenger bellies cannot serve hazardous materials and project cargo, a key sector in air cargo flows; and
5) payload-range considerations on passenger airplanes may limit cargo carriage, which decreases the likelihood that cargo will arrive at its destination on time.

WORLD AIR CARGO TRAFFIC GROWTH OUTLOOK

World air cargo traffic is forecast to grow at 4.0 percent per year over the next 20 years. In terms of revenue tonne-kilo-

Like many other air carriers, Lufthansa has been offering its customers transport options in so-called preighters - passenger aircraft used for transporting cargo only.

metre (RTK) growth, air freight, including express traffic, is projected to grow at 4.1 percent while airmail will grow at a slower pace, averaging 1.7 percent annual growth through 2039. Overall, world air cargo traffic will more than double over the next 20 years, expanding from 264 billion RTKs in 2019 to 578 billion RTKs in 2039.

The Asia-Pacific region will continue to lead the world in average annual air cargo growth, with domestic China and intra–East Asia and Oceania markets expanding 5.8 percent and 4.9 percent per year, respectively. Supported by faster-growing economies and growing middle classes, the East Asia–North America and Europe–East Asia markets will grow slightly faster than the world average growth rate. In the more established and mature trade flow between North America and Europe, growth will be below the world average growth rate.

FREIGHTERS AND PASSENGER LOWER-HOLD DYNAMICS

There are two options for air cargo transport — dedicated freighters and passenger aircraft lower holds (also referred to as passenger belly capacity) — and each offers unique advantages. Freighters are particularly well suited for transporting high value goods because they provide highly controlled transport, direct routing, reliability and unique capacity considerations (volume, weight, hazardous materials and dimensions).

These distinct advantages allow freighter operators to offer a higher value of service and generate nearly 90 percent of the total air cargo industry revenue. With the introduction of a new generation of widebody passenger airplanes with larger lower-hold capacity, more airlines are combining cargo transport with passenger operation to capitalize on additional revenue opportunities.

Belly cargo space offers unique value on noncargo routes by feeding dedicated freighter networks and providing new business opportunities for integrators. However, while lower-hold capacity in widebody airplanes serving longhaul missions has increased in recent years, several parameters can limit the cargo operations in passenger aircraft. The reduced height of the lower deck can limit volumes. Different security standards and regulations may restrict commodities that can be shipped in passenger airplane lower holds. From a network standpoint, freighter routes are highly concentrated on relatively few trade lanes, especially in the world's two largest trade routes, East Asia–North America and Europe–East Asia.

In contrast, passenger networks are much broader and often include destinations where cargo demand is minimal. This difference in passenger and cargo traffic distribution explains the considerable load factor difference in belly space and freighters, which average approximately 30 percent and 75 percent, respectively over the last decade. In addition, range restrictions on fully loaded passenger aircraft and limited passenger service to major cargo airports make freighter operations essential. For these structural reasons, freighters are forecast to carry more than half of the world's air cargo for the next 20 years.

The global travel downturn disrupted supply channels, putting a fresh focus on the role airlines play in flying cargo.

FREIGHTER FLEET FORECAST

The combination of 4.0 percent annual average RTK growth, in addition to the proven need for dedicated freighter capacity to support our global transportation system, results in the need for a 60 percent larger fleet during the next two decades. Over the next 20 years, the freighter fleet will grow more than 60 percent from 2,010 to 3,260 units. There are 2,430 freighters forecast to be delivered, with approximately half replacing retiring airplanes and the remainder expanding the fleet to meet projected traffic growth. More than 60 percent of deliveries will be freighter conversions, 72 percent of which will be standard-body passenger airplanes. Of the projected 930 new production freighters, just over 50 percent will be in the medium widebody freighter category.

CANADA DOMESTIC AIR CARGO MARKET

Canada saw record growth; 17 percent from 2018 through 2019. The Canada domestic market accounts for a small proportion of the total North America air cargo market, but traffic grew significantly in 2018 and 2019, at 23.7 percent and 10.8 percent, respectively. This growth was largely driven by e-commerce, with express operators comprising nearly 70 percent of the Canada domestic market and showing well over double-digit growth from 2018 through 2019 as they continued to build out their networks.

U.S.-Canada transborder air cargo grew above trend, from 324 million RTKs in 2017 to 349 million RTKs in 2019. Traffic in both directions grew in both 2018 and 2019 as economic growth in the United States in 2018 was the strongest it had

been in the last decade (2010–2019), and 2019 also experienced positive, albeit lower, economic growth.

NORTH AMERICA FORECAST

The U.S. domestic market will maintain the dominant share of the total North America market, with about 96 percent of total RTKs. The U.S. domestic market is projected to grow at an average annual rate of 3.9 percent during the first 10 years as e-commerce market share grows and providers continue to build networks and fleets, with growth levelling out in the second 10 years, for 20-year growth of 2.7 percent over the period from 2020 to 2039.

The Canada domestic market is similarly forecast to grow at a higher rate in the first 10 years because of e-commerce and then level out to a lower long-term growth rate for the second 10 years. The Canada domestic market will average 4.4 percent growth for the first 10 years and 2.9 percent over the 20-year period from 2020 to 2039. Transborder air cargo traffic is expected to grow at 1.1 percent over the 20-year period, which is slightly higher than its growth over the past 10 years (0.9 percent). This forecast is expected to be more in line with transborder traffic trends over the past 20 years. Northbound traffic is still expected to exceed southbound traffic. ■

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PACIFIC

Pacific AME Association

What is PAMEA?

The Pacific Aircraft Maintenance Engineers Association (PAMEA), is a non-profit association comprised of aircraft maintenance engineers and associated professionals and is an active member of the Aircraft Maintenance Engineers of Canada (AMEC).

The Pacific AME Association shall always promote and protect the professionalism of the AME, while developing, maintaining and improving our relations with regulatory bodies affecting our industry. We shall represent the views and objectives of our members while promoting proficiency through educational collaboration with other groups on matters of mutual interest. We shall promote honourable practices among our Members and others in the aviation industry, while remaining non-union, non-sectarian and non-partisan.

www.pamea.ca

WESTERN

Western AME Association

Website Now Under Maintenance

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

www.wamea.com

CENTRAL

Central AME Association

New Date: annual Aviation Symposium (postponed)
Although CAMEA was scheduled to host the 26th Annual Aviation Symposium on March 3-4, 2022 at Canad Inns Polo Park in Winnipeg, Manitoba, organizers unhappily announced that the event has been postponed until next year

CAMEA Rookie of the Year Awards
Previously known as the NAASCO Outstanding AME Award. This award recognizes any AME or manager holding an AME licenCE in Manitoba, Saskatchewan, and Northern Ontario that has performed an extraordinary act of service or has shown leadership, dedicated technical service and has been active in nurturing and training other mechanics.

Do you know someone that should be thanked? Do you know an Outstanding AME? Nominate someone today!

www.camea.ca

AME Association of Ontario

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tel: 1-905-673-5681 fax: 1-905-673-5681
email: association@ame-ont.com website: www.ame-ont.com

ONTARIO

Save the date: AME Conference

Our 2022 conference is to be held Wednesday and Thursday, November 2-3. Arrival and set up for vendors and booths will be Tuesday, November 1st. The plan this year will allow two full days of seminars, demonstrations and workshops. Last year we were limited in attendance, however, it is expected that this year there will be no imposed limitations and that we will have an extraordinary gathering with over five dozen exhibitors and two days filled with numerous sessions and educational seminars.

The very successful Skills Competition will also be returning for a full day of intense friendly rivalry thanks to the generous support of the aviation industry. This is a great example of how industry and the Association comes together to highlight the Skills that AMEs bring to the aviation world. We will again be using the Delta Toronto Airport Conference Centre on Dixon Road next to the Toronto Pearson Airport. More details will be available in the coming months.

AME Association AGM & Board News

The rules governing not-for-profit organizations in Canada require us to hold our Annual General Meeting (AGM) within six months of the end of our fiscal year. Since our financial year ends on March 31st, we have until the end of September to hold the AGM.

Unfortunately, with the Annual Conference planned for a later date, we cannot hold our AGM concurrently during the conference. The Board of Directors is therefore planning to hold a hybrid in-person and online meeting on Monday, September 12th. Details for the AGM will be announced before the summer.

Late last year Jim Fowler stepped down as one of our Directors at Large. Jim was one of our first members having joined us when the association started in 1982. He has served numerous times with the board and his advice and input was always appreciated.

At the February board meeting, Carolyne Mounsey was voted in as a Director at Large.

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

QUÉBEC

Welcome AME QC

We are really happy to appear for the first time in AMU magazine. We are the Aircraft Maintenance Engineers Association of Quebec, and we are proud to be able to serve and promote the community of Aircraft Maintenance Engineers in Quebec.

Having been incorporated relatively recently, we are part of the AMEC/TEAC and work with the various AME Associations across Canada on various files, some of which directly with Transport Canada.

The Quebec AME Association holds in high regard the safety of those persons affected by the Aviation Maintenance occupations, to promote safe practices in the workplace and to recognize that safety is the cornerstone of the aviation industry.

Being part of a regional AME Association brings certain advantages. In addition to access to attractive discounts for AMEs, you will receive several magazines dedicated to the world of aeronautics directly at home. It is also an excellent way for AME's to participate into this community.

We had to suspend our annual meetings due to Covid-19, but we are determined to be able to meet our members again this spring.

You can learn more about us at:
www.ame-tea.com
e-mail: info@ame-tea.com

Nous sommes vraiment heureux d'apparaître pour la première fois dans le magazine AMU. 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.

Ayant été constitués relativement récemment, nous faisons partie de l'AMEC/TEAC et 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 dû suspendre nos assemblées annuelles dû à la Covid-19, mais nous sommes résolument décidés à pouvoir rencontrer nos membres à nouveau dès ce printemps.

Vous pouvez en apprendre plus à notre sujet à l'adresse suivant :
www.ame-tea.com / e-mail: info@ame-tea.com

ATLANTIC

Atlantic AME Association

ARAMC 2022: Cleared for Takeoff!

Restrictions are slowly starting to ease! We are Cleared for Takeoff! Planning is well underway for our 42nd annual ARAMC 2022 conference. It will be held April 20-22, 2022 at the Westin Nova Scotian Hotel, in Halifax, Nova Scotia. We have a great list of topics that will be presented. The theme of the ARAMC 2022 conference is Cleared for Takeoff!

The hotel has reserved a block of rooms for the conference delegates at the special conference rate of $185 CDN per night plus taxes. This room block is available now, and we strongly urge you to make your reservations early to ensure that a room is available.

We are working on having the A.M.E. Association present a Human Factors (HF) session on Wednesday afternoon (Registration for this course will be via the website), followed by the Technical Program beginning on Thursday morning. It promises to be interesting and very informative for AMEs, apprentices, students, aircraft owners and operators. We are very excited this year to run concurrent sessions thorough most of the day on Thursday. The curriculum meets the Transport Canada Up-date training requirements as outlined in CAR 573.06.

ARAMC 2022 is a forum where aviation personnel and distributors interact and conduct business. We expect to have over 40 display booths. A displayer sponsored luncheon will be held Thursday, April 19th for all registered delegates. We will also be holding a Skills Competition. Again this year, we will be holding an Industry Social, in the Exhibit area on Thursday afternoon. All the details are not finalized yet, but watch our website for more details as it becomes available.

Thursday evening promises to be an exciting event. Our annual Awards Banquet will be held. This is our opportunity to honour those outstanding Aircraft Maintenance Engineers and their companies in the Atlantic Region for their contributions to their trade. The nomination forms will be available on our website. The entertainment for the evening promises to end the night with a laugh. Friday, April 20th, is another day for the Technical Program and displays.
Please reach out to us if you have any questions.

ARAMC 2022 Co-Chairs
Anneke Urquhart (anneke.urquhart@sobeys.com)
Neil Harding (neil.harding@impaerospace.com)
Hope to see you at ARAMC 2022.

CENTRAL OHIO

Central Ohio PAMA

FAA Awards $5 Million in Grants to Train Next-Gen Techs

The FAA awarded $5 million in grants to develop a diverse talent pool of aviation maintenance technicians. The Aviation Maintenance Technical Workers Workforce Development Grants were awarded to organizations that will teach technical skills and prepare participants to pursue aviation maintenance careers. "A career as an aviation maintenance technician opens a wide world of opportunity. These grants will allow us to reach and support individuals who may not have had the chance to pursue this exciting career before," said FAA Deputy Administrator A. Bradley Mims.

Grantees can use the funds to establish new educational programs; provide scholarships or apprenticeships for individuals pursuing employment in the aviation maintenance industry; conduct outreach about careers in the aviation maintenance industry to primary, secondary, and post-secondary school students; and support educational opportunities related to aviation maintenance in economically disadvantaged areas.
(Reprint from FAA Blast - Week of Jan 9 to 15 2022)

Support COPAMA Scholarship Fund through PayPal

Over the years, COPAMA has provided financial support to AMT Students by awarding Scholarship Funds to pay for the written, oral and practical tests required for their A&P certificates. They are tested twice during their two year training and the cost of those tests by PSI and individual Designated Mechanic Examiners (DME) now total $1,075.

COVID has had a great impact on the Aviation Maintenance Industry with the shutdown of air travel by the major airlines for a period of time, many taking early retirements and leaving the workforce. Now that they are returning to more normal operations, General Aviation techs are leaving to join the airline industry, leaving small aircraft owners searching for mechanics for their repairs and inspections.

We expect new students to seek training in aviation maintenance and fill those entry jobs in General Aviation. We think the requests for scholarship grants will also increase and are ready to provide monetary support to them.

At the end of 2021, the COPAMA Scholarship Fund has raised $187,084 and distributed $165,534 to support AMT students and our various youth groups engaged in aviation related studies. We currently have $21,550 committed but not redeemed due, in part by the COVID Pandemic. Note that once the scholarship award is granted, they have a set period of time to submit the test payment for reimbursement. We have extended that time due to delays due to COVID-19.

In December we awarded nine more candidates $1,000 grants which was the total cost at that time. Unfortunately PSI increased the cost of each written computer exam $25 in January.

We have a way to contribute to the Scholarship Fund directly using the PayPal donation button. Corporations who give a donation of $100 or more will be added to our Corporate Sponsor page with a link to their website. Many corporations help in other ways by funding our Maintenance Symposium and other events and we couldn't raise the funds for this worthwhile cause without them.

Come join us with your contributions to this worthy cause! The full amount of your donations may be tax deductible. Please consult your tax advisor when filling out your annual tax return.
www.copama.org

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Richmond BC V7A 4V4 Canada

777-8 Freighter:
Boeing's Big-Buck Deal

Boeing's 777-8F and 777-9F Freighters

A new air freighter and a multi-billion-dollar deal between two industry giants closed out the month of January.

BOEING unveiled its new 777-8 Freighter at the tail end of January and by doing so expanded its market-leading 777X and freighter families of jetliners with an order for up to 50 aircraft from one of the world's largest cargo carriers, Qatar Airways.

Qatar will be the 777-8 Freighter launch customer with a firm order for 34 jets and options for 16 more, a total purchase that would be worth more than $20 billion at current list prices and the largest freighter commitment in Boeing history by value. The order also supports hundreds of U.S. suppliers from across 38 states, will sustain more than 35,000

Two Boeing 777-Fs, and a 737 MAX-10 of QATAR Airlines.

U.S. jobs, and provide the American economy with an annual estimated economic impact of $2.6 billion during the contract's delivery period.

Featuring technology from the new 777X family and the performance of the 777 Freighter, Boeing says the 777-8 Freighter will be the largest, longest-range and most capable twin-engine freighter in the industry. With payload capacity nearly identical to the 747-400 Freighter and a 25 percent improvement in fuel efficiency, emissions and operating costs, the 777-8 Freighter will enable a more sustainable and profitable business for operators.

At the White House, Commerce Secretary Gina Raimondo, His Excellency Ambassador Sheikh Mishaal bin Hamad Al Thani, Director of the White House National Economic Council Brian Deese, and Boeing President and CEO Dave Calhoun joined the formal signing by Boeing Commercial Airplanes President and CEO Stan Deal and Qatar Airways Group Chief Executive, Akbar Al Baker, who reaffirmed the airline's commitment to the 777X family with the record-breaking 777-8 Freighter deal. First delivery of the new freighter is anticipated in 2027.

"Boeing has a long history of building market-leading freighter aircraft and Qatar Airways is honoured to have the opportunity to be the launch customer for the 777-8 Freighter, an aircraft which will not only allow us to further enhance our product offering for our customers, but also help us meet our objectives to deliver a sustainable future for our business," said Baker. "Today marks a great day in the ever-building and strong relationship between Qatar Airways and Boeing. We certainly push Boeing hard to deliver upon our expectations, and the team at Boeing consistently strives to meet and exceed our expectations, giving the opportunity for us to be here today to launch the most significant new freighter aircraft for a generation."

"We are delighted to launch Boeing's next great cargo airplane – the 777-8 Freighter – with Qatar Airways, one of the world's largest cargo carriers and our partner since the airline began operations 25 years ago," said Deal. "Our team is ready to create an airplane that will serve them well for many decades. Qatar Airways' selection of the efficient 777-8 Freighter is a testament to our commitment to provide

A Boeing 777-8F Freighter.

freighters with market-leading capacity, reliability and efficiency."

Deal added, "We are proud that Boeing provides over 90 percent of the world's dedicated freighter capacity. With global supply chains under pressure and high demand for e-commerce, the performance and capabilities of the fleet is more important than ever."

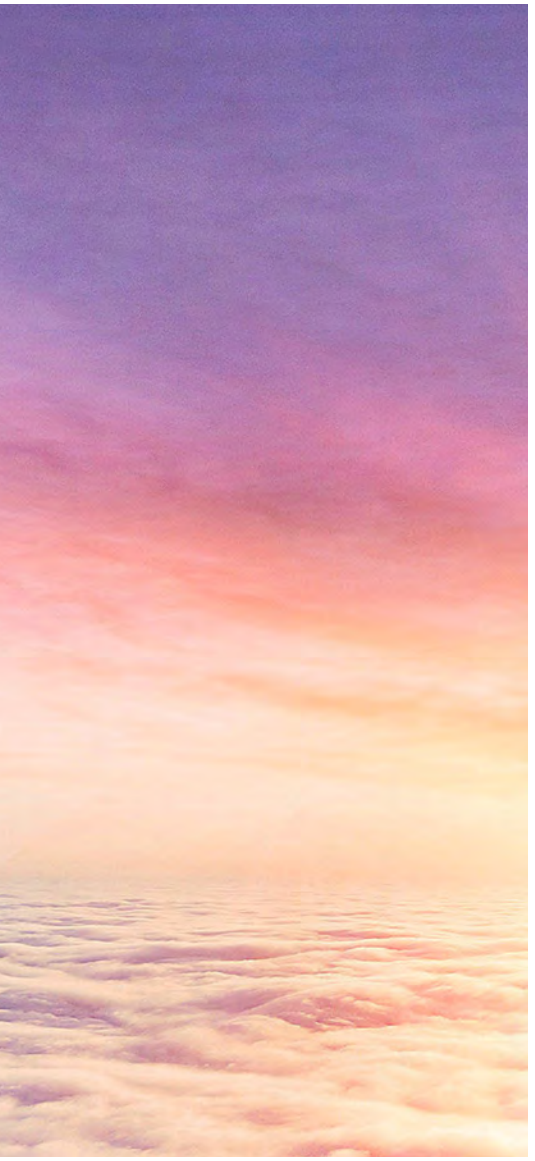
Boeing is designing the 777-8 Freighter, the newest member of the 777X family, to maximize efficiency and environmental performance. The widebody family features engineering design improvements and innovative technologies, including a new carbon-fibre composite wing and new fuel-efficient engines. With a range of 4,410 nautical miles (8,167 kilometres), the 777-8 Freighter has a maximum structural payload of 118 tonnes, allowing customers to make fewer stops and reduce landing fees on long-haul routes.

Boeing will build the 777-8 Freighter in its Everett, Washington, factory. The company has invested more than $1 billion into the Everett site to support 777X production and sustain thousands of local jobs for decades to come.

As part of the agreement, Qatar Airways will convert 20 of its 60 777X family orders to the 777-8 Freighter. Qatar Airways is also ordering two current 777 Freighters – Boeing's best-selling freighter of all time – in order to capitalize on the buoyant air cargo market. Customers from around the world have ordered more than 300 777 Freighters since the program began in 2005.

Boeing and Qatar Airways also signed a Memorandum of Understanding for a firm order of 25 737-10 aircraft and purchase rights for 25 additional airplanes. The total value of this 737-10 commitment is nearly $7 billion at current list prices. The largest model in the MAX family, the 737-10 seats up to 230 passengers in a single-class configuration and can fly up to 3,300 miles. The fuel-efficient jet can cover 99 percent of single-aisle routes around the world.

"Qatar Airways very much looks forward to adding the 737-10 to its fleet, with this new variant of the 737 being ideally suited to our short-haul network, allowing us an opportunity to further enhance our product offering for our



customers, modernize our fleet and operate the most efficient aircraft in its category," said Baker.

"The largest member of the 737 family, the 737-10 is an airplane that offers more capacity, greater fuel efficiency and the best per-seat economics of any single-aisle airplane," said Deal. "We are proud of our partnership with Qatar Airways and honoured that this world-class airline continues to put its trust in our Boeing team."

An international carrier with a passenger fleet including Boeing 777 and 787 Dreamliner airplanes and an all-Boeing cargo fleet of 747 and 777 freighters, Qatar Airways serves more than 140 key business and leisure destinations worldwide. ■

Return to Nipigon 8

An incompletely seated retainer ring leads to tail rotor drivetrain failure.

The occurrence aircraft during recovery preparations.

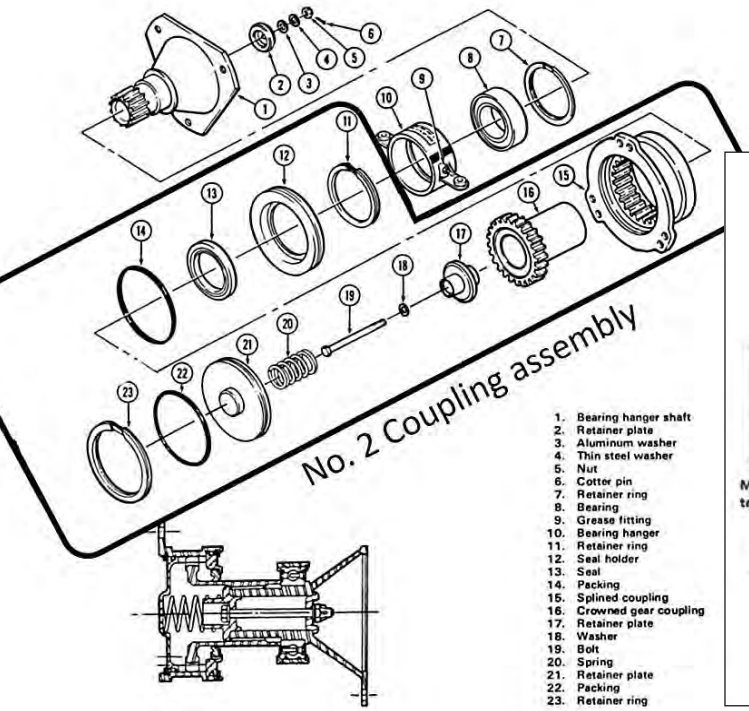
AT **1640 on 07 June 2021**, the Helicopter Transport Services (Canada) Inc. (HTSC) Bell 214ST helicopter (registration C-GDYZ, serial number 28109) with only the pilot on board departed from the Nipigon, Ontario, fire base on a forest-fire suppression flight to wildfire Nipigon 8, located approximately 28 nautical miles northeast of Nipigon. The pilot was flying the helicopter from the left seat and was wearing a lap belt and helmet. The aircraft was equipped with a 550-gallon collapsible water bucket on a 150-foot long line. The pilot conducted approximately 45 drops before informing the fire boss on board the bird dog/spotter aircraft that the helicopter was low on fuel and that the end of his duty day was nearing.

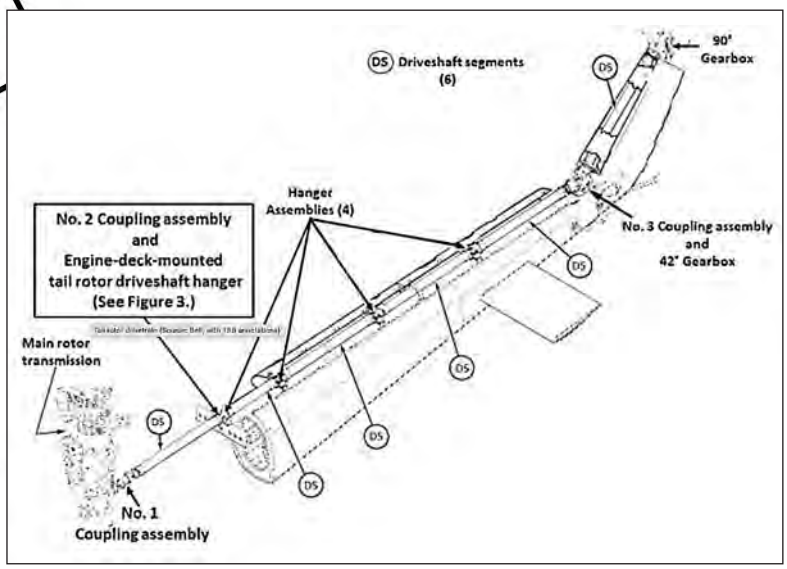
The return trip from Nipigon 8 to the Nipigon fire base was flown at 3000 feet above sea level, about 1600 feet above ground level. The helicopter was travelling at 70 to 74 knots in a nose-down attitude of roughly 7° due to the empty water bucket when the pilot was alerted by a vibration in the tail rotor pedals and a grinding noise. Moments later, the 42° BOX OIL PRESS and 90° BOX OIL PRESS annunciators for the 2 tail rotor gearboxes illuminated, and there was an audible engine overspeed noise. The helicopter yawed to the right and the nose began to pitch down.

The pilot lowered the collective control and moved the cyclic control aft to counteract the nose-down tendency, increase the main rotor rpm, and enter autorotative flight. As the heli-

Bottom, left: Exploded view of the engine-deck-mounted tail rotor driveshaft hanger. Bottom, right: Tail rotor drivetrain

Manufacturer	Bell Helicopter Textron
Type, model and registration	Helicopter, Bell 214ST, C-GDYZ
Year of manufacture	1982
Serial number	28109
Total airframe time	Approximately 20 216 hours
Engine model (number of engines)	General Electric CT7-2A (2)
Maximum allowable take-off weight	7937.87 kg
Recommended fuel types	Jet A, Jet A-1, Jet B
Fuel type used	Jet A





copter began to spin, the pilot released the long line and water bucket by kicking the manual cargo release pedal.

The pilot transmitted a Mayday call on the enroute frequency (126.7 MHz) and informed other aircraft working on the same fire that he had lost tail rotor control. While the helicopter was descending at approximately 1000 to 1500 fpm, the pilot made 3 attempts to use some engine power to fly the helicopter to a suitable landing area near a small lake. He was able to regain some control over the adverse yaw via airflow acting on the vertical stabilizer. As the helicopter descended below treetop height, he raised the collective control to cushion the landing, at which point the low rotor rpm horn activated. At 1924, the helicopter landed on its left skid gear with almost no forward speed. The emergency locator transmitter activated automatically and there was no fire. The helicopter was substantially damaged.

The pilot shut down the engines and electrical systems and was able to climb out of the right-side cockpit door. Another helicopter with fire fighters on board responded to the Mayday call and, within a few minutes, landed near the accident site. The seriously injured pilot was transported directly to a hospital in Thunder Bay, Ontario.

The Bell 214ST is a twin-engine, single 2-bladed rotor helicopter. The helicopter had no known deficiencies before the occurrence flight, and had been recently re-assembled upon return to Canada after operating overseas.

TAIL ROTOR DRIVETRAIN

The tail rotor drivetrain consists of 6 driveshaft segments, 4 hanger assemblies, 3 coupling assemblies, 5 disc assemblies, and 2 gearboxes (42° and 90°) at the base and tip, respectively, of the vertical stabilizer. The coupling assemblies and disc assemblies provide axial and angular flexibility.

Each of the 2 gearboxes is self-lubricated by an internal oil pump and is monitored by a chip detector, temperature switch, and low oil-pressure switch. A separation of the tail rotor drivetrain in front of the 42° gearbox will cause an immediate loss of oil pressure in both gearboxes. As a result, the 42° BOX OIL PRESS and 90° BOX OIL PRESS annunciators on the main warning and caution panel will illuminate.

The forward flange of the splined coupling is bolted to the aft end of the first driveshaft segment. The splined coupling houses, and meshes with, the crowned gear coupling, which has an output shaft that extends through the seal holder. The seal holder is retained in the splined coupling via a retainer ring.

WRECKAGE AND IMPACT INFORMATION

The helicopter landed on its left skid gear and came to rest leaning to the left on soft, boggy terrain. The skid gear cross tubes had been pushed 2 feet to the right from their normal position in the saddle mounts. The trailing edge of 1 tail rotor blade was damaged; however, there was no indication that the tail rotor was rotating at impact.

> *A retainer ring, which should normally secure the seal holder and crowned gear coupling within the splined coupling, was found lying loose in the fuselage compartment.*

The splined coupling on the aft end of the first driveshaft segment was found disconnected from the crowned gear coupling of the engine-deck-mounted tail rotor driveshaft hanger. The first driveshaft segment exhibited rotational scoring as a result of flailing and consequent contact with components in the fuselage compartment.

A retainer ring, which should normally secure the seal holder and crowned gear coupling within the splined coupling, was found lying loose in the fuselage compartment. The seal holder had exited the splined coupling and was loose on the shaft between the crowned gear coupling and the bearing hanger. The No. 1 coupling assembly had remained intact. However the inside face of its seal holder exhibited indentations caused by impact with the teeth of the crowned gear coupling due to the angular displacement of the first driveshaft segment as it flailed within the compartment. The remainder of the tail rotor drivetrain was contiguous from the crowned gear coupling of the No. 2 coupling assembly to the tail rotor.

COUPLING ASSEMBLY MAINTENANCE

The No. 2 coupling assembly was a component of the engine-deck-mounted tail rotor driveshaft hanger. Since its initial installation in November 2015, the No. 2 coupling assembly had undergone regular servicing in accordance with the Bell 214ST maintenance schedule. At the time of the occurrence, the No. 2 coupling assembly had accumulated 1250.1 hours since new and approximately 10 hours since the last servicing.

During the reassembly of the aircraft in early 2021, the 3 coupling assemblies were serviced in accordance with the 500-hour/12-month inspection. They were removed, disassembled, cleaned, inspected, lubricated, and reinstalled on 27 and 28 April 2021. At that time, the occurrence aircraft had accumulated 20 206.1 airframe hours.

All 3 coupling assemblies were serviced by the same aircraft maintenance engineer (AME). Another AME carried out a dual control check (DCC) during the completion of the

work. HTSC had adopted the policy of having DCCs conducted after maintenance is performed on drivetrain components. The DCC must be conducted by personnel who have received the required training. The DCC is also known as a dual inspection or independent check and is to be performed on work that disturbs engine or flight controls.

Rationale and guidance on conducting the inspection is contained in a Transport Canada Airworthiness Notice.The fundamental component of the procedure is that a "second set of eyes" carries out a careful inspection of the completed work. Several daily inspections had been carried out before the occurrence flight. However, the Daily Inspection Check Sheet in use at that time by HTSC did not call for an inspection of tail rotor driveshaft coupling assemblies.

AIRCRAFT MAINTENANCE ENGINEERS

The AME who serviced the 3 coupling assemblies began employment with HTSC in July 2015, as an apprentice AME after completing a Transport Canada-approved AME basic training course. After a 24-month apprenticeship with HTSC, he obtained an AME licence with M1/M2 ratings. After completing type training courses, he received HTSC aircraft certification authority (ACA) for Bell 206 and 407 helicopters.

The AME who conducted the DCC began employment as an apprentice AME with HTSC in 2014 after completing a Transport Canada-approved AME basic training course. He served a 24-month apprenticeship with HTSC before obtaining an AME licence with an M2 rating. After completing type training courses, he received HTSC ACA for Bell 204, 205, 212, and 214ST helicopters.

RETAINER RING

The retainer ring is a spiral of approximately 690° made of flat spring steel that seats into a groove machined into the inner diameter of the splined coupling. The retainer ring secures the seal holder, and thus the crowned gear coupling, within the splined coupling. The dimensions of the retainer ring groove were examined using a coordinate measuring machine, a digital comparator, and optical scanning at a manufacturer's facility. According to specifications, the retainer ring groove in the splined coupling should be between 0.068 inch and 0.073 inch wide. The retainer ring was 0.062 inch thick. This would result in a free space from 0.006 inch to 0.011 inch between the retainer ring and the edge of the groove.

This suggests that a foreign object, or debris, thicker than 0.011 inch trapped between the spiral layers of the retainer

ring could prevent the retainer ring from seating. However, an examination of the retainer ring could not determine whether a foreign object or debris had been trapped between the retainer ring layers.

The occurrence retainer ring was deformed to the extent that the spiral would no longer lie flat. This was likely due to rotational forces and impact with the flailing splined coupling after becoming dislodged. The retainer ring did not appear to be worn, and its outside diameter compared favourably with the exemplar retainer ring.

For an undetermined reason, the retainer ring was dislodged from the splined coupling. Subsequent movement of the main rotor transmission resulted in axial movement of the driveshaft. The seal holder, and ultimately the crowned gear coupling, exited the splined coupling, at which point the tail rotor drivetrain separated. This resulted in the loss of tail rotor thrust, and consequently, yaw control was lost.

The investigation noted that, without the use of a visual inspection aid such as a mirror, or verification with a measuring device, inspection of the installed retainer ring is hampered by the proximity of the bearing hanger.

LOSS OF TAIL ROTOR THRUST

The **Bell Model 214ST Rotorcraft Flight Manual** describes the following effects in the case of a complete loss of tail rotor thrust—it states:

This is a situation involving a break in the drive system, such as a severed driveshaft, wherein the tail rotor stops turning and delivers no thrust. A failure of this type, in powered flight, will result in the nose of the helicopter swinging to the right (left side slip) and usually a roll of the fuselage. Nose

Event Reminders

COPA NATIONAL FLY-IN AND AVIATION EXHIBITION

DISCOVER THE CHARM of the Saint-Jean-sur-Richelieu, Quebec region while participating in a variety of open-air activities at the 2022 COPA National Fly-In and Aviation Exhibition. The meeting point is conveniently located just an hour's drive from the Ottawa and Montreal airports. Visitors will have the opportunity to discover exciting exhibitions, socialize, eat, learn in a variety of workshops and attend the gala dinner at the end of the weekend! With over 500 delegates on site, sponsorship is a great way to get your brand name in front of your target audience. The event is scheduled to run June 23-25, 2022.

CANADIAN COUNCIL FOR SUSTAINABLE AVIATION FUELS LAUNCHED

Canadian aviation industry leaders are joining forces to create the Canadian Council for Sustainable Aviation Fuels, whose mission is to accelerate the deployment of sustainable aviation fuels in Canada to ensure that the Canadian aviation sector remains competitive as it transitions to a net-zero future.

Sustainable aviation fuels can reduce greenhouse gas emissions by up to 80 percent and can be used now without significant modifications to aircraft or supply infrastructure. Their use will allow for rapid results in achieving carbon neutrality in the sector.

Created by a consortium of 60 airlines operating in Canada and comprised of key stakeholders in the Canadian aviation ecosystem including suppliers, aerospace manufacturers, airports, finance, and academia, the Council will aim to facilitate the production and supply of affordable, low-carbon, made-in-Canada SAF.

"Decarbonizing Canadian aviation requires collaboration between industry, governments, scientists and airlines. The C-SAF provides a space for a common dialogue to facilitate the exchange of ideas to reduce GHG emissions from aviation and we strongly believe that with everyone working together, change can happen faster," said Geoff Tauvette, Executive Director of the C-SAF. ✪

down tucking will also be present. The severity of the ships [sic] initial reaction will be affected by airspeed, cabin-loading, center of gravity, power being used, and density altitude.

In the event that the helicopter is in level flight, or a power dive, the following actions are to be taken:

— chop the throttles and reduce pitch immediately; and
— attain an airspeed slightly above normal autorotative glide speed.

NOTE: If altitude permits with airspeed above 60 knots, throttle and pitch can be gently applied to see if some degree of powered flight can be resumed. If any adverse yawing is experienced, re-enter autorotation and continue the descent to a landing.

THE LANDING TECHNIQUE IS PRESCRIBED AS FOLLOWS:

During the final stages of the approach, a mild flare should be executed making sure that all power to the rotor is OFF. Maintain the helicopter in a slight flare and use collective smoothly to execute a soft, slightly nose-high landing. Landing on the aft portion of the skid will tend to correct side drift. This technique will, in most cases, result in a run-on type landing.

On the occurrence flight, at approximately 1600 feet above ground level, the pilot completed these actions when he recognized the loss of tail rotor thrust and was able to slow the spin rate. However, he was committed to an autorotative descent onto the available terrain, which did not lend itself to a run-on type of landing.

SAFETY ACTION TAKEN

The HTSC Bell 214ST daily inspection was amended to require the opening of an additional access panel to facilitate the inspection of the engine-deck-mounted tail rotor driveshaft hanger and the No. 2 coupling assembly. A 5-page handout was added to the HTSC Bell 214ST aircraft certification authority type training course. The handout emphasized inspection areas and reiterated the requirement for a thorough DCC during the 500-hour/12-month servicing of the 3 coupling assemblies.

SAFETY MESSAGES

As seen in this occurrence, the consequences of an incompletely seated retainer ring entering service can lead to a failure of the tail rotor drivetrain and consequent loss of tail rotor thrust. Therefore, since some components, such as a seated retainer ring, may be difficult to view, the use of visual inspection aids and measuring tools may be warranted during installation and subsequent DCC inspection. ■

(These were excerpts from Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 02 February 2022. It was officially released on 08 February 2022.)

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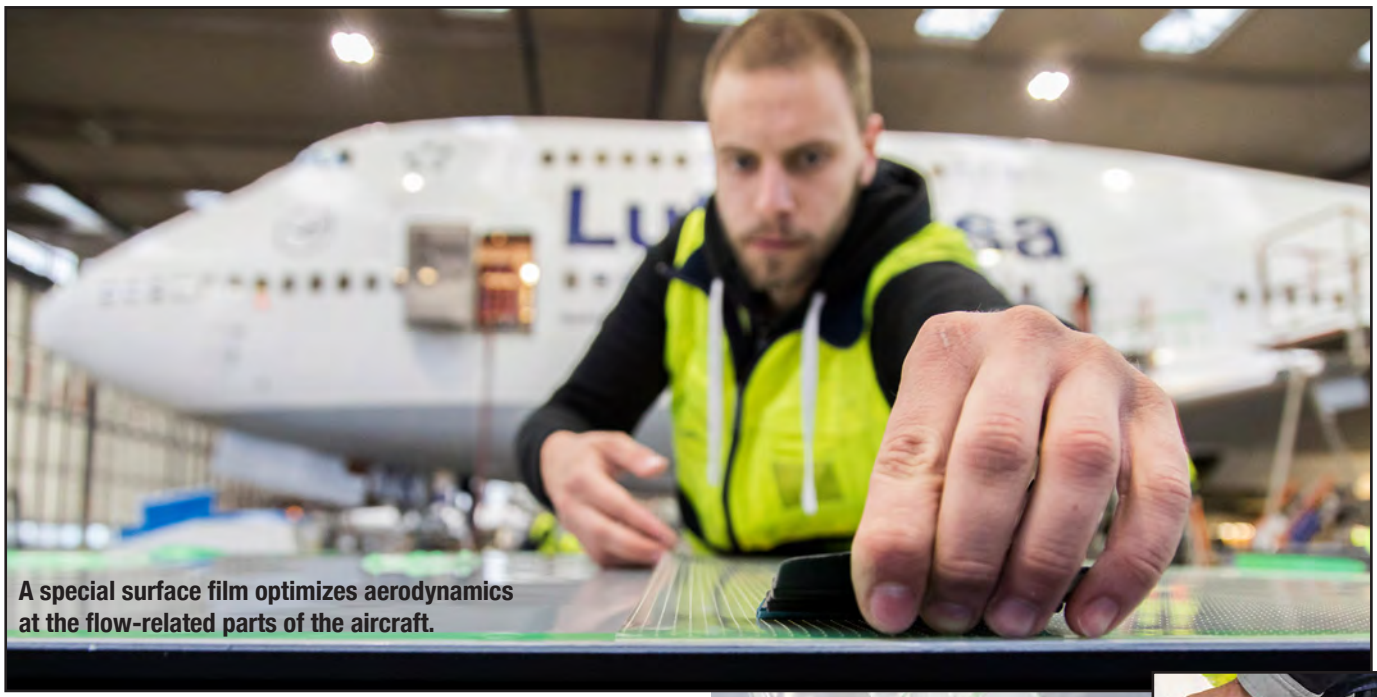

A special surface film optimizes aerodynamics at the flow-related parts of the aircraft.

Nature as a role model. The structure of the surface imitates the properties of shark skin.

SWISS INTERNATIONAL AIRLINES announced in late-February it will equip its entire Boeing long-haul fleet with the fuel-saving AeroSHARK surface technology, developed jointly by Lufthansa Technik and BASF. AeroSHARK is a surface film that mimics the fine structure of a shark's skin and consists of ribs—known as riblets—around 50 micrometers in size. This surface coating dramatically improves aerodynamics and as a result less fuel is needed in flight. Lufthansa Technik and BASF intend to systematically develop the new technology further in the direction of additional aircraft types and even larger surfaces. In initial model model calculations, the sharkskin technology in its maximum expansion stage could even avoid CO2 emissions to the tune of up to three percent.

With approximately 950 square metres of riblet film, the modification of the "long" Boeing 777-300ER will be even larger than the 800 square metres on the Boeing 777F of AeroSHARK's launch customer Lufthansa Cargo. The potential for fuel and CO2 savings on this scale is around 1.1 percent. Converted to the operational profile of the Boeing 777-300ER at SWISS, this means annual savings of more than 4,800 tons of kerosene and roughly 15,200 tons of carbon dioxide, as much as is usually generated on approximately 87 long-haul flights from Zurich to Mumbai.

SWISS will begin installation on its fleet from mid-2022 during suitable maintenance layovers. The airline had already supported Lufthansa Technik and BASF during the development phase of AeroSHARK. In the summer of 2021, a Boeing 777 wing was measured for the entire duration of a regularly scheduled flight between Zurich and San Francisco. With the data collected, Lufthansa Technik was subsequently able to create 3D models for flow simulations, on the basis of which the AeroSHARK modification is to be extended to the wings of the Boeing 777 in the near future in order to realize further savings potential. SWISS will also provide one of its aircraft for the STC flight to obtain the required Supplemental Type Certificate from the European Union Aviation Safety Agency. ■

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