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# AirMaintenance

The Magazine for Aircraft Maintenance Professionals

# UPDATE

Transport Canada Approved for R/T



## Hypersonic at Zero Miles Per Hour

## How Global Travel Took Off

## 8 Great Ideas: Crystal Cabin Awards

## PAMA and AME news

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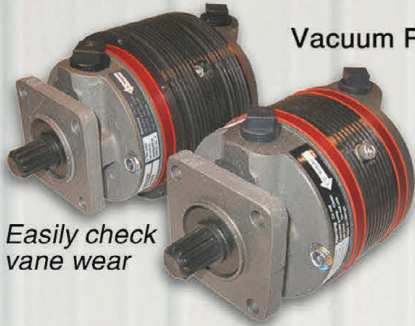
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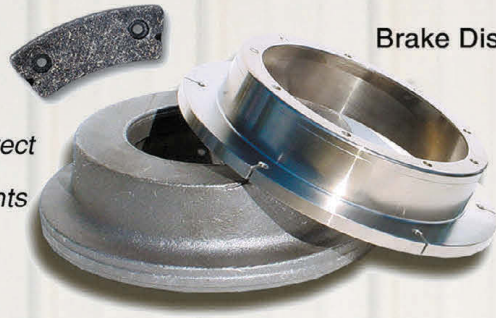
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# Acorn Welding joins Hartzell Family

**T**HE legendary and Minnesota-based Hartzell Aviation company has been noticeably active in the acquisition business of late, expanding its holdings with out-of-shop takeovers and spreading its corporate umbrella. And now the propeller firm has turned its eyes northward with this summer's acquisition of Acorn Welding, located in Edmonton, Alberta. The announcement was made in July at the 2022 EAA AirVenture Oshkosh air show. A key factor in the acquisition was that Acorn expands Hartzell's ability to produce exhaust and engine mounts. Hartzell also benefits from Acorn's geographic location.

"Acorn Welding integrates well with our business and allows us to add exhaust stacks and air boxes to our product lines," said Ryan Latham, who is president of Hartzell Aerospace Welding, one of the entities in the parent company's business portfolio. "The company's proven ability to develop and obtain Parts Manufacturer Approvals will enable us to build out our product portfolio," he added. "Additionally, its location in Western Canada permits us to better serve customers."

The 50,000-square-foot Acorn Welding operation is a Transport Canada Civil Aviation approved maintenance organization, a TCCA-approved manufacturer and holds ratings for welding, components, nondestructive testing, and structures, as well as for distribution of aviation parts. Acorn Welding has grown into Canada's largest aircraft exhaust and engine mount company and is the largest radial and vintage aircraft exhaust company in the world. It offers a line of almost 100 new manufactured products, aircraft exhaust, and engine mounts for over 50 aircraft makes and 270 models, and 750 fabrication fixtures. ■

— John Campbell, Editor



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# Upcoming Events

## Aircraft Mechanics Union and UPS reach deal



**UPS AND ITS AIRCRAFT MECHANICS UNION** reached a deal during mid-September for a three-year contract extension which includes pay increases and benefit improvements. The tentative agreement struck between the shipping giant and Teamsters Local 2727 would give the aircraft mechanics a 3.3 percent annual raise over the next three years and an increase in pension contributions. It's subject to ratification by about 1,700 rank-and-file members.

Teamsters Local 2727 was established October 21, 1987 for the Aviation Maintenance Class and Craft at United Parcel Service. Among other aviation professionals, Local 2727 represents Aviation Maintenance Technicians and Aircraft Maintenance Inspectors, and is located at various gateways throughout the United States with headquarters in Louisville, Kentucky.

The contract extension deal between

UPS and the union was struck after about eight months of negotiations, said Timothy Boyle, president of Teamsters Local 2727. The current contract runs through November 1, 2023, and the extension would extend it until November 1, 2026.

Aircraft mechanics represent a relatively small portion of the company's workforce of more than 500,000. Of the roughly 1,700 maintenance technicians and related employees who work on the company's jets, hundreds work at the company's air hub in Louisville, and about 40 work in Atlanta. The aircraft mechanics are under a separate contract from other UPS employees such as drivers and parcel handlers and, as part of the airline industry, are governed by a different labour law than the rest of the UPS workers. 🔄

(Source: *The Atlanta Journal-Constitution*)

## COMING EVENTS

### NBAA Business Aviation Convention & Exhibition

October 18-20, 2022  
Orlando, Florida  
[www.nbaa.org](http://www.nbaa.org)

### Bell Fort Worth Alliance Air Show

October 22-23, 2022  
Ft Worth, Texas  
[www.atxaviationexpo.com](http://www.atxaviationexpo.com)

### 2022 Helicopter IA training seminar

October 27, 2022  
North Hollywood, California  
[chris@rotorcraftsupport.com](mailto:chris@rotorcraftsupport.com)

### HAC Convention and Trade Show

November 2-4, 2022  
Calgary, Alberta  
[www.h-a-c.ca](http://www.h-a-c.ca)

### Aviation Nation Air Show

November 4-6, 2022  
Nellis AFB, Nevada  
[www.nellis.af.mil](http://www.nellis.af.mil)

### Canadian Aerospace Summit

November 7-9, 2022  
Ottawa, Ontario  
[www.aerospacesummit.ca](http://www.aerospacesummit.ca)

### Bell Maintainer & Operator Conference

November 30-December 01, 2022  
Kelowna, BC  
[news.bellflight.com](http://news.bellflight.com)

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# STCs & new products

## Flap kit eliminates grease

Canada's **Marsh Brothers Aviation** has incorporated its proprietary thermoplastic polymer bearing AeroTough GF (grease-free) technology into a new flap roller upgrade kit for the Beechcraft King Air light aircraft range. The kit has been developed to replace the traditional greased flap rollers supplied by the original equipment manufacturer with an alternative self-lubricating, lightweight polymer material to prevent seizure and reduce metal-to-metal contact. The AeroTough GF material eliminates the need to grease the flaps or use separate phenolic, steel or Teflon thrust washers. [www.marshbrothersaviation.com](http://www.marshbrothersaviation.com)



## Landing light tolerates vibrations

**Amglo's** new Q4559X halogen aircraft landing light is said to produce the highest light output on the market for increased visibility by day and night for aircraft approach, landing and takeoffs. Its PAR64 lamp is designed to withstand high cyclic vibrations for innumerable takeoffs and landings. The lamp is manufactured through an offline annealing process to ensure glass stability and prevent breakage. Additionally, its filament, designed through a proprietary process, further enables the lamp to tolerate high vibrations without distortion. Features include an average life of 100 hours and Boeing IPC-approval. [www.amglo.com](http://www.amglo.com)



## Nozzle test stand rolls on wheels

**XL Aerospace** has developed a new portable fuel nozzle test stand designed to be moved on its wheels, and only requires standard electrical and shop air connections for operation with no requirement for water for system cooling. Other key features include in-situ mass flow calibration; built-in specific gravity test function; quick disconnect fixtures for quick interchange of fuel nozzles and incorporation of a digital protractor providing superior accuracy as relates to spray and skew angles. The XL Aero FNTS is sold as a ready-to-operate system. [www.xlaero.ca](http://www.xlaero.ca)



## Test set measures any signal

**Tel Instruments' SDR-OMNI** flight line test set is a suite of radio frequency avionics test capability in a single package for demanding commercial and military customers. Professionally formatted reports can be downloaded via USB or wirelessly printed to a local wireless printer. The combination of hardware and software can test virtually any RF signal from 200 kHz to 2.0 GHz. Test functions are implemented using software-defined signal processes that generate, receive, and measure complex avionics signals covering narrow band analog or digital communications, intricate navigation, and wide-band pulse or data protocols. [www.ametekmro.com](http://www.ametekmro.com)



## Welder has built-in TIG solenoid

**Lincoln Electric's POWER MIG** 215 MPI multi-process welder is a lightweight dual-input voltage machine with a new ergonomic design. It can handle a range of welding processes: MIG, Flux-cored, stick and DC TIG. Other new features include: increased duty cycle for longer weld time; a built-in TIG solenoid that requires no installation by the user; an improved wire drive that ensures consistent wire feeding. New options include gas purge functionality, ArcFX technology and memory capability. [www.lincolnelectric.com](http://www.lincolnelectric.com)



## Cabinet locks down flammables

**Snap-on Industrial's** keyless entry flammable liquids storage cabinet safely isolates flammable materials from the immediate area. It's an all-welded 18-gauge, powder-coated steel cabinet that provides extra-rigid support for cans and pails. Providing the protection is a double-wall thermal barrier that securely isolates materials. Dual vents with built-in steel fire baffles relieve internal pressure, allowing flammable vapour to be piped away. The keyless entry system gives access to the cage by swiping a badge or through the keypad and supports up to 3,000 users. [www.b2b.snapon.com](http://www.b2b.snapon.com)



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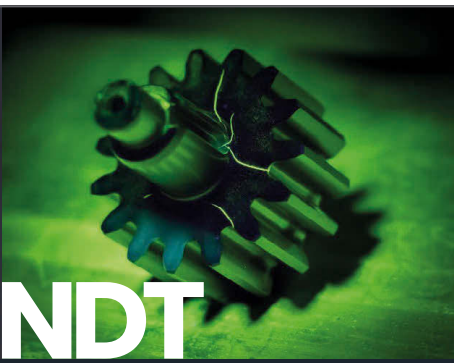
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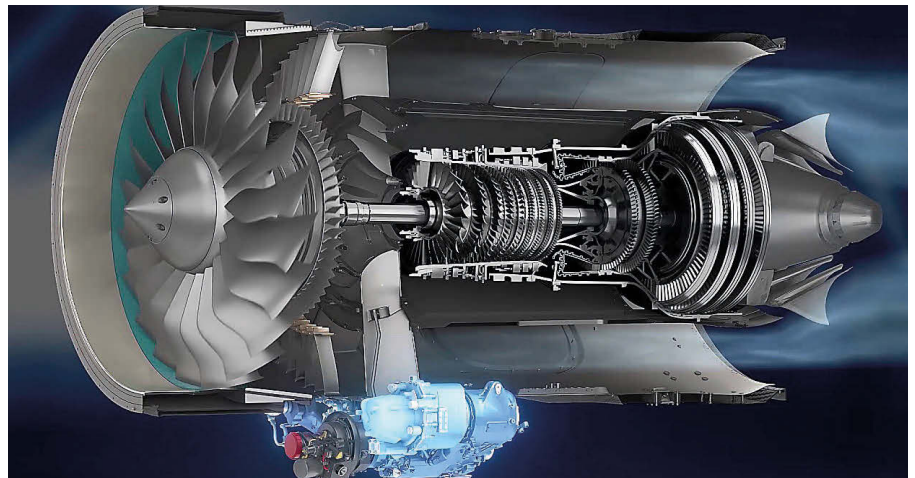
All Nippon Airways will be the launch customer for Boeing's Insight Accelerator, a new cloud-based flight data analytics system. By using augmented analytics to discover and deploy predictive algorithms for anomaly detection, the Insight Accelerator enables airlines to take proactive maintenance and repair action and prevent unscheduled delays. "IA's built-in artificial intelligence, guided exploration and powerful visualizations allow airlines to investigate flight and maintenance data, identify trends and discover insights, all without specialized coding or programming skills," said Duane Wehking, vice president of Digital Aviation Solutions at Boeing Global Services.

## TWO NEW STANDARDAERO MRO SHOPS

StandardAero has announced the addition of two new approved facilities for Rolls-Royce RR300 helicopter engine

MRO. With the new expanded capability the company is now able to service this engine type for Robinson R66 helicopter operators in New Westminster, British Columbia and Concord, North Carolina in addition to its existing facilities in Winnipeg, Manitoba, Portsmouth U.K. and Singapore. While RR300 MRO will now take place at the two new facilities, engine testing capabilities will remain at StandardAero locations in Winnipeg, Portsmouth and Dallas. StandardAero also services helicopter engine LRU's including fuel control units, PT governors, fuel pumps and starter generators.

common core with the Pratt & Whitney GTF commercial jet engine, which has flown more than 2.2 million hours since launch in 2016.

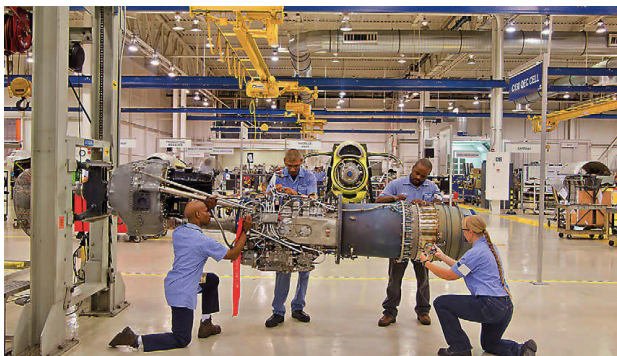


## PW800 REACHES KEY MILESTONE

Pratt & Whitney Canada says its PW800 engine program has reached a key milestone with the Type Certification of its PW812GA engine by Transport Canada Civil Aviation. Gulfstream Aerospace Corp. announced in October 2021 that the PW812GA was selected to power the Gulfstream G400 business jet. The PW800 offers double-digit improvements in fuel burn, emissions, maintenance intervals, and noise. The engine also incorporates the latest generation of technologies from advanced design to innovative maintenance functionality. The PW800 engine shares a

## GOLDBERG'S RIDE ENTERS SERVICE

Bombardier announced in late September that its new Challenger 3500 business jet destined for the program's launch customer, Les Goldberg, chairman and CEO of Entertainment Technology Partners, has entered into service. Goldberg, a long-time Bombardier customer, was previously announced as the launch customer for the new aircraft at NBAA 2021 and will take ownership later this year. The latest in the Challenger line, the Challenger 3500 offers many of the features of the company's Global family as standard equipment, including Bombardier's Nuage seat. The aircraft has the industry's first voice-controlled cabin to manage lighting, temperature and entertainment systems.







## LUXURY AIRCRAFT FEATURES DINING AREA

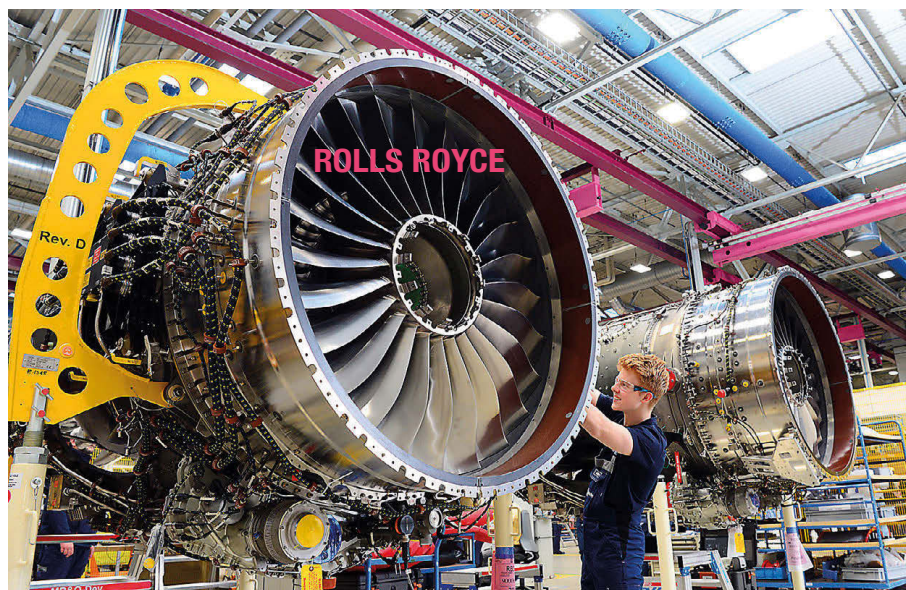
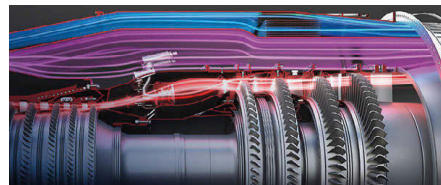
Gulfstream's second fully outfitted production-test Gulfstream G700 aircraft flew in September, adding an additional testing platform for the most spacious cabin in business aviation. The aircraft joins the first outfitted G700, which has already set eight international city-pair speed records and was awarded the 2022 International Yacht & Aviation Award in the Private Jet Design category. The test aircraft features include the all-new high-definition dynamic circadian lighting system, a grand suite and newly designed spacious lavatory with natural light, full vanity and shower, as well as a six-place dining area with an expandable, self-contained table.

## FAA OKAYS COMPOSITE PROPS

Hartzell Propeller has received a Supplemental Type Certificate from the FAA to replace Diamond DA40 NG MT wood/composite propellers with new and higher performance three-bladed lightweight Polaris composite props. The 74-inch diameter three-blade ASCII carbon fibre prop for the Austro Engine E4-A features a lightweight Bantam aluminum hub and 2,4000-hour/six-year TBO. "Hartzell's Top Prop performance conversion kit includes the propeller, a white or metallic silver composite spinner, and STC documentation," said Hartzell Propeller president JJ Frigge. "It delivers light, smooth and state-of-the-art improved climb performance..."

## ROLLS ROYCE ENGINE HAS EUROPEAN APPROVAL

The Pearl 700 engine for the brand-new Gulfstream G700™ and G800™ has received official certification by the European Union's Aviation Safety Agency. Developed by Rolls Royce, the engine demonstrated exceptional performance operating at sea-level and altitude conditions on both conventional jet fuel and 100 percent Sustainable Aviation Fuel. It proved its ability to withstand bird-strike, ice, hail and water ingestion as well as passing the critical fan blade containment test, during which a fan blade is deliberately released at maximum speed. Testing was conducted at Rolls-Royce locations including Manitoba and Montreal. The engine is able to propel customers as fast as Mach 0.925.

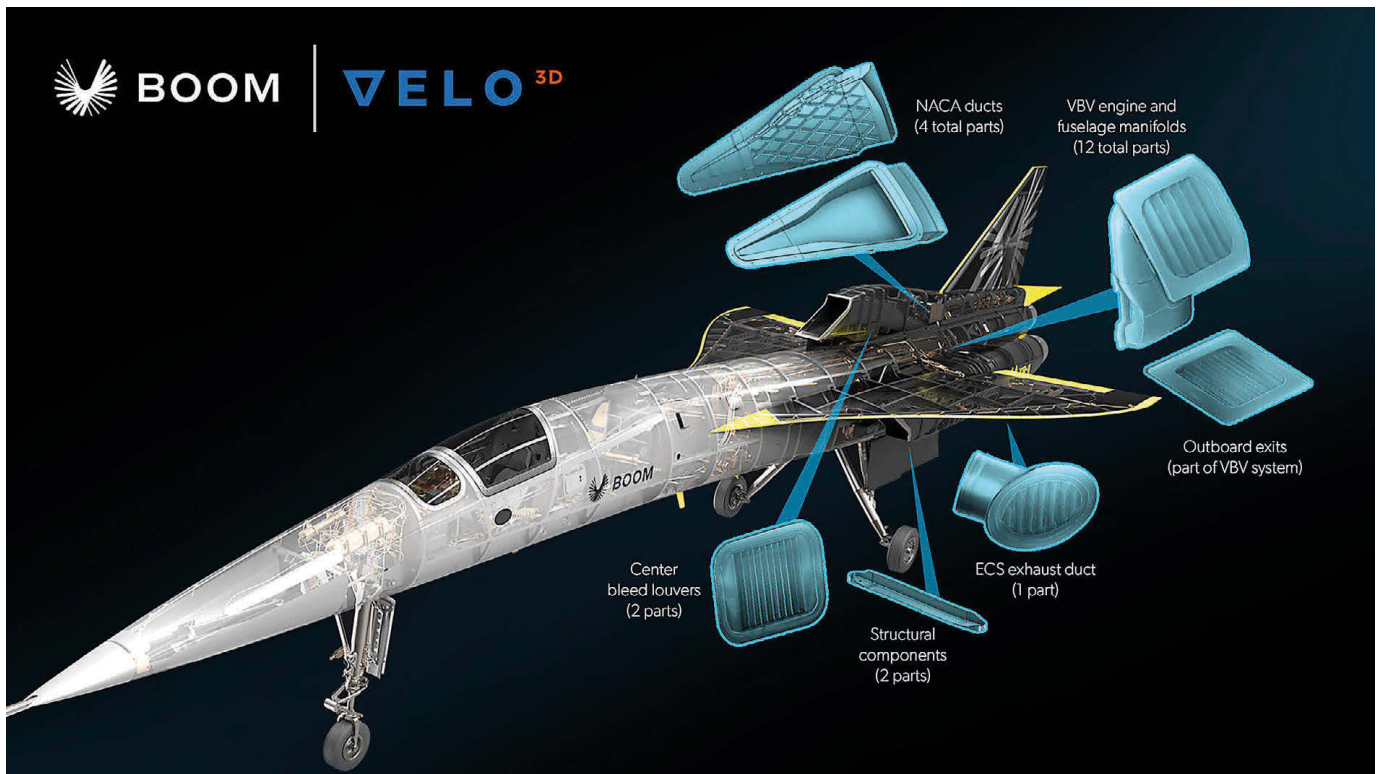


## TESTING COMPLETE ON XA100

The U.S. Air Force and GE have concluded testing on GE's second XA100 adaptive cycle engine at the Air Force's Arnold Engineering Development Complex. With testing at AEDC completed, GE has accomplished the final major contract milestone of the Air Force's Adaptive Engine Transition Program, which began in 2016. The XA100 combines an adaptive engine cycle that provides both a high-thrust mode for maximum power and a high-efficiency mode for optimum fuel savings and loiter time. Component technologies include ceramic matrix composites, polymer matrix composites and additive manufacturing that increase thrust more than 10 percent. ■

# Hypersonic at Zero Miles Per Hour

Purdue Researchers use 3-D printed injector components to create Mach 6 conditions for a ground-testing facility.



**In October 2020, Boom Supersonic unveiled its XB-1 aircraft with more than 20 VELO3D-enabled components.**

**T**HE TERM “HYPERSONICS” is getting renewed attention these days, with the release of a U.S. government report about unidentified aerial phenomena with “impossible” flight behaviour—at speeds exceeding the critical Mach 5 level that defines the word. Whether you believe it’s extraterrestrials, competitor nations, or domestic R&D (or maybe all of the above) behind the ongoing mystery, the lure of vehicles with unheard of speed and agility is compelling.

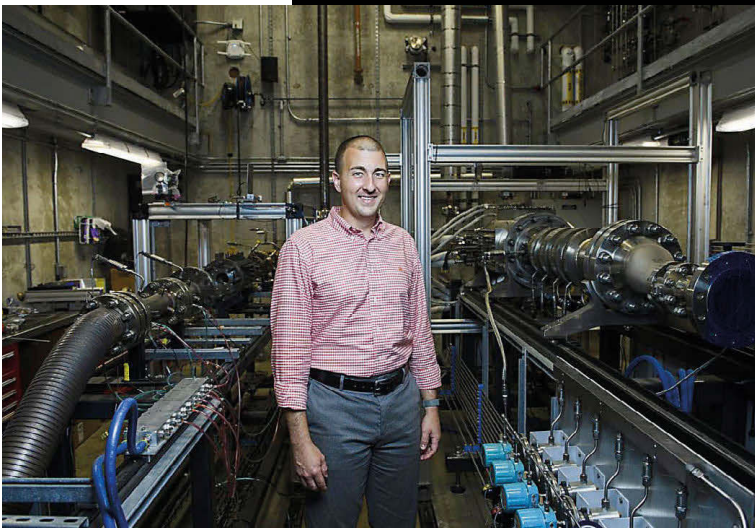
“Supersonics” denotes aircraft that break the sound barrier at Mach 1 (like the now-retired Concorde and the up-and-coming Boom Supersonic), and extends to around Mach 5, which is five

times the speed of sound and more than 3,500 mph at sea level. But very weird stuff starts happening as that upper speed is reached—you enter the hypersonics environment.

Exploring that unusual environment turns out to be a perfect proving ground for metal 3D printing, as researchers at Purdue University are learning. Their recent work is demonstrating that advanced additive manufacturing (aka 3D printing) technology is now capable of producing fully dense, end-use parts with robustness that surpasses traditional methods like casting. Parts that can create hypersonic conditions and live to tell the tale.



**Above: Two years ago VELO3D and Honeywell Aerospace announced a partnership to qualify VELO3D's Sapphire system as a viable manufacturing platform for 3D print production of aircraft components.**



**Above: Associate Professor Carson Slabaugh and his team are using 3D-printed parts in a test rig that duplicates the hypersonic environment without ever leaving the ground.**

## THE BIZARRE WORLD OF HYPERSONICS

And it's quite a tale: "There's a line you cross at around Mach 5," said Purdue Associate Professor Carson Slabaugh, whose 20-person team at Zucrow Laboratories has been studying high-speed combustion systems since he started his lab at Purdue in 2015. "When a vehicle flies that fast, extreme compression and heating of the air flowing around and within the fuselage occurs. At Mach 5, it's about a six-fold increase in the temperature and a pressure increase of a few hundred times. That kind of thermal and mechanical loading causes the regime of aerodynamics and thermodynamics and structural mechanics to completely change compared to lower-speed systems."

According to Slabaugh, what this means is that even just coming back through the atmosphere in response to gravity, "you're traveling through a fireball at hypersonic speeds."

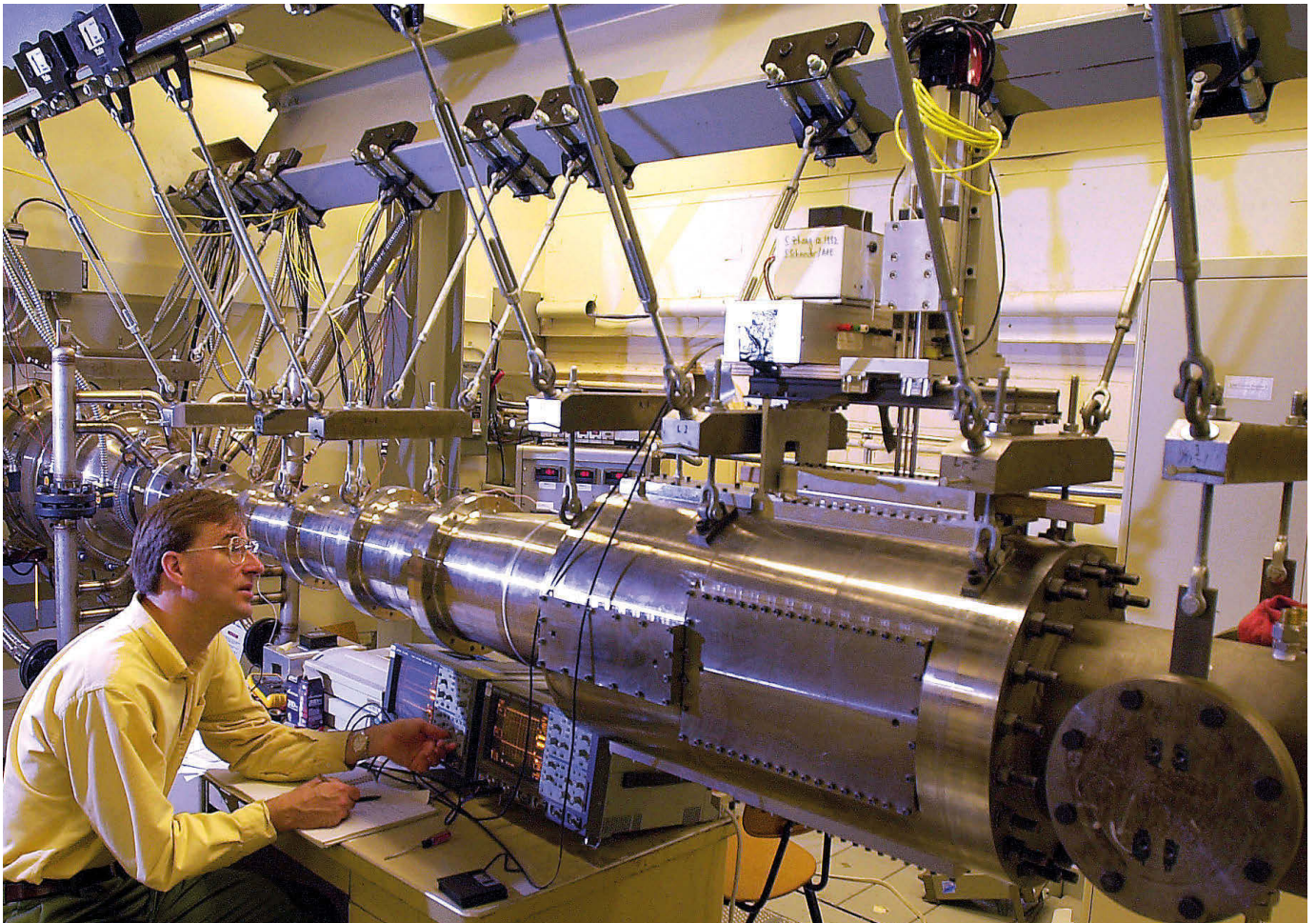
This happens when astronauts return to Earth from the International Space Station—and is why their modules are protected by massive heat shields.

But if you want to achieve powered hypersonic flight—with a controllable aircraft, unmanned vehicle or missile—you need to add an engine, which is where it gets really intense.

Above Mach 5, the temperature of atmospheric air as it rushes by is thousands of degrees and the pressure is several hundred psi. The air itself can even become chemically reactive if you fly fast enough. These extreme flow conditions become a challenge to any vehicle-propulsion system whose thrust comes from burning fuel.

"If the incoming air is too hot, you really can't add more useful energy to the flow by burning fuel. Dissociation effects become very strong and the reactions cannot proceed to completion," said Slabaugh. "Cooling also becomes exceedingly difficult at these flight speeds." To avoid what rocket scientists jokingly call "unplanned rapid disassembly," the team at Zucrow Labs is focused on learning everything possible about the critical turbulent (reacting) flow physics that must be accounted for when an engine reaches hypersonic speeds.

To meet this challenge, Slabaugh and his team partnered with VELO3D, a company that develops and sells metal 3D printers, to 'print' fuel injectors with complex geometries that achieve very high fuel-air mixing performance. The parts could not have been made with conventional fabrication methods, especially not with the high-temperature, high-strength metal superalloys needed to survive the extreme testing conditions. The teams worked together to rapidly prototype the Purdue



team's designs for testing, evaluation, and design iteration. Slabaugh and team then used the data from the prototypes to scale up their designs into a full-scale system, which VELO3D also manufactured.

"Through our partnership, we helped VELO3D to understand the design requirements for high-speed combustion systems and they taught us how to better design for additive manufacturing," said Slabaugh. "This is the sort of mutually beneficial relationship we build with industry partners as we solve the challenges associated with advanced technology transition."

**Top photo:** Purdue University engineers have developed a wind tunnel that is the only one of its kind in the world capable of running quietly at "hypersonic" speeds, helping researchers to design advanced aircraft.

**Above:** 3D-printed injectors to produce stable, powerful turbulent flames.

## WHY EVEN HIGH-SPEED COMPUTING CAN'T KEEP UP

Because designing and manufacturing parts for hypersonic conditions—let alone attempting to fly vehicles going that fast—is understandably expensive, much of the R&D for developing hypersonic capabilities has been supported by



**Flying high above: Propulsion systems with 3D-printed parts are under development to push flight craft to hypersonic speeds.**

NASA and defence-level budgets. Flight testing these systems is expensive, and has major limits on what can be actually measured for research purposes. Engineers lean heavily on earthbound solutions to develop new technologies while keeping costs in check. They are recreating the conditions experienced during hypersonic flight and proving-out engine components in ground-test facilities—like the one at Purdue for which Slabaugh’s team is building a rocket that will never leave Earth.

“We engineer components that will experience hypersonic environments while going zero miles per hour and staying bolted to the ground,” he said.

It’s even more difficult than it sounds because this actually IS rocket science. For some time now, advanced computer simulation software has been a valuable tool for engineers who need to explore the relationship between complex physics and physical structures. Methods like computational fluid dynamics and fluid-structure interaction can be used to simulate material and structural behaviour in response to the flow of air or liquid, allowing engineers to optimize their designs before ever manufacturing anything. But hypersonics turns out to be extremely unpredictable, defeating even the most sophisticated computer-simulation capabilities.

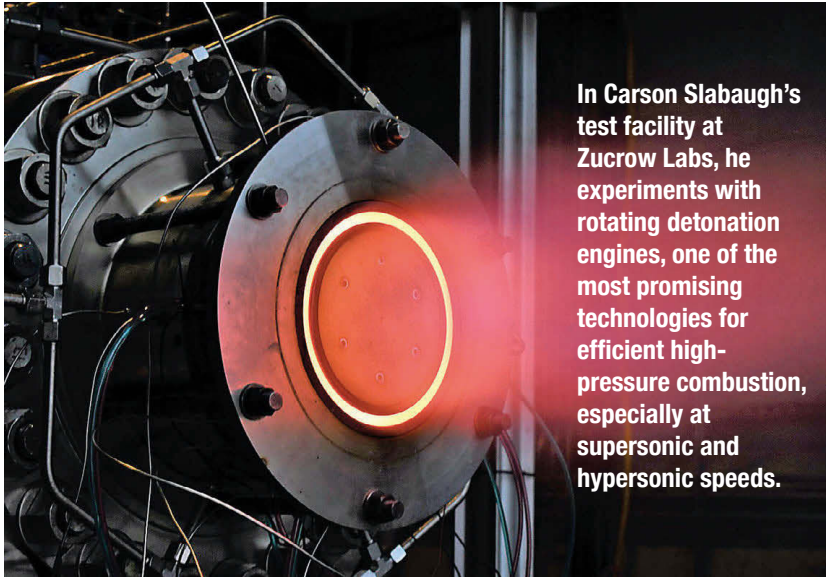
“One fundamental problem is that we can’t reliably

predict the flow and flame conditions within the engine at hypersonic conditions,” said Slabaugh. “Reacting, turbulent-flow is extremely complicated to model with CFD; we’re at such extreme levels of turbulence and flow conditions that we just can’t capture everything that happens as the flame evolves. Within the flow you have evolving density, viscosity, velocity, species, etc.—and when you add in mechanical structures like engine walls to contain the flame you get even more complicated with cooling designs that can also affect the flow and flame. The computational power you need to analyze even the smallest part of this engine is hugely expensive—and the end result is that many simplifying assumptions must be made for integrated design analysis.” Evaluating these assumptions and their effect on model accuracy is a key theme of Slabaugh’s work.

### **3D PRINTING DELIVERS**

So how do you get engineers unstuck from this kind of problem? Leave simulation behind and go back to the real-world, classic, manufacturing paradigm of “build and break” (or build and burn, in this case). With a twist this time: using advanced metal AM for the “build” part of the equation.

“What we’re working on with VELO3D is basically a very



In Carson Slabaugh's test facility at Zucrow Labs, he experiments with rotating detonation engines, one of the most promising technologies for efficient high-pressure combustion, especially at supersonic and hypersonic speeds.



**Above: Flame inside a test chamber, like the one used to create a hypersonic environment for high-speed propulsion system testing.**

large 3D-printed burner, which will be used to create the hypersonic flow environment on the ground in a test cell,” said Slabaugh. “Effectively, if you want to test a hypersonic vehicle on the ground you build a rocket engine with a big converging-diverging nozzle and a supersonic plume of extremely hot gas; the ‘fireball’ that the vehicle is flying through. The whole system is bolted down into lots and lots of concrete. You then stick whatever component you’re designing inside that plume and watch what happens. With VELO3D, we’re designing the injectors for that combustor to produce very specific turbulent flow fields that mix fuel at a certain rate and allow us to stabilize a very powerful flame in a very compact volume. This creates the conditions for all the things we’re going to test downstream.”

This is where AM is proving its worth for the “build and burn.” The ability to quickly 3D print a variety of injector geometries for the test combustor—in this case made out of Hastelloy X, one of the few high-strength, high-temperature superalloys that can withstand the hypersonics environment—enabled the Purdue team to rapidly identify which design worked best.

For Nick Strahan, a test engineer working on Slabaugh's team, the experience of using AM was an eye-opener. “We had essentially approached this problem with traditional subtractive manufacturing techniques in mind before,” he said. “But there were some features in our design that would have limited the performance of the combustor—and doing it additively with VELO3D instead enabled us to integrate our unique geometry much more easily.”

## SWERVING PAST THE ROADBLOCKS

Using traditional subtractive manufacturing would have meant casting individual parts, which requires long, drawn-

out cycles of tooling, mold-making, and design iteration. “AM techniques significantly shortened manufacturing lead times as we optimized our designs,” said Strahan.

The engineers subtly varied the flow passages of the injector with five different designs (just a matter of tweaking the STEP data file that the Velo3D Sapphire system's print-preparation software accommodated automatically), printed them out and ran them through a gauntlet of hypersonic-relevant test conditions.

“The VELO3D end-to-end manufacturing system produced dense parts requiring minimal post-processing,” said Strahan. “With just a little bit of cleanup machining, we could install them into our research-scale combustor for testing. We could then measure the combustion efficiency produced by each geometry with the goal of generating a flow that is chemically and thermodynamically similar to the atmosphere at very high flight speeds.”

In just two weeks the team was able to isolate the highest performer that had all the stationary and dynamic features they were looking for.

That high-performance injector met the critical parameters that the engineers valued most for performance of the combustor: flame power (as a proxy for the simulated flight conditions) and flame stability (a metric for the health and efficiency of the combustor).

“Both power and stability were necessary for us to create the realistic ground-test environment with our device, but these are often very difficult parameters to balance in a large-scale device,” said Slabaugh. “We were able to tune the injector geometry and flow conditions independently in our testing to achieve optimum outcomes with these two, inseparable parameters. We see AM as a powerful tool with which we can bring other creative engineering solutions to complex design problems into reality more quickly.” ■

# Eight Great Ideas

The Crystal Cabin Awards are back in business and here are the new winners.



The Crystal Cabin Award is THE international prize for innovation in the aircraft cabin. After three long years, the awards were held in person again in 2022, honouring excellence and ingenuity in aircraft interiors. A wealth of innovative concepts and products were among the 24 ideas selected as the finalists in eight categories. Now a jury of industry experts has named its winners.

## WINNER CABIN CONCEPTS: ELEVATE

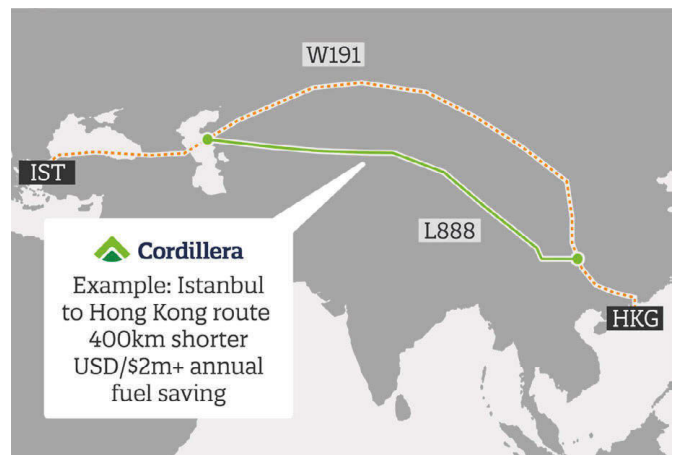
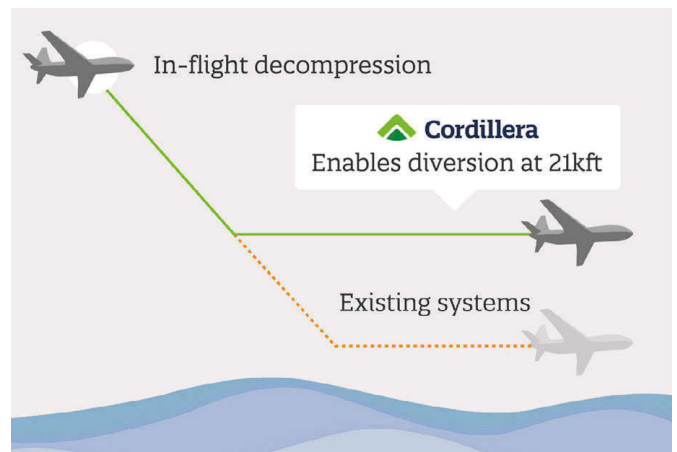
A winner in the Cabin Concepts Category was Elevate by Teague and NORDAM. Elevate was among the entries that attracted the most media attention in the run-up to the award ceremony on June 14, being keenly anticipated by industry insiders and non-trade media. This visually arresting design uses floating furniture attached to wall braces to give a freer, more organic and more immersive feel than comparable



premium accommodation concepts for single-aisle aircraft. The key driver behind the approach was to offer the privacy and exclusivity of the wide-body premium experience to narrowbody airliner passengers. The challenge: to give premium passengers in single aisle cabins a genuine sense of space ownership, while offering airlines the same seat capacity. Other features of the Elevate concept include lower weight, resulting in lower fuel burn, as well as simpler components that are easier to maintain.

## WINNER CABIN SYSTEMS: CORDILLERA

In the 2022 edition of the Crystal Cabin Awards, Cabin Systems was the arena for an inspiring mix of competing ideas with different approaches to adding value for passengers and airlines alike. Since the dawn of commercial aviation, safety has been the prime concern of engineers and designers. One emergency scenario with a legacy that challenges operators and design engineers alike is in-flight cabin decompression. Caeli Nova's Cordillera system is designed to disrupt the established processes and protocols and allow airlines to open direct routes over mountain ranges by extending the time aircraft can fly at high altitude after a decompression incident from 22 to 180 minutes. This is a potential game-changer for airlines that have until now had to circumvent high terrain such as the Himalayas, Rockies or Andes. One route that would become widely available using Cordillera is airway L888, which crosses the Himalayas and is 30 minutes quicker than other routes between Europe and parts of Asia. The jury







was more than impressed by anticipated annual savings for airlines of \$500 million and 1.2 million tonnes of CO<sub>2</sub>, all by allowing direct routes across mountainous regions, yet without any weight or maintenance penalty.

## WINNER HEALTH AND SAFETY: FIRE RESISTANT CARGO CONTAINER

An uncontrolled fire is a nightmare scenario for flight crews or passengers alike. The ubiquity of digital devices containing lithium ion batteries has also brought a new hazard: lithium ion battery fires. So-called Class D fires are among the most dangerous, involving burning metals combusting at extremely high temperatures and spreading very quickly. Fires involving lithium ion batteries harbour even more risk potential because damage to the battery can cause it to self-ignite. During a Class D fire, the battery releases a flammable vapour, itself injecting further fuel into the fire. Another problem with these types of fire is that they cannot be extinguished and can only be contained until they die out naturally. Safran Cabin's Fire Resistant Cargo Container wowed the jury by offering fire containment for Class D fires for up to six hours, the maximum distance aircraft are allowed to fly from an airport. The device gives passengers, crew and operators an additional level of protection from a threat that has the potential for catastrophic consequences during flight.



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## WINNER PASSENGER COMFORT: SPACECHILLER

Innovations in this category seek to give all passengers a feeling of exclusivity and luxury, regardless of whether they're sitting in first or economy. The winner this year in the Passenger Comfort category was SpaceChiller by Collins Aerospace. This personal refrigeration unit for individual passengers or larger areas of the aircraft cabin eschews traditional air-cooling technologies. Offering customers cooled snacks and drinks within arm's reach was long considered difficult to implement. SpaceChiller requires half the power of traditional designs.

Its modular architecture offers a premium passenger experience and gives airlines added flexibility for services and crew workspace. Conceived primarily for premium seat classes, SpaceChiller can be scaled in size as required, another factor that impressed the jury. This enables airlines to provide self service catering areas for passengers without encroaching on flight attendant workspaces or passengers' personal space. The core technology behind

SpaceChiller is a heat sink developed for DARPA. The quiet thermoelectric cooling system operates at higher efficiency and offers better performance in a small space than previously possible, without the use of environmentally unfriendly refrigerants.

# AirMaintenance UPDATE

The Magazine for Aircraft Maintenance Professionals



AMU

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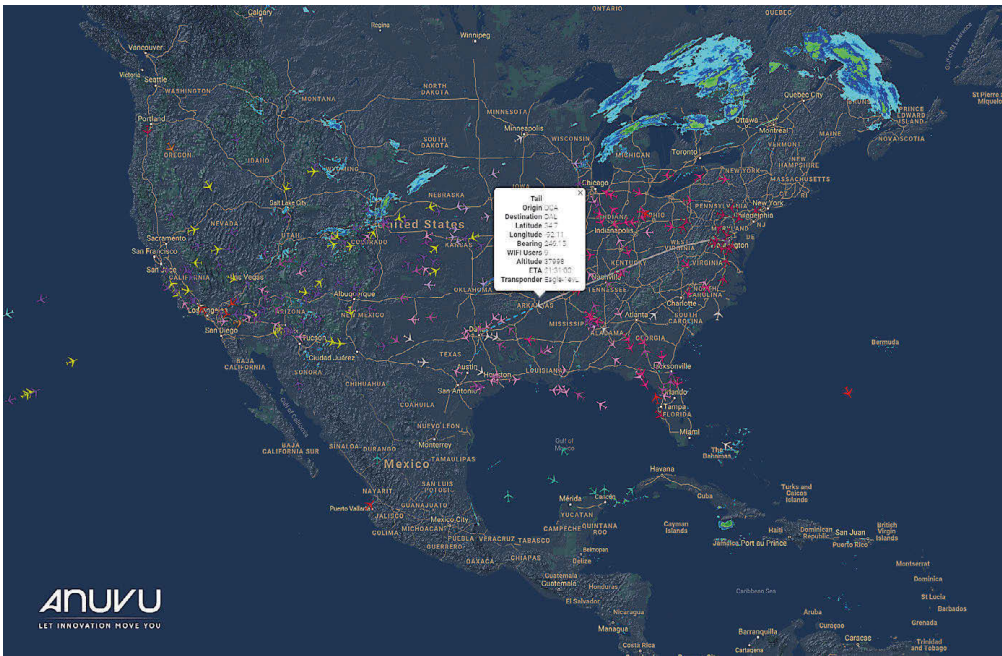
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please visit [www.amumagazine.com](http://www.amumagazine.com)



## WINNER IFEC & DIGITAL SERVICES: DEDICATED SPACE

Digital connectivity is fast becoming a prime concern for passengers who have become used to fast internet access wherever they travel. At the same time, more digital devices are in use on more aircraft, all competing for bandwidth. This year, the jury awarded the industry's top prize in the IFEC & Digital Services category to Anuvu and Southwest Airlines for a new system called Dedicated Space. The system promises a five-fold increase in available personal bandwidth and a dramatic reduction in latency. Along with faster downloads and uploads, passengers are promised more stable inflight connectivity with the new system. Dedicated Space uses proprietary technology that combines aircraft



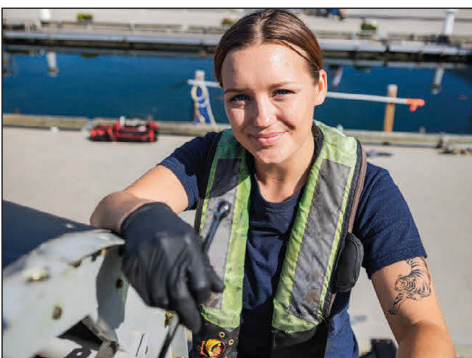


hardware and intelligent software in a different approach to using satellite bandwidth onboard an aircraft. The software analyses bandwidth demand and dynamically assigns traffic based on individual aircraft requirements. Prospective airline customers Airlines don't have to wait to adopt the new system, as it's already certified for current aircraft.

### WINNER MATERIAL & COMPONENTS: PULSE

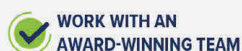
The tactile and visual quality of materials and components play a crucial role in passengers' subjective cabin experience. But so do the functionality and the ability of cabin components to provide the experience passengers expect in 2022. The option to charge personal devices anywhere is taken for granted on the ground; on-wing, the situation has often been more challenging. The winner in this hotly contested category was Thales Avionics with Pulse, a charging solution for aircraft cabins that uses patented power management technology to

dynamically allocate power during the flight. This slim, low-weight power supply unit lets passengers recharge their device in flight via USB-A, USB-C or wireless connection, taking away charge anxiety and letting travellers enjoy their device at any point during their journey.



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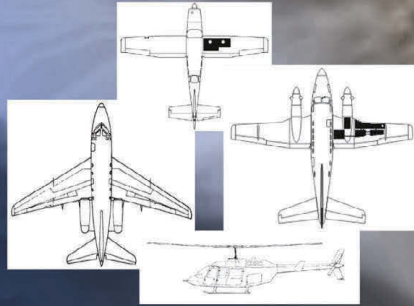
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## WINNER SUSTAINABLE CABIN: 100 PERCENT RECYCLABLE PANELS

Sustainability is a central issue of almost any discussion about aviation in 2022. But the depth of innovation towards a more sustainable future goes far beyond propulsion technologies such as liquid hydrogen or Sustainable Aviation Fuel. It came as no surprise that the Sustainable Cabin category was a hotbed of activity in the 2022 edition of the Crystal Cabin Awards, with many creative submissions that reduce aviation's ecological footprint. The top honour in this category was claimed by Swedish manufacturer Diab in cooperation with AkzoNobel, Rescoll and Roctool. The group has pioneered a thermoplastics manufacturing process to produce 100 percent recyclable panels for cabin interiors. Among the aspects that particularly impressed the jury were overall reduction in life cycle cost and lower environmental impact by facilitating recycling of cabin elements. The process developed by Diab

and its partners is not only more eco-friendly but also faster than methods using adhesive films. The thermoplastic sheets are welded directly to the foam core which also offers improved acoustic insulation for the finished material. 3D-shaped and decorated panels can be produced in a one-step process, resulting in components that are lighter and cheaper to produce.

## WINNER UNIVERSITY: PORTAL

The University category is a playing field for imaginative concepts with a clean sheet approach to a range of issues and situations. The 2022 winner in this fascinating category is Ken Kirtland from the Georgia Institute of Technology. His idea for new type of airline featuring electric aircraft convinced the jury with its unique approach to sustainable air travel. The focus of the concept is to use underused regional airports in a fascinating departure from traditional hub and spoke concepts for air networks. Portal envisages a new type of zero-emission electric-powered aircraft to ferry passengers between local hubs; the plane would have a range of 1000 miles and accommodate 30 or more passengers. The layout of the Portal cabin was another aspect that drew the jury's admiration. The cabin features all-premium seating with panoramic window views. Seating is arranged around the cabin to speed up access and provide incredible views through the large windows. The system would also capitalize on a slower airspeed by offering a more immersive, relaxing travel experience, while flying at low altitude. ■



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# AirMaintenance UPDATE

The Magazine for Aircraft Maintenance Professionals

HOME PAGE | CURRENT ISSUE | FEATURES | NEWS | ARCHIVE | EVENTS | CLASSIFIEDS | JOBS

**Dec-Jan 2013**

AMU Chronicles:  
Aviation Terms – Part 2  
HRF Explained  
Human Factors  
The Regs

**Upcoming Events**

- 5 Feb
- 11 Feb: Middle East Business Aviation Summit at Al Maktoum International Airport
- 16 Feb: Pacific AMC 30th Year Celebration

**News Update:**

Victor Aerospace Hosts PTSA Victor Aerospace Hosted the PTSA Customer Day Event at Facility in Johannesburg, South Africa For Immediate Release – [...]

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## Pacific AME Association



### Mission Statement

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.amec-teac.ca/pacific](http://www.amec-teac.ca/pacific)

## Western AME Association



### Website Still Under Maintenance

#### Website still 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](mailto:info@wamea.com) or [president@wamea.com](mailto: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](http://www.wamea.com)



## Central AME Association



### Manitoba's Annual Aviation Symposium

The 26th Annual Aviation Symposium is on **March 2-3, 2023!** Early bird discounts in effect **before February 5, 2023.** Save 10 percent.

#### Event Venue:

Canad Inns Destination Centre Polo Park  
1405 St Matthews Ave  
Winnipeg, Manitoba

#### Event Schedule:

Thursday  
0745 to 0900 Registration & Continental Breakfast in Trade show area  
0900 to 1530 Speakers & Presentations / Trade Show Open  
15:30 to 16:30 Skills competition  
1630 to 1830 Banquet Reception/Cocktails On-site in the TYC Event Centre  
1830 to 2100 Banquet in TYC

Friday

0745 to 0900 Registration & Continental Breakfast in Trade show area

0900 to 1630 Speakers & Presentations / Trade Show Open until 1400  
(Booth tear down @ 1400)

#### Event Speakers:

Thursday, March 2

Key Note Speaker: Kendra Kincade - President of Elevate Aviation

\*Pending\* Special 1 Day Course (Pre-registration required, limited capacity)

Friday, March 3

\*Pending\* Special 1 Day Course (Pre-registration required, limited capacity)

#### About CAMEA

The association was formed to provide a forum for Aircraft Maintenance Engineers resident or employed in the Central Region and more particularly to promote that species of knowledge which distinguishes the occupation of Aircraft Maintenance Engineer in the aviation industry. [www.camea.ca](http://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



## Annual General Meeting

The Annual General Meeting of the AME Association of Ontario was held on-line as a Google Virtual Meeting on Monday, September 12, 2022. Louis Anderson was voted in as our new president replacing John Longo who did a wonderful job keeping us on track through the pandemic. Additional new additions to the Board of Directors are Len McKay, Director-at-Large and Joe Brazeau, Director Northern Region. Thank you to all attendees and congratulations to our new board members.

## Shaping the future

Have you ever been perplexed when someone complains about politicians, but then admits that they don't vote? The same can be said of a lot of things including public policy, effective government, youth recreation and our profession. Decisions, policies, laws and programs are put into place by governing boards, citizen groups and professional organizations that rely heavily on volunteer leadership. It's one thing to have a good idea, but it's another thing entirely to manage, fund and determine how that idea is put into practice. Those who show up actually end up doing it all.

Consider volunteering with the regional AME Associations. You can contribute with opinions and expertise regarding training and regulations. You can help ease the burden of our dedicated volunteers who work hard to make our associations excel.

## 2022 Ontario Aircraft Maintenance Conference

The 2022 Ontario Aircraft Maintenance Conference will be held in Toronto at the Delta Hotel on Dixon Road on November 2-3, 2022. For details and registration see our website.

Something new this year is a special two-day "Fatigue Risk Management" course November 1-2 for managers and safety stakeholders. This course, along with other seminars planned for the conference, address the demand for more training within the "soft skills." The very popular Skills Competition will return with several new challenges. This event allows teams of students and veteran AMEs to show their abilities in problem solving, knowledge and manual dexterity to complete a series of tasks in aircraft maintenance.

— Submitted by **Stephen Farnworth**, For the Board of Directors

[www.ame-ont.com](http://www.ame-ont.com)



# Quebec AME Association

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



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We are delighted that you will continue to support us in our efforts to make our careers stronger and better recognized, while building cohesion between Aircraft Maintenance Engineers from Quebec and the rest of Canada.

## About Us

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.

The Association will ultimately become the AME's voice to Transport Canada's ears and will work with existing AME associations from coast to coast to make our profession stronger and more cohesive. One of the great goals of our association is to elevate ourselves to the status of a professional and to be recognized as such by the various federal government bodies. The other major mission of our association will be to make our profession better known. Our association offers many benefits to its members such as group discounts from various vendors, free magazine subscriptions, and discounts for AME's insurance.

[www.ame-tea.com](http://www.ame-tea.com) / e-mail: [info@ame-tea.com](mailto:info@ame-tea.com)

## Qui sommes-nous ?

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.

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.

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.

[www.ame-tea.com](http://www.ame-tea.com) / e-mail: [info@ame-tea.com](mailto:info@ame-tea.com)

# Atlantic AME Association



## Objectives / By-laws

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

### AME ASSOCIATION (ATLANTIC) INC BY-LAWS:

- All voting members of the Association must currently hold an AME license in any category or be a retired AME who has held an AME license. [ or
- Be a non-licensed aviation maintenance technician, technologist or individual meeting a recognized aviation trade standard (CGSB, Mil Standard, CCAA, SCA) or holding a position named in a MCM, MPM or ATO [ or
- Be a non-licensed person who holds a paid or volunteer administrative position actively involved in the daily running of the AME association for a period of no less than 5 years. Such person shall not occupy the position of president, vice president or sit as the representative of the Atlantic AME association on the CFAMEA board of directors.

### STUDENT MEMBERSHIP:

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

### CORPORATE MEMBERSHIP:

- Corporate membership is available to any corporation supporting the objectives of the Association, and which is actively involved in the aviation industry in the Atlantic region.
- A representative of a Corporate member shall have the right to attend all meetings but shall not be entitled to vote or hold office in the Association.

### BY-LAWS

1. Membership privileges are available to all members in good standing with dues paid to date. Lapsed membership may be re-instated with the payment of annual dues.

2. The Association President shall call Executive meetings as are deemed necessary. Normal notice of meetings shall be thirty days. Emergency meetings will be called as required.
3. Executive decisions can only be made with a quorum of 50% of the directors + one. Either the President or Vice-President must be included as one of the directors.
4. An annual meeting of the general membership will be held to normally coincide with the ARAMC.
5. All committee Chairpersons will report to the general membership at the Annual General Meeting.
6. An election of executive officers will be held annually at the general meeting. In the event that an elected committee chairperson resigns, for whatever reason prior to the expiry of his/her term, the President shall appoint another elected director to fill the position for the remainder of the resignee's term.
7. The Executive committee will be composed of a maximum of ten (10) and a minimum of six (6) directors who will manage the affairs of the Association.
8. Half of the executive will be elected at each AGM. All nominations must be accompanied with one signature of a member in good standing. Elections will follow the nominations. Nomination Forms must have the nominee's signature of acceptance of the nomination or the acceptance can be verified by phone call or e mail from the nominee.
9. If a serving member of the executive is nominated to another position on the executive, he/she shall tender their resignation upon accepting the nomination.
10. Elections will be by secret ballot.
11. Members serving on the Executive should be prepared to offer their service for two years and attend executive and other meetings as required.
12. The president will not be a voting member, with the exception of a tie-breaking vote.
13. An agenda will be required for the AGM for discussion and action on items proposed during the year, and will be mailed thirty days in advance.
14. Membership fees (regular, student and corporate) will be established on an annual basis by the members at the AGM.
15. Any amendments to the AME Association Objectives or By-Laws will be approved by the general membership at the AGM.

[www.atlanticame.com](http://www.atlanticame.com)

# SoCal PAMA Chapter



## Open Letter to SoCAL members

As the world evolves in the wake of the COVID pandemic, so has your SoCal PAMA Chapter. As many of you may or may not know, after 49 years in operation, the 94th Aero Squadron permanently closed their doors in May 2022. The 94th was a popular and perfect geographical location for our Chapter meetings and will be sorely missed.

The SoCal Board Of Directors has been conducting an exhaustive search for an alternate venue including the Odyssey Restaurant, Castaways Restaurant, other local restaurants as well as a hangar option on Van Nuys Airport, but none offer suitable seating capacity, speaker presentation accommodations and full-service dining provisions at an affordable price.

So, until another suitable venue becomes available to resume in-person meetings, SoCal PAMA is temporarily shifting to an on-line forum and will continue to provide free-of-charge job announcements, industry information and Scholarship opportunities via Constant Contact email broadcasts and the SoCalPAMA.org website. As a not-for-profit organization, SoCal PAMA depends entirely upon volunteers, member donations and corporate sponsorships and wishes to thank the following supporters once again for their donations during the pandemic: Aero-Nasch, Extraord-N-Air, Aircraft Window Repairs.

The Board of Directors is also seeking volunteers for several positions left vacant due to retirement and other obligations so please feel free to contact anyone on the BOD if you are interested. Donations to the Chapter are always welcome and appreciated too!

With sincere thanks,  
SoCal PAMA Board of Directors

[www.socalpama.org](http://www.socalpama.org)

## Central Ohio PAMA



### Support the COPAMA Scholarship Fund

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 shut down 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.

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At the end of 2021, the COPAMA Scholarship Fund had 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 the difficulties associated with COVID-19.

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# HOW GLOBAL TRAVEL TOOK OFF

By Harriet Bond



Larger and more economical aircraft have made cheaper air travel possible.

Here, we examine the timeline during which commercial flights evolved from being an experience that was once exclusively for the wealthy.

**F**LYING has become the transport of choice for business travellers and holidaymakers across the globe and is now considered the fastest, most convenient and safest form of long-distance travel. But how did commercial flights go from being exclusively for the wealthy to the mainstream and affordable option it is today? The following is a guide through the various decades of air travel and how it has shaped modern-day living.

## THE FIRST COMMERCIAL FLIGHT

The first ever passenger flight took off in May 1908 when Wilbur Wright carried Charles Furnas just 2000 feet across the

beach at Kitty Hawk in North Carolina. Just one year later, and the first airline in the world – German airship company DELAG – was founded.

In 1914, the world's first scheduled passenger service, an airboat piloted by Tony Jannus, set off from St Petersburg in Florida and landed at Tampa – around 17 miles away. The service only ran for four months, but it had unlocked the appetite of those keen to tap into the novelty of air transport.

## A NEW ERA OF AVIATION

However, it most likely wasn't until the 1920s when commercial flights carrying paying passengers started to become commonplace with the introduction of

the multi-engine aeroplane, the Lawson C-2, which was specifically designed to carry passengers.

During this time, more and more start-up airline carriers were being established – some of which are still in operation today. These include KLM in the Netherlands (1919), Colombia's Avianca (1919), Qantas in Australia (1920) and Czech Airlines (1923).

Aircraft from this period would land frequently to refuel and fly at lower altitudes due to unpressurized cabins. This made travelling by plane noisy, cold and expensive. Flying times were lengthy and turbulence was frequent. Passengers regularly experienced air sickness and many airlines hired nurses to reduce anxiety and tend to those affected.



**Above: Freddie Laker founded one of the first airlines to offer budget alternatives. Top, right: The airline carrier Pan Am was a front runner in pioneering and marketing the very best air travel had to offer. Right: The introduction of the Douglas DC-3 in 1935 had a big impact on the future of commercial flight.**

In 1935, one of the world's oldest airlines, Qantas, operated its first international passenger flight, travelling from Brisbane to Singapore. From there, the British-owned Imperial Airways connected this flight to the UK. This was to set the wheels in motion for creating a regular travel route between Australia and the UK in the coming decades.

Despite flying being quite dangerous and extremely expensive during the 1930s, it was still a fashionable way to travel for the rich. According to the Smithsonian National Air and Space Museum, the number of airline passengers grew from just 6,000 in 1930 to nearly half a million by 1934 — the aviation industry was well on its way to becoming hugely important to the global economy.

## **INNOVATION THAT REVOLUTIONIZED AIR TRAVEL**

The introduction of the Douglas DC-3 in 1935 also had a big impact on the future of commercial flight. The propeller-driven airliner was a larger and much improved aircraft compared to its



predecessors. Faster and more reliable, it could carry up to 32 passengers and had a cruising speed of 207 mph with a range of 1,500 miles. This made it popular with well-established airlines, including Delta, TWA, American and United, who soon added the aircraft to their fleets.

During the 1940s, the onset of WWII meant commercial aviation developments slowed considerably. However, by the end of the decade, the industry was heading towards a new era as Pan Am began operating its fleet of Boeing 307s, which featured the first ever pressurized cabin. This transformed air travel for passengers, allowing them to enjoy a comfortable experience at an altitude of 20,000 feet.

Major airlines were now ramping up their advertising spend and offering travellers smooth journeys to far flung destinations and business hubs, including Pan Am's iconic New York to London route.

## **THE GOLDEN AGE OF AIR TRAVEL**

The 1950s and 1960s heralded the age of the jet engine aircraft and with it came an upsurge in commercial flights, airline carriers and international flying routes. Commercial air travel was booming, and major airlines were fiercely competitive, offering passengers more and more inflight perks, including lavish silver-service meals and fine wines.



**Today, the world's largest low-cost carrier is Southwest Airlines.**

The airline carrier Pan Am was a front runner in pioneering and marketing the very best air travel had to offer. It was the first airline to fly worldwide and introduced ground-breaking changes to the industry, such as adding jet aircraft to their fleets and utilizing computerized reservation systems.

In the 1960s, work began on creating the world's first supersonic aircraft and what would eventually become an iconic symbol of commercial flight, the Concorde. Offering transatlantic flights in just 3.5 hours, the aircraft was a hit with business travellers and royalty alike. However, tickets were extremely expensive and only a privileged few could afford to travel via Concorde.

## **THE RISE OF THE NO FRILLS AIRLINE**

Seeing a gap in the market for making air travel more accessible to everyday people, British-owned Laker Airways, which was founded in 1966 by Freddie Laker, was one of the first airlines to start offering a budget alternative by adjusting its inflight offer.



**The tragic events of 9/11 had a profound effect on air travel.**

Using the budget airline business model that is commonplace today, Laker was able to offer lower price fares by reducing inflight services and luxuries, such as free meals. The airline also found innovative ways to reduce fuel consumption and engine wear by introducing the reduced thrust take-off technique and faster climbs to obtain the optimum flying altitude in as little time as possible. Sadly, the airline was

a casualty of the 1980s recession and subsequently went bankrupt. However, it had paved the way for budget travel and had opened a world of possibilities for millions more people to get the chance to travel by air.

Today, the world's largest low-cost carrier is Southwest Airlines in the US. Synonymous with budget travel, the company's low-cost domestic and short haul offer has undoubtedly inspired



many other well-known brands to tap into the no-frills market, including Ryanair and EasyJet.

## AIR TRAVEL FOR THE MASSES

Larger and more economical aircraft, such as the Boeing 747, had also made cheaper air travel possible. Airlines were now able to carry more passengers than ever before, meaning ticket prices could be sold at a reduced rate. Holidaying abroad was no longer reserved for the rich. This change in dynamics meant airlines now started to look for different ways to retain the luxurious service and long lunches that had been synonymous with the golden age of travel, without compromising on providing a budget alternative.

First-class cabins, sophisticated onboard bars and exclusive-use airport lounges meant those who could afford to, could still travel in style. During the 1980s and 1990s, the budget airlines Ryanair and EasyJet launched. Offering airfares for as little as \$30 CDN, they changed the face of commercial flying and put pressure on traditional carriers to lower ticket prices.

**During the 1980s and 1990s, budget airlines such as EasyJet launched, offering airfares for as little as \$30.**

## SECURITY TIGHTENING IN THE 2000S

The tragic events of 9/11 had a profound effect on air travel. Security at airports was increased significantly and passengers without a ticket at US airports could no longer accompany friends and family through security to the gate. Cockpit security also heightened. Previously, it had been possible for passengers to visit the flight deck and speak to the pilots. However, after 2001, cockpit doors were locked with only the pilots controlling who could enter.

## A NEW ERA FOR AIR TRAVEL

According to the Bureau of Transportation Statistics, it took until 2004 for air passenger numbers to reach pre-9/11 levels and until 2007 to reach a record high. During this period, low-cost carriers were experiencing increased demand as the popularity of booking websites surged and, by 2009, figures from the tourism research company

PhoCusWright reported that half of all travel-related bookings were being made online. Passenger numbers continued to surge throughout the 2010s and by the end of the decade the volume of travellers using commercial airlines was at an all-time high.

## THE POST-PANDEMIC ERA

Prior to the pandemic, the International Air Transport Association predicted that the number of airline passengers could reach 7.2 billion by 2035. However, nobody in the industry could prepare for the global aircraft groundings and unpredictable travel restrictions caused by COVID-19.

Despite this, the industry is full of optimism. As we enter a new era for aviation, and reflect on the past, we can be confident that no matter what obstacles we encounter in the future, air travel will prevail. ■

*(Story submitted by Harriet Bond, on behalf of Artemis Aerospace.)*



# Weaker Than Required

*Tensile strength is called into question when a main rotor hub strap retaining pin fails.*



**Above: Occurrence helicopter. Above right: Accident site looking east.**

**ON** 28 JUNE 2021, the Yellowhead Helicopters Ltd. Bell Textron Inc. model 212 helicopter (registration C-GYHQ, serial number 30933) was conducting operations in support of forest fire fighting efforts approximately 4 nautical miles west-northwest of Evansburg, Alberta. At approximately 1800 Mountain Daylight Time, the helicopter departed the staging area to complete a series of 3 flights transporting groups of forest fire fighters back to the staging area.

The first 2 trips were completed uneventfully. During the last trip, as the helicopter was approaching the landing area to pick up the final group of fire fighters, one of the main rotor blades separated from the rotor head assembly. The second rotor blade and rotor head assembly then broke free from the helicopter and the helicopter crashed. The pilot, the sole occupant on board, was fatally injured. There was a post-impact fire that destroyed the helicopter. A signal from the 406 MHz emergency locator transmitter was not received.

## PERSONNEL INFORMATION

The pilot held an airline transport pilot licence — helicopter and type ratings on the Bell 204, 206, 212, 47, and 47T; the Hughes 500 series of helicopters; the Kamov KA32; Robinson Helicopters models R22 and R44; and the Airbus AS350. The pilot held a valid Category 1 medical certificate. His last pilot

proficiency check for the Bell 212 series of helicopters was conducted on 18 November 2020, and he completed his last Bell 212 written type exam on 08 July 2020. The pilot held the appropriate licence and ratings for the flight in accordance with existing regulations.

## AIRCRAFT INFORMATION

The Bell model 212 is a utility helicopter powered by a Pratt & Whitney Canada PT6T-3B Twin-Pac engine. The rotor head is of the semi-rigid teetering design, with a 2-bladed main rotor that has a diameter of 48 feet. The aircraft incorporates traditional collective, cyclic, and anti-torque pedal controls.

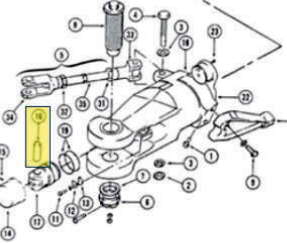
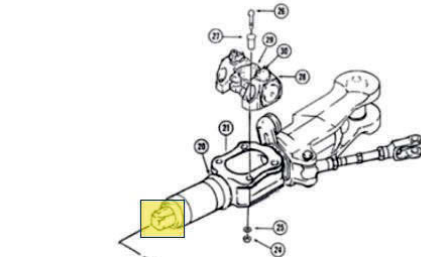
## PREVIOUS MAINTENANCE

On 20 June 2021, the occurrence helicopter had scheduled maintenance performed at the Yellowhead Helicopters facility in Prince George, British Columbia. Both main rotor hub straps and the associated main rotor hub strap retaining pins had been replaced with new parts acquired from Bell. This work was completed to comply with the requirement to replace the parts after 1200 flight hours or 24 months. At the time, the helicopter had accumulated 29 605.9 hours total time on the airframe (TTAF). This maintenance action was completed by company maintenance personnel.





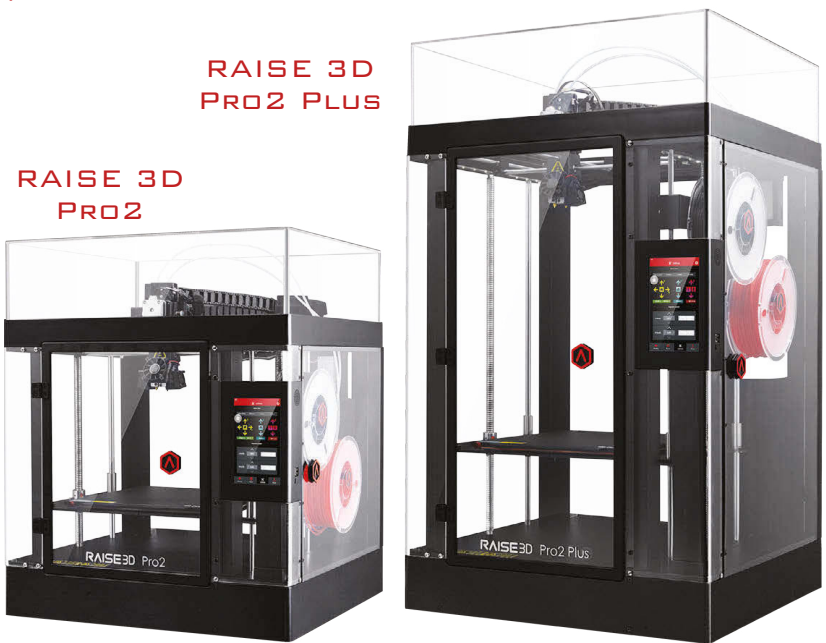
Above: Main rotor blade A strap and failed hub strap retaining pin.  
 Above right: The occurrence helicopter's 4 main rotor hub strap retaining pins.  
 Below left: The shipments of conforming pins (left) and non-conforming pins (right).  
 Bottom: Map of the accident site and approximate fire area, with the accident site staging area in inset.  
 Right: Example of 316 stainless steel pin on the left and H11 tool steel pin on the right.  
 Bottom right: Shaded boxes denote the strap restraining pin (16) and the strap.



- |               |                 |                  |
|---------------|-----------------|------------------|
| 1. Plug       | 13. Lock        | 25. Washer       |
| 2. Nut        | 14. Nut         | 26. Bolt         |
| 3. Washer     | 15. Key         | 27. Bushing      |
| 4. Bolt       | 16. Pin         | 28. Pillow Block |
| 5. Drag Brace | 17. Fitting     | 29. Trunnion     |
| 6. Nut        | 18. Grip        | 30. Reservoir    |
| 7. Washer     | 19. Packing     | 31. Nut          |
| 8. Bolt       | 20. Radius Ring | 32. Nut          |
| 9. Bolt       | 21. Yoke        | 33. Fitting      |
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 Supported OS: Windows, macOS, Linux. Network: Wi-Fi, Ethernet. Power-loss Recovery.  
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 Filament Run-out Sensor. Print Head Travel Speed: 30-150 mm/s. Layer Height: 0.01 - 0.25mm.  
 Nozzle Diameter: 0.4mm (Default) and 0.2/ 0.6/ 0.8/ 1.0 mm. Max Nozzle Temperature: 300 °C.  
 Max Build Plate Temperature: 110 °C. Connectivity: Wi-Fi, LAN, USB port, Live camera.  
 Filter: HEPA with activated charcoal. Certifications: CB, CE, FCC, RoHS. ISO 9001 & ISO 14001.

On 22 June 2021, a local post-maintenance test flight was conducted. No defects were noted. Between 22 and 27 June 2021, the occurrence helicopter accrued 18.9 flight hours.

At the time of the occurrence the main rotor hub strap retaining pins had accrued approximately 21.4 hours of service time.

**WRECKAGE AND IMPACT INFORMATION**

The helicopter came to rest on its right side in muskeg. The east side of the fuselage wreckage site was accessible via stable but burned out earth and trees. The west side of the fuselage wreckage was in a muskeg area in water that was several feet deep. The majority of the fuselage was consumed by the post-impact fire. The tail boom remained largely intact.

The first main rotor blade to separate from the helicopter came to rest in a burned out bush area approximately 460 feet southwest of the main wreckage site. The tip of this blade was buried in the muskeg approximately 10 feet deep, with the blade grip end pointing up.

The second main rotor blade separated from the helicopter with the rotor head assembly still attached and came to rest on top of wet muskeg 85 feet northeast of the main wreckage site.

Both main rotor blades were recovered from the muskeg and brought to the staging area where the main rotor blades were removed from their respective blade grips. Investigators observed that the main rotor hub strap retaining pin of blade A had failed. Both grips and the main rotor head assembly were shipped to the TSB Engineering Laboratory in Ottawa, Ontario, for a detailed examination, and metallurgical analysis. No other defects were found that would have contributed to the occurrence.

**TSB ENGINEERING LABORATORY EXAMINATION**

Both main rotor blade grips and the rotor head were disassembled so that all

4 of the main rotor hub strap retaining pins could be removed for examination. Metallurgical analysis of the 4 pins (part number 204-012-104-005) revealed that the failed pin (serial number FNFS90) was manufactured from 316 stainless steel, whereas the other 3 pins (serial numbers FNFS49, FNFS54, and FNFS75) were manufactured from H11 tool steel. The TSB Rockwell hardness test of the failed pin averaged 7.6 on the C scale.

### FORE MACHINE COMPANY

FMC was located in Haltom City, Texas, United States, and had been producing various components for Bell since 1985. More specifically, the company started producing flight safety critical aircraft parts for Bell in 2015. The main rotor hub strap retaining pins (part number 204-012-104-005) in this occurrence were from FMC's first production batch for Bell.

Bell established the design criteria and specifications for the part required, and FMC produced a part that met those specifications. If any non-conformances were discovered during the manufacturing process, 1 of 2 things occurred: FMC reworked (fixed) the part to ensure it met the design specifications (non-controlled product only), or Bell was notified of the non-conformance in the product, and the matter was dealt with via the appropriate process (both controlled and non-controlled product).

On 19 November 2021, FMC ceased all operations and released all company personnel. The investigation determined that when the occurrence pins were manufactured in the fall of 2018, FMC stored the raw material in its stores area by material diameter, not by type or composition. This meant, for example, that all rods that were 1 inch in diameter were stored together, regardless of the material they were made of (aluminum, carbon steel, stainless steel, brass, etc.). As a result, the onus was on the individual selecting the material for the job at hand to ensure that it was of the correct composition and specification.

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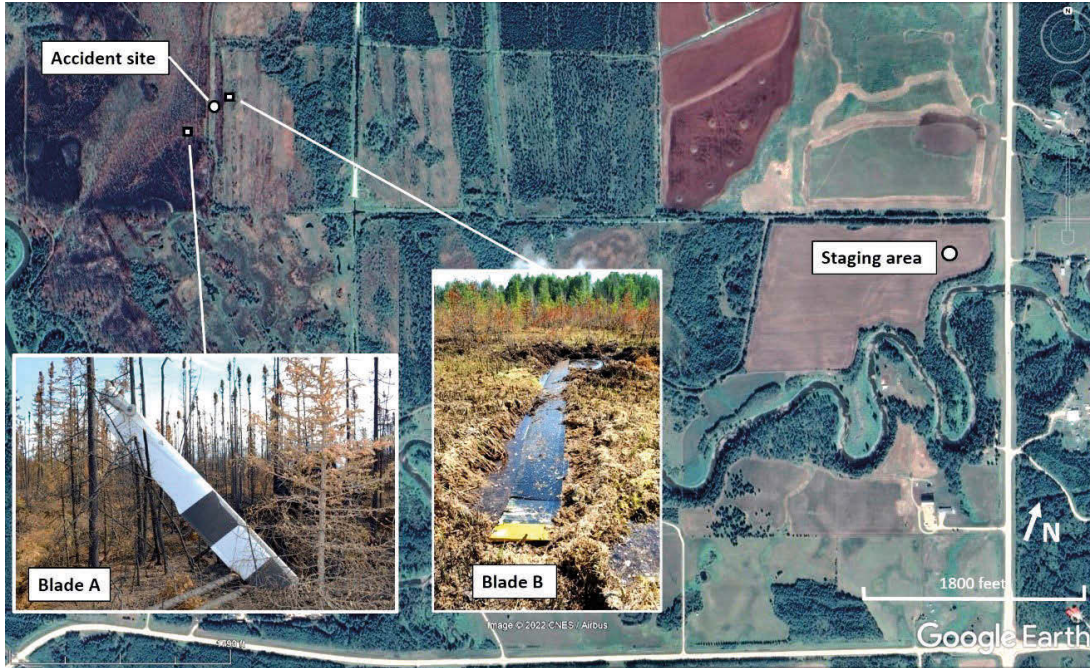
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**Above: Map showing the location of the staging area and accident site, with inset photos of the 2 main rotor blades.  
Below: Photo of the main rotor blade B and rotor head assembly.**



## ANALYSIS

The investigation determined that operational factors were not considered to have contributed to this accident; therefore, the analysis will focus on the manufacturing process of the non-conforming main rotor hub strap retaining pin, including inspections for quality and conformance.

## MAIN ROTOR HUB STRAP RETAINING PIN

The outboard main rotor hub strap retaining pin (part number 204-012-104-005, serial number FNFS90) failed in flight and one of the main rotor blades separated from the helicopter and rotor head assembly. The investigation determined that the pin was manufactured from 316 stainless steel instead of tempered H11 tool steel as designed. Because 316 stainless steel has approximately  $\frac{1}{3}$  the tensile strength of H11 tool steel, the pin was unable to withstand the forces applied to it during normal operations. As a result, the pin failed in a shear mode approximately 21.4 hours of time in service after being installed in the rotor head assembly.

## FINDING AS TO CAUSES AND CONTRIBUTING FACTORS

One of the main rotor hub strap retaining pins—a flight safety critical aircraft part—was manufactured from a type of steel that was weaker than the steel required by design. As a result, the pin failed in flight and its associated main rotor blade separated from the helicopter. The remaining blade and the main rotor head assembly subsequently separated from the helicopter and the helicopter impacted the ground.

## FINAL INSTALLATION

The last opportunity to catch non-conforming material is when a part is installed on the component or aircraft. In this occurrence, it would have been when the aircraft maintenance engineer at Yellowhead Helicopters replaced the set of 4 pins and 2 straps the week before the accident.

After reviewing the documentation that the company received with the part from Bell, and reviewing the physical characteristics of the non-conforming pin against a conforming pin, the investigation determined that it would be unreasonable to expect the aircraft maintenance engineer to have been able to identify the differences between the 2 parts. The physical appearance of each pin was essentially identical, and the weight difference between the 2 of them was approximately 13 grams, a discrepancy of 3.2%.

## FINDINGS

One of the main rotor hub strap retaining pins—a flight safety critical aircraft part—was manufactured from a type of steel that was weaker than the steel required by design. As a result,



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the pin failed in flight and its associated main rotor blade separated from the helicopter. The remaining blade and the main rotor head assembly subsequently separated from the helicopter and the helicopter impacted the ground.

For undetermined reasons, the quality control inspector at Fore Machine Company did not observe, either through visual inspection or through a review of the certification paperwork, that mixed material was identified in the lot. Consequently, pins made of the incorrect material specification were allowed to continue through the production process.

The lack of training requirements for hardness testing within the standard operating procedures likely contributed to the procedure being completed incorrectly. As a result, the non-conforming pins were allowed to continue in the manufacturing process. For undetermined reasons, the quality control systems in place at Fore Machine Company did not identify the non-conforming main rotor hub strap retaining pins; consequently, the pins were not identified and removed from the supply chain.

## SAFETY ACTION TAKEN

On 05 July 2021, Bell Textron Inc. (Bell) issued 4 alert service bulletins covering model 204B, 205, 205B, and 212 helicopter fleets. The alerts required the review of the aircraft's technical record to determine if any main rotor hub strap retaining pins with the serial number prefix FNFS were installed. If pins with the affected prefix were installed, they were to be replaced with pins of a different serial prefix before further flight.

On 05 July 2021, Transport Canada issued an emergency airworthiness directive (CF-2021-23) mandating compliance with the Bell alert service bulletins affecting model 204, 205, and 212 aircraft fleets in Canada before further flight.

## YELLOWHEAD HELICOPTERS LTD.

On the evening of 28 June 2021, shortly after the occurrence, Yellowhead Helicopters Ltd. stood down all aircraft operations. On the afternoon of 29 June 2021, the Bell 206 and Airbus AS350 fleets were returned to service. The Yellowhead Helicopters Ltd. Bell 212 fleet remained grounded until the Bell alert service bulletin 212-21-165 was issued, and it had been confirmed that the remaining aircraft did not have main rotor hub strap retaining pins with the affected serial number range installed. The Bell 212 fleet was returned to service on the afternoon of 05 July 2021. ■

*(These were excerpts from Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 17 August 2022. It was officially released on 07 September 2022.)*

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## The Numbers Game

*At least one industry watcher forecasts a multi-trillion-dollar splurge in commercial jet production over the next 10 years.*



**Airbus and Boeing will account for most of the commercial jet production in the next 10 years.**

**F**OR MORE THAN 45 YEARS, Connecticut-based Forecast International has dished-up research and analysis for the aerospace industry. And now the firm is predicting that 18,679 large commercial jet transports will be produced in the 10-year period from 2022 to 2031, with the value estimated at 2.94 trillion US dollars. This forecast indicates that Airbus and Boeing will account for 96.7 percent of total production in the large airliner market during the 10-year forecast period.

“The large commercial airliner market remains essentially an Airbus/Boeing duopoly,” said Forecast International Senior Aerospace Analyst Raymond Jaworowski. “Nevertheless, the two giant manufacturers do face some challengers, particularly in the narrowbody segment.” New narrowbodies entering the market include the COMAC C919 from China and the Irkut MC-21 from Russia. Boeing has made considerable progress in getting its 737 MAX program back on track. The company resumed customer deliveries of MAXs in December 2020.

Demand for large commercial airliners picked up substantially in 2021. Combined, Airbus and Boeing recorded 1,666 gross orders for large commercial airliners in 2021, almost triple the 561 gross orders registered by the two companies in 2020. Order cancellations did continue at a high (though reduced) rate into 2021, suppressing net order totals.

Boeing is well-positioned in the widebody market, where

its twin-engine 777 and 787 models have proven to be popular items. The 787 program did suffer a production hiccup in 2021, causing a temporary suspension of deliveries, but this should prove to be only a short-term obstacle. As for the 777, Boeing is currently managing a transition from the Classic versions to the new 777X series, a move that has become somewhat complicated in the midst of a difficult widebody market. Production of the four-engine 747-8 is scheduled to end in 2022.

Airbus has also been in the process of refashioning its product line. In the narrowbody segment, the re-engined A320neo variants have largely succeeded the original members of the A320 family in production. The A321LR and A321XLR versions of the A321neo are mounting at least a partial foray into the Boeing 757 replacement market. Acquisition of the CSeries from Bombardier has provided Airbus with a product, re-named the A220, positioned at the lower end of the narrowbody market.

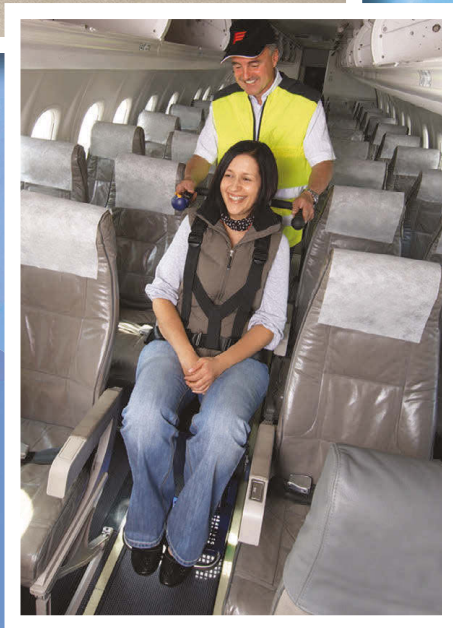
In the widebody arena, Airbus is replacing the original A330 with the re-engined A330neo. The production ramp-up of the A350 was interrupted by the pandemic, but is slated to resume in 2023. A freighter version of the A350 is under development. Production of the 500+ passenger A380 ended in 2021. ■

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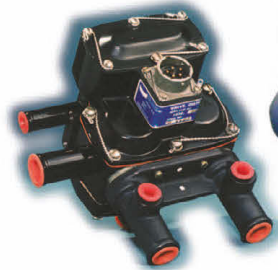
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