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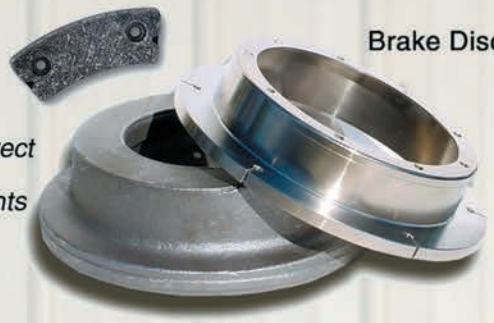

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New life for a historic asset

As mentioned in 'Industry Forum' this issue, construction of an aerospace cluster at Toronto's Downsview Park is now well underway with backing from members of the aerospace community and of course from federal and provincial governments, which contributed a combined $44 million to relocate and expand Centennial College's aerospace program at Downsview. This is the first step toward the creation of the Downsview aerospace hub, and it's an exciting development to consider.

By some estimates this initiative will create 14,400 jobs and contribute $2.3 billion to the economy over the next 20 years. The heart of the cluster will include Downsview Aerospace Innovation and Research (DAIR) consortium members Centennial College, University of Toronto Institute for Aerospace Studies, York University, Ryerson University, and eight aerospace companies: Pratt & Whitney Canada, FlightSafety International, UTC Aerospace Systems, Honeywell, Safran, MDA, Bombardier Aerospace, and Canadensys Aerospace Corporation. These firms will participate in the DAIR Innovation Centre, which will provide shared space and test facilities to collaborate on new research, development and commercialization initiatives.

The Downsview site was a military base for many years until it was closed in 1996. Today, the site consists of numerous buildings and complexes considered part of a rare collection of structures linked to the aviation history of Canada.

University of Toronto's Institute for Aerospace Studies professor David Zingg, a DAIR founding member, calls the development a whole new approach to aerospace education.

"The opportunity that Downsview presents for companies, colleges and universities to work together in close proximity on aerospace education, research and product development cannot be overstated. We know that it is through this kind of industry-academic collaboration, facilitated by clustering, that the most significant and innovative results occur," said Zingg. Apparently DAIR has already attracted the attention of other leading aerospace companies in the US and Europe, who are looking at Downsview as a growth opportunity for their companies in the Canadian marketplace. ■

Departments

10

Features

AirMaintenance Update

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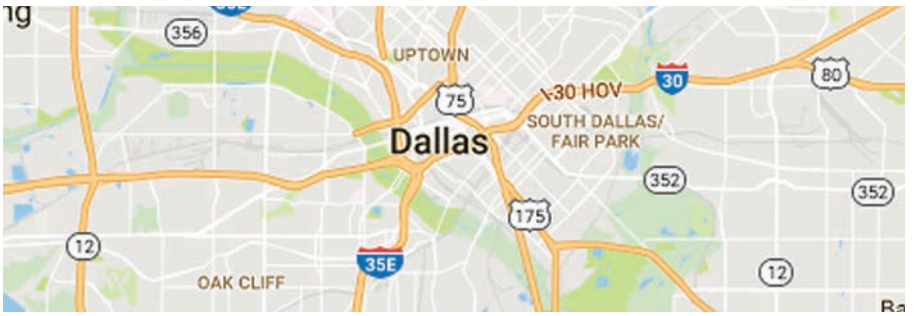
Upcoming Events

Call for papers for Dallas event



CHC Helicopter is making a formal call out for papers for its 2017 CHC Safety & Quality Summit, focusing on the theme, "Can we truly manage all of the risk: what if the barriers are not as robust as we think?" In its 12-year history, the summit has grown to become an industry-leading aviation safety event. This year's summit will take place September 27-29 at the Gaylord Texan Resort & Convention Center located near Dallas, Texas. Each year, the summit draws hundreds of attendees who gather to hear speakers including experts from the aviation, oil & gas and safety industries. Speakers share best practices and present on topics with an aim toward making helicopter transport and aviation industry better through promoting excellence in safety and human factors, and maintaining a robust safety environment.

Most sessions have a 90-minute scheduled timeframe, however that can vary depending on the topic presented. Those interested in leading a session during the three-day event are encouraged to visit www.chcsafetyqualitysummit.com to access submission form for papers and other information. Submissions should include proposed session titles, a description or outline, objectives and audience benefits, a brief presenter bibliography and contact details. Relevant topics may include (but are not limited to): compliance monitoring, technology and safety methods of training, crisis management, human factors, flight data monitoring, safety management tools, or practical tools.

Send all submissions via email to summit@chc.ca.

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STCs & new products

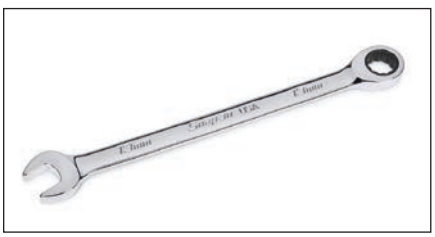
Aircraft maintenance-specific creeper reduces injury

The Ez Creeper Company offers an aviation creeper that is reportedly designed by a pilot specifically for aircraft maintenance.

This product is adjustable without dismounting and comes with hand-powered hydraulics that elevates and de-elevates on-the-fly. Manufactured with a 1/8-inch aluminum frame, the Ez Creeper comes with a limited lifetime warranty and a claim that it will reduce injury.

For more information visit www.ezcreeper.com

Ratcheting wrenches offer more torque in tight spaces



Snap-on's new ratcheting wrenches are said to deliver up to 20 percent more ultimate torque and 95 percent additional cycle life. These non-reversible ratcheting wrenches are engineered with a zero degree offset, uni-directional design to deliver more power in less lateral space. Features and benefits of the new ratcheting wrenches (SAE & metric sizes) include an 80-tooth ratcheting gear and the Flank Drive wrenching system.

For information visit www.snapon.com

Coverall offers protection from liquid splashes

Kimberly-Clark's Kimtech Pure A6 liquid splash protection coverall with hood is able to provide liquid splash protection and comfort in a single suit through two low-lint fabrics: high-performance laminated film for the front panel, hood, arms and legs; and lightweight, breathable filter material for the back panel.

The new coverall also offers a claimed 94 percent bacterial filtration efficiency, built-in thumb loops, and elastic cuffs.

For information visit www.kimtech.com

Timberland footwear provides good grip on a bad floor

Timberland PROIndustrial Traction footwear features the Rigmaster, Triflex, and Quadro outsoles, which are intended to deliver slip-resistance on a variety of surfaces.

The work boot styles feature slip-resistant outsoles, anti-fatigue technology, Titan XL safety toe, Timerberland Pro rubber, and positioned lugs.

For more information visit www.timberlandpro.com

Rotary blade storage rack from JETechnology

JETechnology's aluminum storage rack is designed specifically for rotary blades. The RBR comes with telescoping rails that allow it to be lengthened to accommodate varying lengths of blades. It comes equipped with UHMW plastic on all contact surfaces of the rack to limit any damage to blades. The RBR is mounted on a set of polyurethane coated, solid iron casters that enable the rack to be used by hand. A towbar is also included for movement of the rack by powered machinery.

For more information visit www. aircraftmaintenancestands.com

Ballistic nylon engine cover provides shelter from the storm

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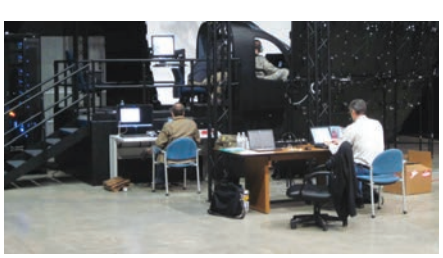
TWO AFGHAN CHINOOKS ARE MUSEUM BOUND

The Ottawa Citizen reports that museums in Trenton and Petawawa have taken possession of the two remaining RCAF CH-147 D-model Chinook helicopters, aircraft that both served during the Afghan war. They have been donated to the National Air Force Museum of Canada and the Canadian Forces Base Petawawa Military Museum, respectively, according to the Department of National Defence. The helicopters were purchased from the United States in 2009 to provide an interim capability for the Canadian military while it was operating in Kandahar.

One of the helicopters arrived at 8 Wing Trenton on November 17, 2016, where it will be re-assembled and painted. Its counterpart arrived at Canadian Forces Base Petawawa on November 18, and it too will be re-assembled, refinished and put on display as a gate guard outside 450 Tactical Helicopter Squadron. Two other D-model Chinooks were "damaged beyond repair" in Afghanistan. Another two were sold to Boeing.

BIG CANADIAN CONTRACT FOR GLOBAL TRAINER



The international aviation training firm CAE announced in early January that it has signed two long-term training services contracts with the United States Army and the Royal Canadian Air Force with a combined value of more than C$1 billion, including options. The contract with the US Army is for rotary-wing flight training classroom, simulator, and live flying instructor support services for one year with eight one-year options until 2026. The training is delivered at the US Army's Aviation Center of Excellence at Fort Rucker, Alabama. The contract with the RCAF is a modification and extension to 2023 of the NATO Flying Training in Canada program where CAE provides ground-school classroom and simulator training, and supports the live flying training of military pilots in Moose Jaw, Saskatchewan and Cold Lake, Alberta. In addition, CAE will also add new capabilities and perform a range of upgrades and updates to the overall NFTC training system and aircraft over the next several years. The modified operating period of the NFTC contract includes a one-year option to extend through 2024.

MORE ORDERS FOR BOEING'S FAST-SELLING MAX

Boeing and GE Capital Aviation Services, the commercial aircraft leasing and financing arm of General Electric, made an early-January announcement of an order for 75 737 MAX 8 aircraft. The order, booked in December, has an approximate value of $8.25 billion at list prices. The follow-on order increases the GECAS firm order book for the 737 MAX to 170 airplanes, the largest of any aircraft leasing company. To date, customers have ordered 3,419 MAXs, making it the fastest-selling airplane in Boeing's history.

NEW CENTRE WILL PUT DRONES TO WORK

The New Jersey-based maker of navigation technology for unmanned vehicles, Luftronix Inc., has reported it will open a test and demonstration centre at the Cape May Airport and says it is "pretty certain that this is the first time that drones are being tested on a regular basis for aircraft inspections." The company will use the new centre to conduct aircraft inspection flights with drones to scan the airplanes and test for damage from corrosion, dents and lightning strikes. The new test centre is located in the main hangar at Cape May airport where Luftronix will use a De Havilland DHC-4 Caribou airplane for the testing and demonstration program.

HELIJET GIVEN GREEN LIGHTS AT BC HOSPITALS

It was the gift they'd hoped for when in early December 2016 Helijet International Inc. received the necessary regulatory approvals from Transport Canada to re-establish full 24-hour emergency air ambulance service to all hospital heliports in British Columbia, including Vancouver General Hospital, Surrey Memorial Hospital and Royal Columbian Hospital in New Westminster. Full service resumed December 2nd.

Questions raised by Transport Canada last spring resulted in Helijet voluntarily suspending its Sikorsky 76C+ air ambulances from landing at up to seven BC hospital helipads, pending resolution with the federal regulator. In August, exemptions were granted resulting in the restoration of Helijet flights to five hospitals, but restrictions remained at the Royal Columbian and Surrey Memorial Hospital helipads. BC Emergency Health Services used an alternate service provider for day flights to those facilities.

The matter has been resolved due to work between Helijet, Transport Canada, the aircraft manufacturer and an independent aviation expert, Maxcraft Avionics. Detailed aircraft data verification was done and a new Supplemental Type Certificate was issued by Transport Canada. This certificate is being permanently added to the S76C+ flight manual documentation and permits the full resumption of landings at all previously restricted elevated hospital heliports.

EVEN BETTER THAN AIRBUS HAD HOPED FOR

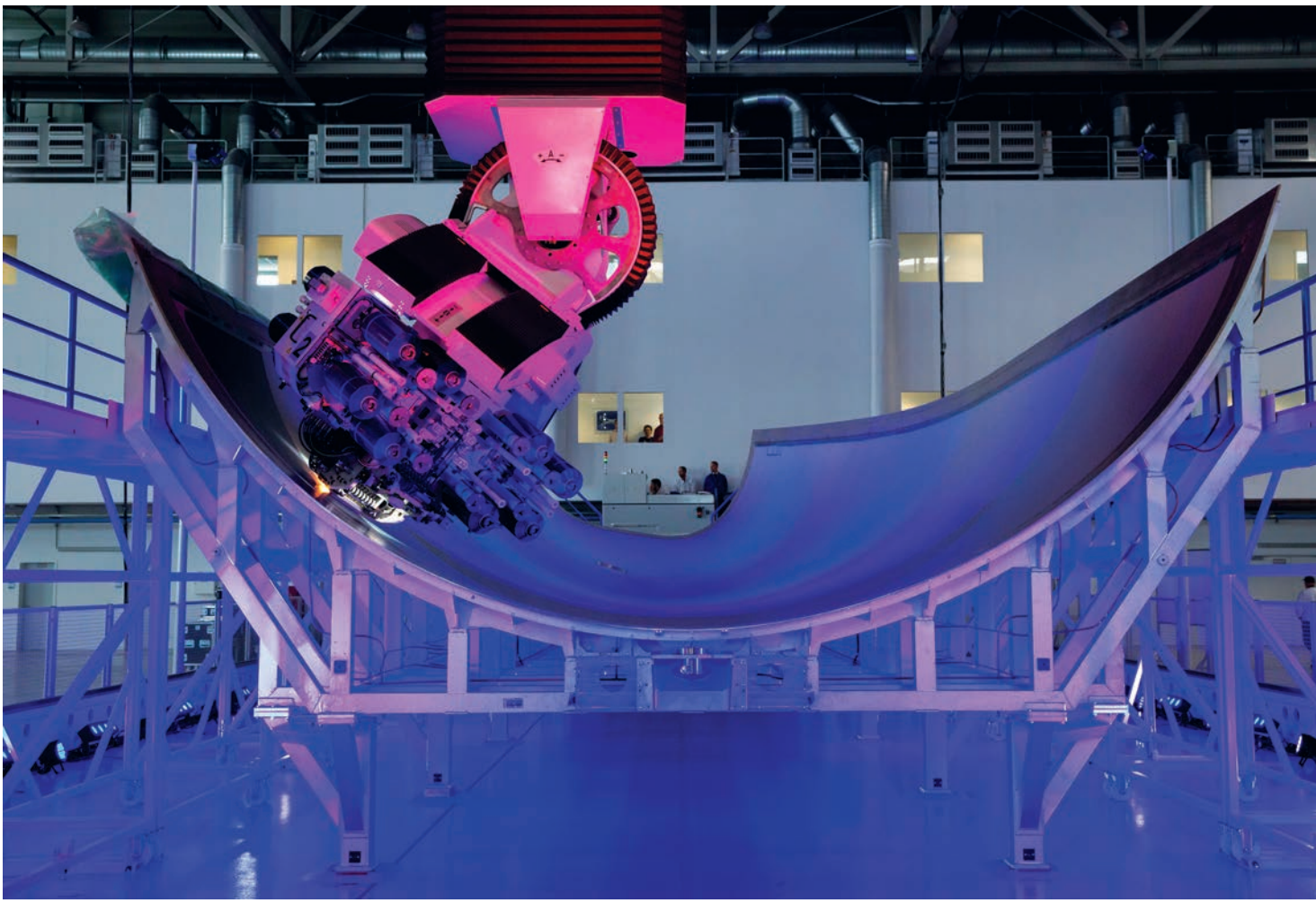
Airbus posted an eight percent rise in deliveries last year, beating its own forecasts by a comfortable margin to set a company record, and pulled off a last-minute surge in orders to beat arch-rival Boeing in the race for new orders. Confirming an estimate published by Reuters, Airbus said it had delivered 688 aircraft in 2016, compared with its most recent forecast of 670. Airbus announced a fourth successive win in the race for new business after posting 731 net orders for 2016, including more than 300 orders in December, confirming potential business reported earlier by Reuters. Boeing kept the title of No.1 producer with 748 deliveries but registered a lower figure of 668 net orders. The surge in Airbus orders included 98 out of 100 aircraft sold to Iran under a historic sanctions deal.

CENTENNIAL COLLEGE AEROSPACE CAMPUS TAKES FLIGHT

Centennial College in Toronto has broken ground on its Downsview Park aerospace campus, the first step towards creating an aerospace training and research hub for the development of new technologies in Ontario. The historic de Havilland of Canada building at Downsview Park in Toronto will be adaptively re-used to serve as the new home of Centennial College's aerospace technology programs. The project will involve selective demolition as well as new construction. General contractor is Bondfield Construction. The project, which has a total price tag of $72 million, repurposes the historic building to create an estimated 138,000 square feet of academic space. Rehabilitation of the de Havilland building is scheduled for completion in the fall of 2018. The facility will house classrooms, laboratory space, workshops, offices, a library and hangar space. The college said the hangar would be large enough to accommodate commercial jets. *(Patricia Williams, Daily Commercial News report)*

RCAF ORDERS 16 AIRCRAFT

The Government of Canada announced it has selected the Airbus C295W for its Fixed-Wing Search and Rescue Program. As part of that program, the Royal Canadian Air Force will purchase 16 C295Ws modified for Search and Rescue. The C295W features substantial Canadian content—every C295 is powered by Pratt & Whitney Canada engines, pilots will be trained at a new facility developed by CAE, and the electro-optical systems for FWSAR will be provided by L3 Wescam. Canada's C295Ws are expected to be delivered starting three years after contract award. ■



Composite nondestructive inspection techniques:

To keep up with new aircraft materials, particularly in the Boeing 787 and the Airbus 350, aircraft inspection techniques are changing. Sandia National Laboratories has developed a first-of-its-kind composite nondestructive inspection techniques course that will be provided to aircraft manufacturers and airline inspectors to help them better inspect aircraft made out of solid-laminate composite materials.

Above left: A highly automated placement machine lays the first carbon fibre layers and after hardening in a special oven, these will form the Airbus 350's fuselage shell.
Above right: Boeing completes First 787 Composite Development Section.

lessons in a new material world

As manufacturers build more wings, fuselages and other major commercial aircraft parts out of solid-laminate composite materials, Sandia National Laboratories has shown that aircraft inspectors need training to better detect damage in these structures. So the Airworthiness Assurance Center — operated by Sandia for the Federal Aviation Administration (FAA) for the past 26 years — has developed the first course to train inspectors in the airline and aircraft manufacturing industries nondestructive inspection techniques (NDI) for solid-laminate composite materials.

The course was first presented last summer at Delta Air Lines Inc. in Atlanta, Georgia, to 35 engineers and inspectors from six countries. The FAA sponsored development of the course, which is now available to private industry.

"We're trying to improve the proficiency of these inspectors so that they're better able to detect damage in composite structures," said Dennis Roach, a senior scientist in Sandia's Transportation, Safeguards & Surety Program. "We're also trying to increase the consistency in inspections across the commercial airline industry."

Above: Sandia National Laboratories mechanical engineer Stephen Neidigk, center, teaches the first Composite Nondestructive Inspection Techniques Training Class to several aircraft inspectors. (Photo by Dennis Roach)

By volume, 80 percent of the Boeing 787 and more than half the Airbus 350 by weight are made from composite materials, driving the need for this training, said Stephen Neidigk, a Sandia mechanical engineer and principal developer of the Composite NDI Training Class.

Alex Melton, a Delta manager of quality control and nondestructive testing, said the course began at the right time for his company. Delta will receive the Airbus 350 aircraft next year and the Bombardier C-Series shortly thereafter. Delta plans to have a custom version of Sandia's course in place for its inspectors.

"This type of class enhances inspector proficiency insofar as it develops the skill of the inspectors," Melton said. "I think it's going to be a really good curriculum for our inspectors as we develop the training and integrate it into our training program and, certainly, I think it's going to be valuable to the greater industry."

The Composite NDI Training Class provides an overview of composite materials, in-depth knowledge of nondestructive testing techniques, the use of

Above: Boeing Moves 787 Dreamliner Fatigue Test Airframe to Testing Rig.

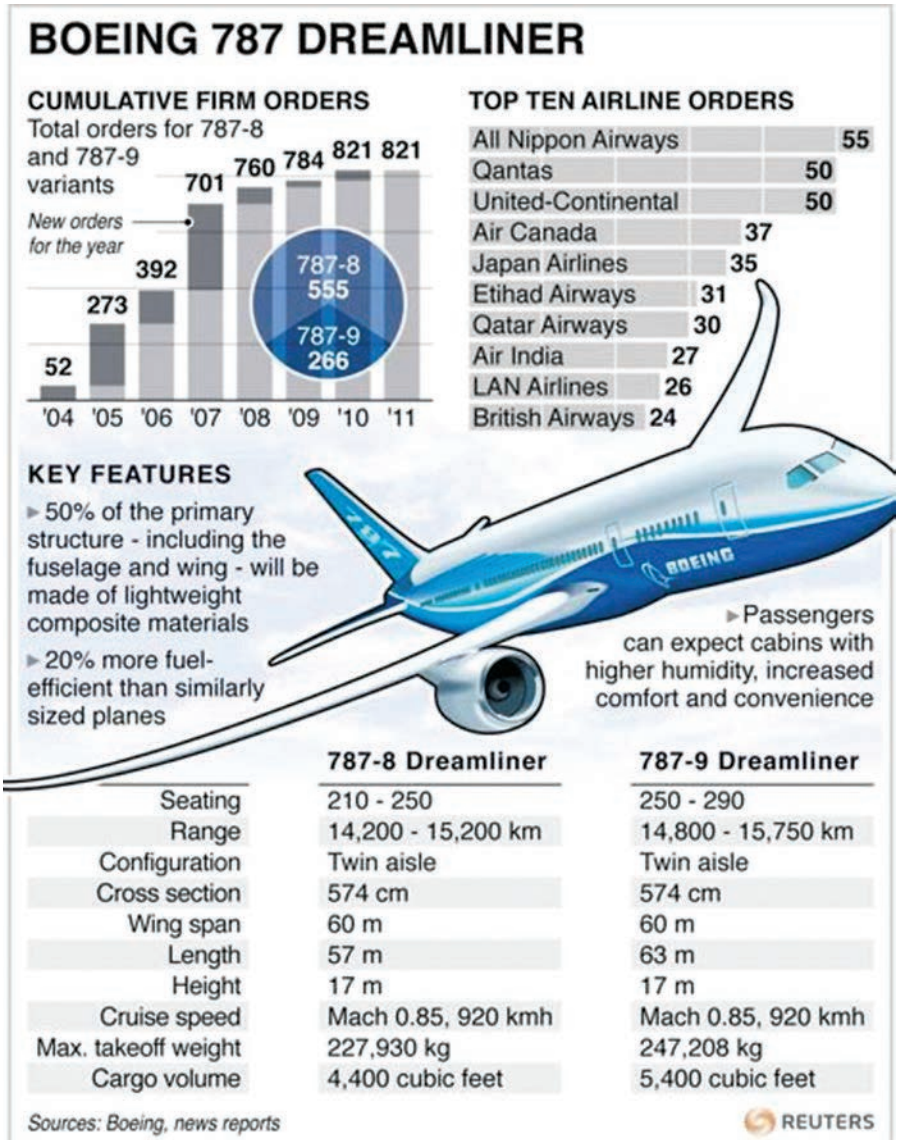
ultrasonic technology for testing and practice with engineered samples to increase proficiency in composite inspections. For more information, call (505) 284-2200 or email sneidig@sandia.gov.

Experiments detecting composite damage showed need for inspection course

For the past decade, Sandia has conducted experiments on the probability of detecting damage in composite materials — honeycomb and solid-laminate structures — that showed wide variations in inspectors' abilities and techniques, Roach said.

Because many experienced aircraft inspectors started their careers when airplanes were made mainly of aluminum and because composites behave in so many different ways than metal, Sandia recommended the training.

"We saw people not using the exact equipment setup, procedures or methods that would produce optimum inspection results," Roach said. "They needed customized training that didn't exist."



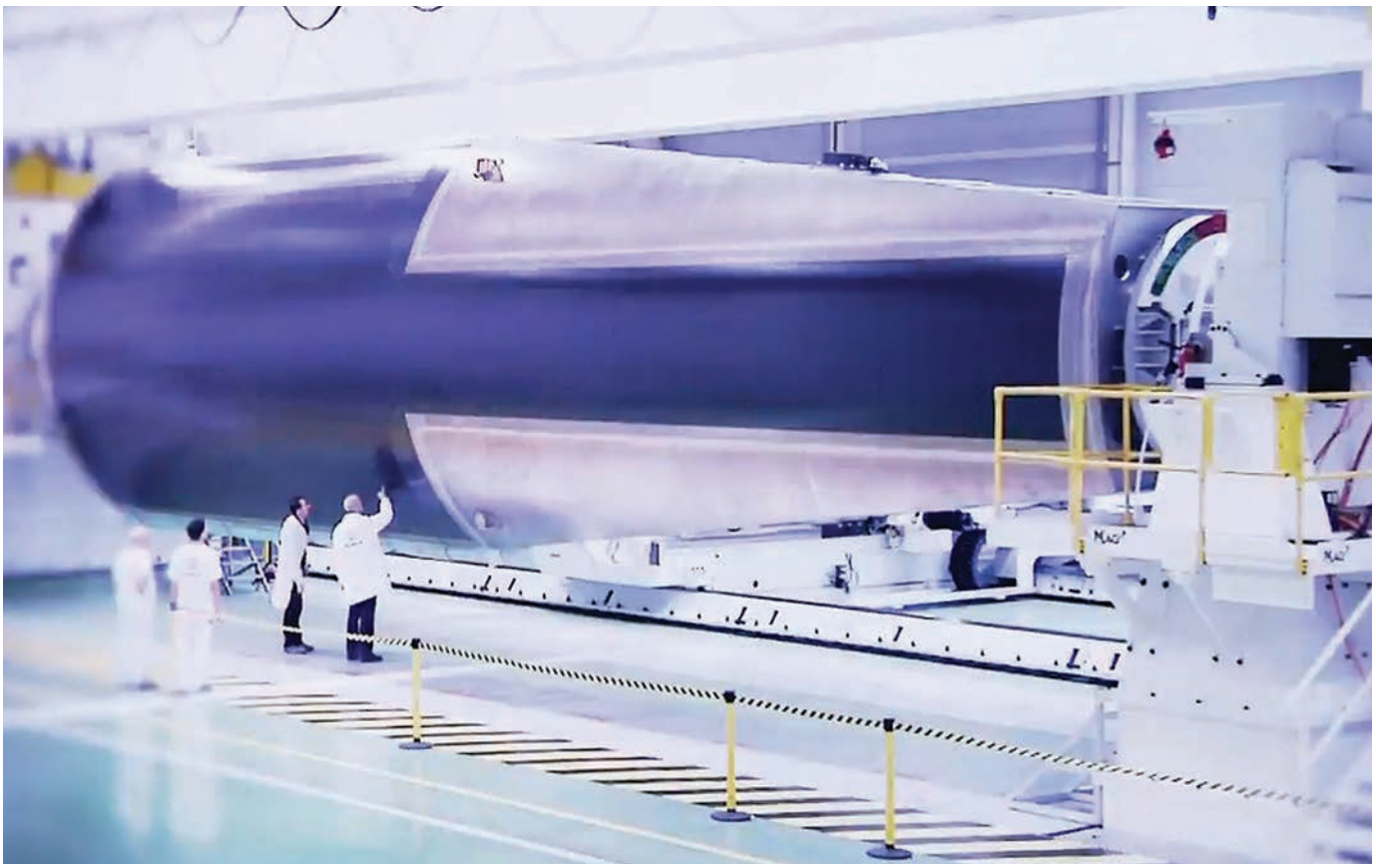
Building on that recommendation, Sandia conducted two workshops in 2014-15, inviting regulators, airlines and aircraft manufacturers from 12 countries to refine the course's content. The FAA also provided feedback on the course and the design of the NDI Proficiency Specimens used in the hands-on portion of the class, Roach said.

The two-day course covers the properties of composites, the manufacturing processes and the benefits and shortcomings of the materials. Composites produce more fuel-efficient aircraft because they are lighter than metal. Due to the materials' structures, they are resistant to fatigue and do not crack as easily as metal, in part, because they use fewer joints and fasteners where cracks can originate.

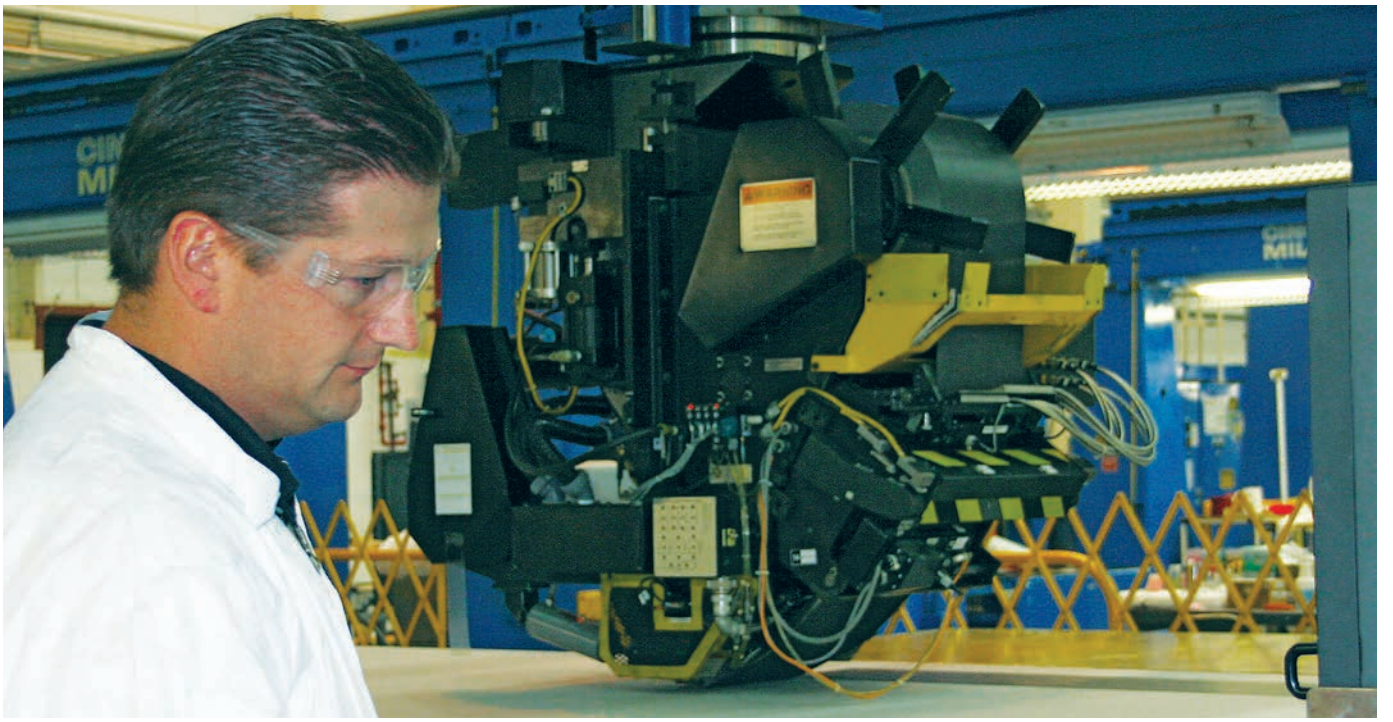
But one drawback is that solid-laminates can suffer damage, particularly from impact, that's not visible at the surface, often because the visible, external surface pops back into place, masking subsurface damage, Roach and Neidigk said.

Sandia's Laboratory Directed Research and Development program sponsored two research projects — on the structural health monitoring of composite materials and the development of sensor network systems to assess damage in transportation infrastructure — that produced information that was useful in the course's development.

Above: Fifty percent of the primary structure of the Boeing 787 Dreamliner, including the fueslage and wing, are made of lightweight composite materials.



Above: The rear fuselage of the Airbus A350 is a composite material.



Above: Boeing Composite Manufacturing Center begins fabricating 787 Vertical Fin.

Damaged parts based on years of research help inspectors practice

In the course, inspectors learn about non-destructive testing techniques through hands-on exercises. They examine custom carbon-fibre composite samples representing various types of structural configurations common on aircraft, but including engineered defects that range in complexity to fine tune their skills, Neidigk said.

The samples were designed and built by Sandia and aerospace company NORDAM in Tulsa, Oklahoma, based on years of Sandia research.

The inspectors set up commercial scanners, including phased-array ultrasonic scanners where they "paint" a two-dimensional image of the composite with ultrasound (C-scan image) to detect damage, and learn to optimize settings to more clearly detect damage, Neidigk said.

They learn how to recognize structural features found in composites, including laminates with substructure, such as co-cured bond lines or tapered laminates, and types of damage, including disbonds, delamination, porosity and impact damage. The airline industry wants to save time and money by reducing false calls, when inspectors believe they have found signs of damage that is not actually there. An eye-opener for course participants was noticing that the scanner signals decreased in amplitude or intensity due to the presence of acoustic tiles and sealant accompanying composite fuselage panels. These are commonly used to mitigate aircraft vibration noise for passengers. The poor readings on the detection equipment might appear as damage to an untrained inspector, Neidigk said. But with practice the inspectors learned to discern the

effects of the acoustic tiles on the signals generated by the defects. "One of the most valuable things in our view about this class was the opportunity to practice with these materials because we really don't get that opportunity and feedback on the aircraft," Melton said.

In preparing the course, Sandia engineers recorded the best results they obtained in the lab to identify flaws in the samples and produced flaw maps and grading templates.

"After the participants have the chance to inspect the panels, we use our grading templates to point out which ones they hit and missed. Then we show them how the reflected signal changed for a particular flaw and why they missed it," said Neidigk.

Roach and Neidigk expect companies to customize the course, as Delta plans, to meet their needs and Sandia will support those efforts as necessary. The team hopes to develop further nondestructive testing courses, particularly to inspect composite aircraft repairs. ■

At 80 percent, this commercial aircraft is one big flying composite proposition. (See diagram below)

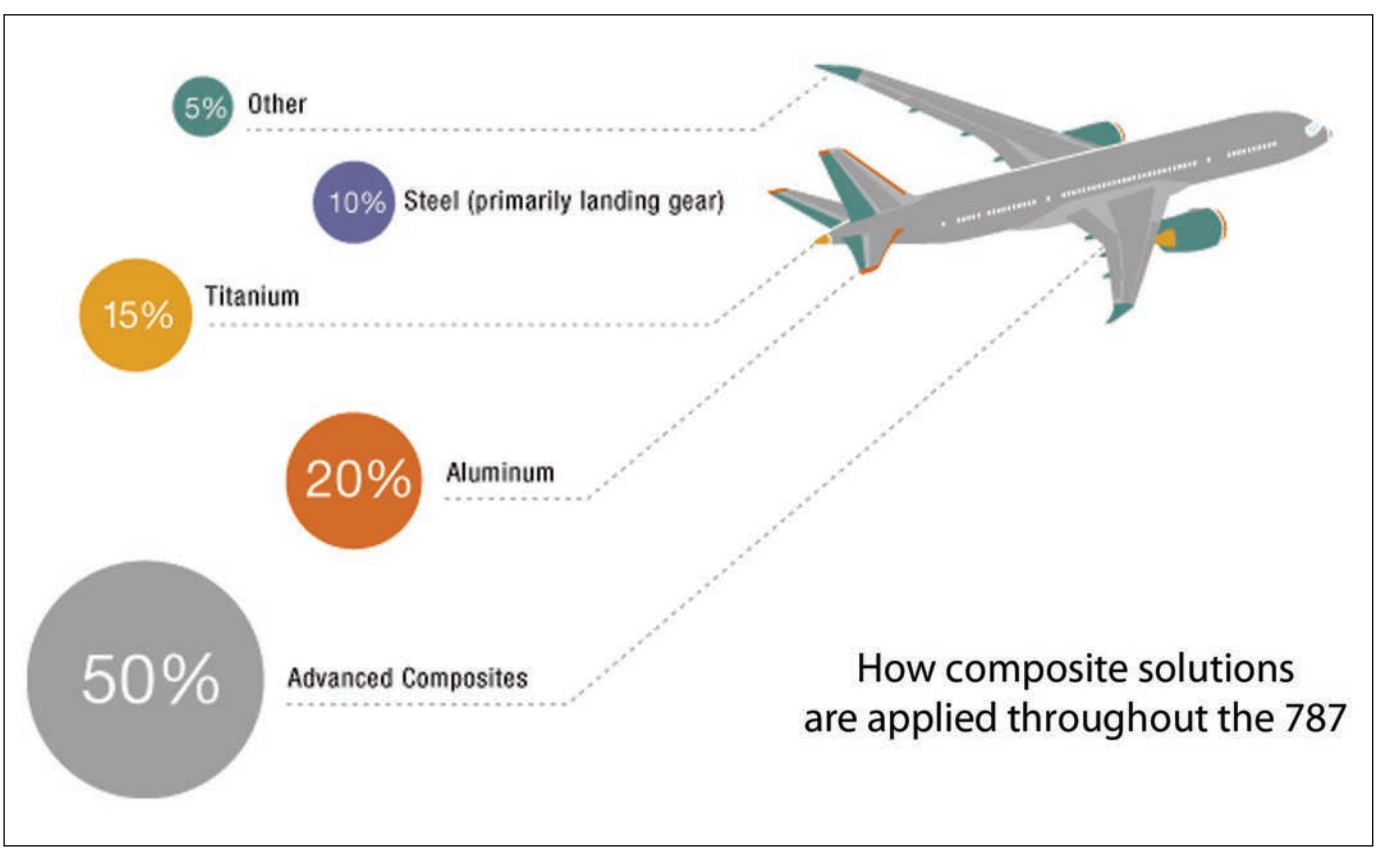
Boeing 787: Skin-deep Beauty

The Boeing 787 makes greater use of composite materials in its airframe and primary structure than any previous Boeing commercial airplane. Undertaking the design process without preconceived ideas enabled Boeing engineers to specify the optimum material for specific applications throughout the airframe. The result is an airframe comprising nearly half carbon fibre reinforced plastic and other composites. This approach offers weight savings on average of 20 percent compared to more conventional aluminum designs.

Selecting the optimum material for a specific application meant analyzing every area of the airframe to determine the best material, given the operating environment and loads that a component experiences over the life of the airframe. For example, aluminum is sensitive to tension loads but handles compression very well. On the other hand, composites are not as efficient in dealing with compression loads but are excellent at handling tension.

The expanded use of composites, especially in the highly tension-loaded environment of the fuselage, greatly reduces maintenance due to fatigue when compared with an aluminum structure. This type of analysis has resulted in an increased use of titanium as well.

Where loading indicates metal is a preferred material system but environmental considerations indicate aluminum is a poor choice, titanium is an excellent low-maintenance design solution. Titanium can withstand comparable loads better than aluminum, has minimal fatigue concerns, and is highly resistant to corrosion. Titanium use has been expanded on the 787 to roughly 14 percent of the total airframe.



POLE TO POLE: the flight of Sky Polaris

A remarkable man spends 10 years modifying a Vans RV-8 and then, in the name of science, challenges the planet's most inhospitable places.

This past year Spaniard Michel Gordillo became the first pilot to circumnavigate the north and south poles in a homebuilt aircraft weighing under 1,750 kilograms and the only pilot to ever fly a single-engine aircraft across the continent of Antarctica. Much more than an adventurer's lark, Gordillo's primary mission was to gather critical data on the build-up of black carbon in the Earth's atmosphere in remote regions of the world. For this, his aircraft—a highly modified Vans RV-8—was fitted with an instrument called an aethalometer, which absorbs aerosols. The data gathered by Captain Gordillo and the project he dubbed 'Sky Polaris' was in support of a study conducted by the University of Granada under the supervision of Dr. Lucas Alados.

"Because of its altitude and airspeed, the Sky Polaris has retrieved some very unique data from the atmospheres over big oceans, the Arctic, Antarctica, the Amazon region, and desert areas I crossed during my flights," said Gordillo, who recently retired as an Airbus A320 captain for Spain's Iberia Airlines. He also served in the Spanish Air Force and was an

Advanced Navigator with the US Air Force. "The data is very good and will be distributed to scientists all over the world."

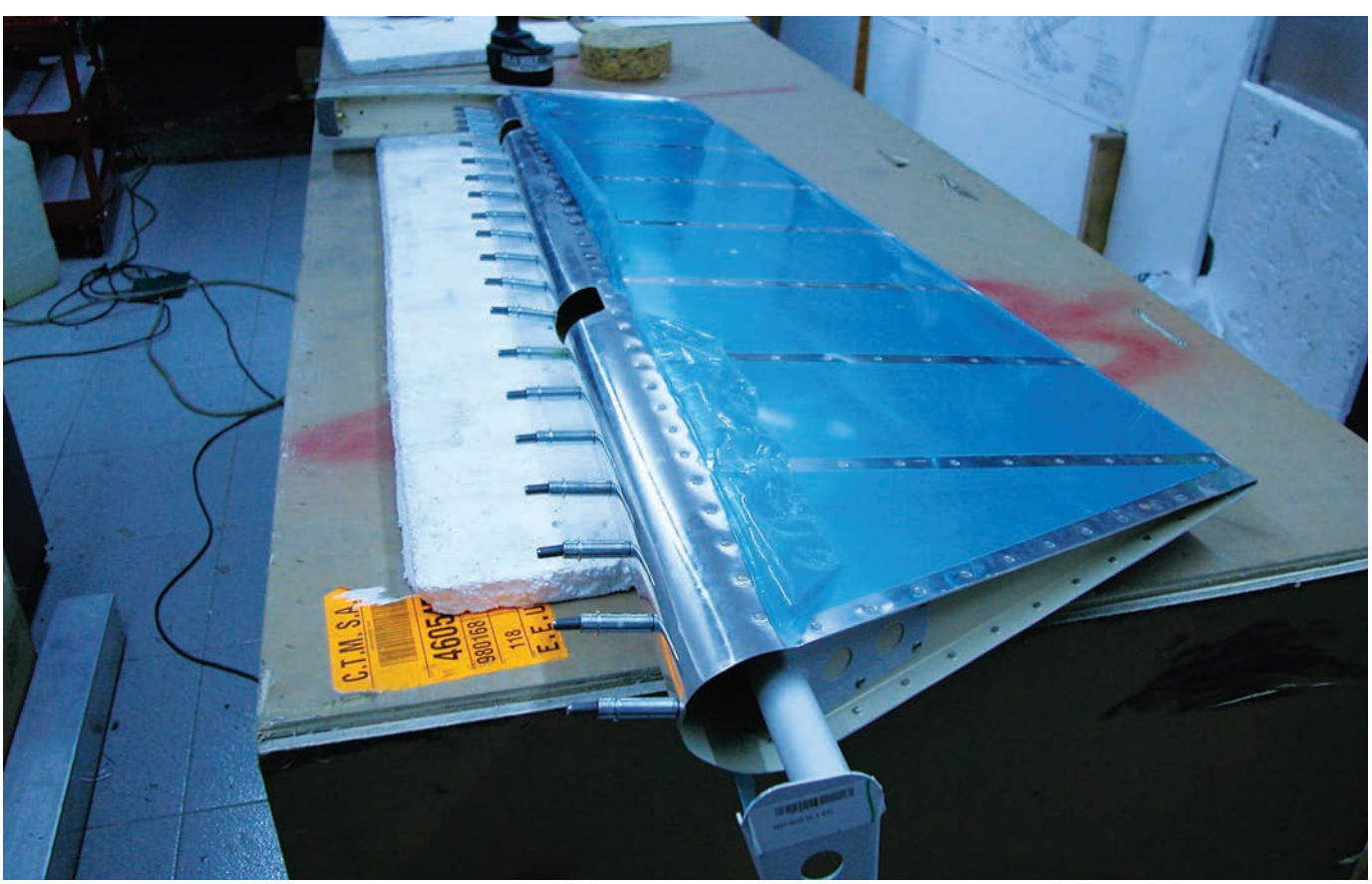
Obviously there were countless highlights for Gordillo and his aircraft during their record-setting trip. Together they logged 305 flying hours and 76,400 kilometres including a 4,735-kilometre leg (the longest), they visited 25 countries and reached an altitude of 15,500 feet enroute to consuming 730 litres of fuel. Gordillo said that engine fuel efficiency and reliability were key because of the long expanse of area he needed to cover flying east-to-west from Hobart Cambridge, Tasmania over the South Pole to Marambio Base, Antarctica and back up to Ushuaia, Argentina.

"That leg was over 4,700 kilometres and took me directly over the South Pole with only one stop. During its 10-year construction, I made many modifications to my RV-8 to hold as much fuel as possible for this critical stage. Running out of fuel was not an option."

His selection of the Vans RV-8 was an interesting one.

Above: The Sky Polaris, completed and ready for flight.

Above: Construction of the wings. Below: Building the ailerons.



Introduced at Oshkosh in 1995, the high performance airplane with fighter-style centreline seating is capable of high speeds (200 mph) and landings on short fields. In stock form, it came with a large 42-gallon fuel as standard and a 200-horsepower IO-360 Lycoming engine. But the long modification program conducted by Gordillo and his daughters at their home in Madrid included the fitment of extra fuel tanks for long distance flying and the installation of a 180-hp Superior XP IO 360 engine. "I chose the Superior XP-Engine because of the materials quality, closer tolerances, roller lifters and better oiling of the crankshaft," Gordillo said. "Superior's craftsmen built the engine for me and it delivered the performance and efficiency I needed during my flight." The challenge facing Gordillo was enormous, and of course each stage of preparation had to be meticulous. In his build notes, Captain Gordillo describes the process.

RV-8 Sky Polaris (in Captain Michel Gordillo's words)

Since really long time ago, I wanted to build and fly an RV-8. That was even before the building of my Kitfox 4, but the budget at that time was somehow limited and the Kitfox was another good choice. I did like the RV-8 because of many reasons. It is a proven aircraft and it is easy to check all other Vans aircrafts types that are being built and flown.
The RV-8 is beautiful, it has a fighter handling and also it is very stable. The design of the structure is very nice, light and sturdy. It can support aerobatics and though it is better for some overload, as needed for my project. And even with his short wing, it is fast and also it is able to land at low speeds.

Since the very beginning, I had in mind to modify some areas of the original design, not because it is not well designed, but because of the goals I had for it. For instance, my aircraft, EC XLL or Extra Large as I call him (XL) is intended to perform at very high temperatures (more than 50C/122 F) and also at really low ones (-50C/-58F).

The canopy could be riveted, as indicated by the plans, but I have chosen the option to glue it. The thermal expansion or contraction of the canopy plastic is very large, and any rivet hole can lead to have one or many cracks, or just the canopy to be broken.

It is not nice to have the canopy departing the aircraft, flying at 140 kts, with an OAT (Outside Air Temperature of -58F). Even with the windshield intact, I think that it would be hard to keep flying under those conditions.

I did contact many glue manufacturers and finally decided for Loctite epoxy. It is flexible enough for all the temperatures range I could expect over the Sahara desert or over Antarctica. I have tried to find those -40C, to check the integrity of the canopy. I took my RV aloft, and was able to climb to 24,000 feet. Climbing to 18,000 was straightforward, but to reach 24,000 was a longer and more difficult history.

I was able to just get -25C, far away from my goal, but already pretty cold.

I stayed up there some 90 minutes, but no longer because of the oxygen system (Hi pressure bottle with demand diluter) was becoming empty.

Concerning the fuel requirements, extra fuel capacity was mandatory. I wanted to cross Antarctica (it is the longest leg of the whole flight) without landing there. That would be departing from Dunedin (New Zealand) and landing at Ushuaia (Argentina). That flight would take some 32 hours, no wind, no reserve. Could be okay if there was some inland alternate airports, but the only thing around is just water and I don´t like cold water! So I estimated to have an endurance of 24 hours, at Carson speed, and I had to land and refuel two or three times when crossing Antarctica, to have provision for winds and weather.

I am able to carry more than 730 litres (192 US gallons).The main modification during the building was the fuel system and the wing fuel tanks. Now I have a full leading edge wet, and that means that I had to move the landing light at the wingtip.

I bought another wing tank kit from Vans, and the thicker skins from Harmon Rocket aircrafts (to get the full span of the wing, as the RV-8 wing tank is smaller than half wing). As my kit was a quick built one, I had to remove from the wing, the original leading edge skin and use some of the rivets holes, to install the anchor nuts that hold the new wing tanks.

I designed a special tool to convert the 3/32 rivets holes, into the AN 506 bolt holes, but taking in account that the original and late holes would be tangents. That was for the wing spars and also for the joining ribs.

The other extra tanks were located at the copilot seat, at the belly of the aircraft, and at the forward luggage bay. The rear seat tank has a capacity of 250 litres (66 gallons), belly tank 150 litres, and forward luggage of 30 litres (7.9 gallons). That forward tank is mainly welcome to help the balance of the plane.

Concerning the belly fuel tank, the jettisoning system comes from an aircraft 500 pounds bomb release system. I modified it removing the most important elements and adapting them to my airplane.

The forward one is hanging from the fuselage wing carrying spars. That forward hook will take almost the full load of the belly tank. It will also carry the support that will allow the tank not to swing away of the aircraft longitudinal axis. The rear element will just keep the tank aligned with the air stream to maintain the desired incident or pitch.

I had to install a wind vane and a camera in order to record and visualize the air stream across the belly tank, at different speed to find the better incidence of the tank.That incidence was a little bit positive when the plane is fully loaded, just to provide a small amount of lift.

The rear tank is built from one millimeter (0.040 inches) 6082 T6 aluminum. I use soft soldering aluminum to seal some areas and sealant, plus rivets everywhere. Belly tank is built with one millimeter 2024 T3 aluminum. Cross area is 40×30 centimeters (15, 7×11, 8 inches). I know, it is closer to a box than to a fish, but it was fine.

The fuel system control is rather easy. The original left selector valve has three positions: left wing, right wing, auxiliary tanks and closed. Auxiliary position will allow the fuel from the right selector valve. The right selector valve

Above: Oxygen system bottle and helmet for the attempt to reach low temperatures. Captain Gordillo was able to climb at 24,000 feet.

has three positions also: outer wing tanks, rear fuselage tank, forward luggage tank and closed.

You can ask about the belly tank… Well, that tank will have initially its fuel pumped into the rear tank, as the fuel level at the rear tank decreases. Also I am able to jettison the belly tank, if I need to crash land the RV.

The rear tank has a fast fuel draining system. I built a kind of restroom flushing system. Would I need to emergency return, I would drain that rear tank, and if time is available, I would pump the belly fuel into the rear tank and drain again. If no time, I would just jettison the full the tank. But imagine that you are taking off with that heavy aircraft, and the engine fails… If I have altitude, I will just use my parachute, but if I am too low, I will have to jettison the belly tank and drain the rear tank, until crash landing. So, all the belly of the fuselage would be plenty of fuel, and may be, when crash landing, some sparks can put the plane on fire…The flames would advance forward and enter the rear tank, which would still have some fuel in it. I don´t want to imagine the explosion just in back of my head.

Above: View from the Sky Polaris in flight.

So the system, when draining, will do it through a 2.25 inches diameter tube between the rear tank and the belly of the plane. Just before landing I close the drain valve and discharge a fire stopping foam inside that 2.25 tube, to stop that flame entering the rear tank.

The propeller is a two blades 74 inches constant speed Hartzell. The goal is to have a better efficiency for long range, compared to a two blades 72 inches prop and a three blades prop. Engine is a Superior XP IO 360 engine. Even though carbureted engines are better for the poor quality fuels that I can find at some places of this world, injection is better for icing conditions and smaller fuel flow.

I have installed a Lasar system that provides a better spark at engine starting time and it is said, a better fuel efficiency. If the electronic system fails, the ignition turns into a classic magneto one.

The instrument panel is a mixture of steam gauges with electronic ones. Most of them come from my MCR01 aircraft. For navigation, I used a Garmin 430 set and a Garmin 496. Also an iPad and an iPad 2. For engine display, a VMC 1000 system provided me all the information I need.

VHF 1 Communications are from the Garmin 430 and VHF 2 from an Icom A210. Also, I had an Iridium satellite phone, with tracking system and short messages system, and not to forget a portable emergency radio, with 121.5, 243 and 406 MHz capabilities with GPS reporting function. That radio was initially provided by the Spanish Air Force. Also a Garmin 760, for HF communications, was installed in the airplane. Earthrounder Bill Harrelson, has provided me pictures and notes from his installation on his world record Lancair IV aircraft. I like very much the way he did it and I tried to reproduce it on my RV. Thank you very much, Bill! Transponder is an S system, Garmin 330.

For comfort, I had a Trutrak autopilot, integrated with the Garmin 430. Also some MP3 music from an iPod, in the audio system centralized in a PS engineering audio set.

I had some external cameras for recording some videos and had those post-produced for TV. The selection of the cameras is not easy. Most of the small cameras are wide angle and I think that they are nice for close-ups, but not so nice to record countryside.

Another problem is the control of the camera and battery capacity. The Wi-Fi system is nice to control the start and ending of the recording, but I think that it is not reliable. Also, the cold temperatures I encountered made the small batteries of an external system almost useless. The solution was a pen size camera, linked to a central recorder inside the cockpit.

(Michel Gordillo currently has over 15,000 hours of flight time. He lives in Madrid, Spain with his family. To learn more about Captain Gordillo and his Sky Polaris project, visit: www.skypolaris.org) ■

Report from the 16th Canadian Aviation Regulation Advisory Council

The December 13th, 2016 plenary meeting in Ottawa was the 16th gathering of the various interest groups from the Canadian Aviation industry and the Top Civil servants of Transport Canada, Civil Aviation. Transport Canada representatives were as follows:

- Aaron McCrorie: Director General, Aviation Safety Regulatory Framework, Civil Aviation
- Denis Guindon: Director General, Aviation Safety Oversight and Transformation, Civil Aviation
- Marie-Anne Dromaguet: Chief Regulatory Affairs, Civil Aviation
- Michel Beland: Director, Policy and Regulatory Services, Civil Aviation
- Robert Sincennes: Director, Standards, Civil Aviation

In attendance in Ottawa was (among others): ATAC, NATA, COPA, HAC, CBAA, ALPA, various unions of airline employees, Air Canada Pilots Association, Flight Attendance union, CUPE, etc. Various places were linked by videoconference, with approximately 100 people present either live or via video link. Aaron McCrorie introduced the panel, welcomed everybody to the meeting with opening remarks and outlined the format of the meeting. Marie-Anne Dromaguet tabled the decision record of the October 25, 2013 CARAC meeting and they were reviewed and accepted. That meeting was about the modernization of the CARAC process and establishing procedures for PICA (Preliminary Issue and Consultation Assessment), revised template for the NPA (Notice of Proposed Amendment) and the establishing of new CARAC Management Charter and a CARAC Procedures Manual.

Michel Beland reviewed the activities since the last CARAC meeting in 2013 and the new CARAC Management Charter and Procedures Manual. It became clear that TC is committed to involve the industry in the rulemaking process. Focus groups of Stakeholders will be the way forward and TC will organize these meetings.

CARs Part III review of activities was presented and TP312 Aerodromes Standards and Recommended Practises is published. An amended regulation for the Aerodrome Work Consultation is published and should be in effect some time in 2017.

CAR 521 – Airworthiness

The purpose of the new CAR521 is to streamline and simplify the regulatory environment, clarify the responsibilities and accountabilities between the Minister and the holder of Canadian aviation documents, as well as to harmonize Canadian regulations to the greatest extent possible with our major trading partners. Good progress has been made on this, but it is still ongoing.

CARs Part VI – General operating and Flight Rules

The maintenance standards for 406 MHz ELT's have been drafted and ready for an NPA in February 2017. It is the plan that the regulation for the new 406 MHz ELT installation could be in effect by out for public comments with Gazette I in May 2017.

CARs Part VII – Commercial Air Services

There are a few items that are being worked on such as, CRM (Crew Resource Management), MMEL (Master Minimum Equipment List), Seaplanes Operations with Gazette II in April 2017, Flight Attendants and Emergency Evacuation, Flight Crew Fatigue Management with Gazette I in June 2017.

Representatives in Attendance

Aaron McCrorie handled the discussions very well and invited the various union representatives to a future meeting to hear their concerns and find a common ground.

CARs – New Part

Dealing with the UAV (Unmanned Air Vehicles) or UAS (Unmanned Aircraft Systems) or commonly known as drones are of great interest as of late and a new CAR dealing with the regulation and standards will be drafted. This is fairly high in the pile of "Things to do."

Denis Guindon guided us through a presentation on Transport Canada Civil Aviation's Transformation Project that was established in April 2015. The drivers for this transformation are the large and diverse air transport system with over 15 million square kilometres of airspace, more than 35,000 registered aircraft, 68,000 licensed pilots, and 15,839 AMEs. Canada also has 567 certified aerodromes made up of 306 airports and 261 Heliports and 1,820 non-certified aerodromes. Other reasons for this transformation are major technological advances, and it is estimated that 90 percent of the world's aircraft fleet will be new generation aircraft by 2036. Canada has advanced into the third place for the production of civil aircraft and is expected to grow 22 percent by 2021. Major restructuring has already taken place with a national Organization Review, Design and implementation of SMS since 2005 for 705 operators, Aerodromes, and Air Navigation Service providers. A system-based surveillance has been in effect since 2008 for all operators. The transformation also addresses the TCCA internal challenges with 1,263 (NOV 2016) employees spread out from coast to coast and oversight and service delivery have to be consistent in all regions. The management structure from HQ to Regions and TCCA offices is complex and creates challenges for the executive leadership.

Michel Beland presented TCCA's overview of the Prioritization of Aviation Safety Risks. Issues are captured in PICA (Preliminary Issue and Consultation Assessment) and these are raised based on Safety Data, Risk Profile/Exposure and Strategic Risk Assessment. The internal Civil Aviation Management review team handles this process and if the issue warrants further action, the CARAC process is initiated.

The Priority system is triggered by TSB findings, and CADORS (Civil Aviation Daily Occurrence Reporting System) and this provided a four level Safety Risk Action Plan.

1. Top priority – Approach and Landing;
2. Unmanned Vehicles;
3. Loss of Control in-Flight;
4. Human Performance Factors.

www.wamea.com

ARAMC 2017 update December 2016

Hello fellow AMEs, apprentices, students and Corporate members, it's time for an update on the Atlantic Region Air-craft Maintenance Conference (ARAMC 2017). The focus is on ARAMC 2017, scheduled for the Delta St. John's Hotel and Conference Centre, April 26-28, 2017. Since last April, the team of volunteers in St. John's is gearing up for the spring event. The hotel has reserved a block of 100 rooms at a special conference rate of $199 per night plus applicable taxes. This room rate will be available until March 24, 2017. Make your reservations well in advance to ensure a room is available and don't forget to advise the reservations clerk that you are attending the ARAMC 2017. The theme of the conference is "Safety Management – Everyone Contributes". This year's committee is comprised of a group of volunteers which include Mel Crewe (Chairperson); Bob Pardy, (Vice Chairperson and Awards); Bob Whittle, (Speakers); Randy Cross, (Finance); Elaine Hutchings, (Secretary); Mark Evans, (Displays); Brenda Huber, (Administration); Uli Huber, (Advisor and President A.M.E. Association (Atlantic) Inc.; Helen Staubitzer, (Registration Desk) and Mary Matthews, (Registration Desk).

The committee has already met in October and November to set the wheels in motion. Each member has its share of Duties and Responsibilities. In the early stages, the most important task is to prepare the Displayers mail-out packages, Delegates mail-out packages and the tentative Technical subjects. The Displayers' mail-out was sent out in early December with the Delegates packages due to go out in early to mid-January. When you receive your package, make plans to attend the ARAMC 2017. The registration desk will be open in the Crush lobby at 12 noon on Wednesday, April 26, 2017. Activities kick off Wednesday evening with the Meet and Greet at 7:30 p.m.

The conference officially opens Thursday morning at 8:30 AM in Salon "A" and the Technical sessions commence at 9:00 AM. The technical Displays in Salon B, C and D open at 8:00 AM. Technical sessions will be ongoing until 3:00 PM and the AME Association (Atlantic) Inc. annual meeting will be held in the Conception Bay Room at 3:30 PM. (Members only).

On Thursday, a Displayer sponsored lunch will be held in the Display area, (Salon B, C and D) at 11:45 a.m. -1:00 p.m. On Thursday evening there will be a Cocktail hour in the Crush lobby at 6:00 p.m. prior to the Awards Banquet at 7:00 p.m. The Awards banquet will be followed by the presentation of awards recognizing individuals and companies for their contribution to the aircraft maintenance industry. The Earl Blakney/Aviall Canada Award is presented annually to an individual for his/her outstanding performance in the aviation industry during his/her career. The Roger Richard Memorial is presented annually to the retired AME who has distinguished himself/herself during their career. The third award is the Newfoundland Government Air Services Memorial Award presented annually to an individual/corporation for their outstanding interest and support of the AME Association and/or the Atlantic Region Aircraft Maintenance Conference. Another award is the AME Association (Atlantic) Inc. bursary award. This award is presented to a student from the Nova Scotia Community College and the College of the North Atlantic (Gander campus). Following the awards presentations, talented Newfoundland and Labrador entertainers will entertain the group for approximately one hour. Technical presentations and displays will resume Friday morning and the closing ceremonies will be held at 3:00 PM followed by Critique Draws and Silent Auction lucky bidders.

Plan to attend the ARAMC 2017, April 26-28, 2017. The conference is approved as re-current training as per requirements of CAR's 573.06. Come and enjoy our hospitality and excellent cuisine. For a complete listing of forms and conference info, visit www.atlanticame.ca

— Melvin D. Crewe, Chairperson, ARAMC 2017

Upcoming Events

- ARAMC 2018 will be held in Halifax, Nova Scotia from April 18-20 at the Delta St. John's, 120 New Gower Street.
- ARAMC 2019 will be held in Moncton, New Brunswick from April 24-26 at the Delta St. John's, 120 New Gower Street.
- ARAMC 2017 will be held in St. John's, Newfoundland from April 26-28 at the Delta St. John's, 120 New Gower Street.

Provincial Aerospace Limited, and Airbus awarded C295FWSAR contract

Airbus Defence and Space and Provincial Aerospace Limited have announced the creation of AirPro SAR Services. The new company will manage the acquisition of the new SAR aircraft, the C-295 FWSAR purchased by the Canadian government to replace the aging fleet of DH C-115 Buffalo and Lockheed CC-130 aircraft. AirPro will be the in-service support integrator of the FWSAR C-295 fleet for the life of its service in Canada. The $2.4 billion contract will be a major boost for Provincial Aerospace Limited. The contract is for 16 C-295SW aircraft to replace the C115 Buffalo and CC-130 Hercules aircraft. The new aircraft will be equipped with technological advanced systems to support Canada's Search and Rescue operations. The initial contract is for 11 years and includes six years of acquisitions and set ups, construction of a new training facility in Comox, BC; as well as five years of maintenance and support services. The contract also includes options to extend maintenance and support services for an additional 15 years. If Canada exercises its options, the contract would increase to $4.7 billion plus applicable taxes. The first delivery of the new aircraft is expected in three years and has potential for another 150 jobs.

Objectives of AME Association Atlantic

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

www.atlanticame.ca

ONTARIO

AME Association of Ontario

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

CFAMEA reorganization required

The Canadian Federation of AME Associations (CFAMEA) held its annual meeting in October in Ottawa. Two delegates from the Ontario AME Association attended with the intention to work together with the other regional AME Associations to take the current CFAMEA organization to the level of a true National AME Association.

Unfortunately this did not come to pass. Most of our regional AME Associations were formed about 30 years ago. A "federation" of these regional groups was formed and became the CFAMEA we have now. A two-day meeting was held once per year with one person from each region representing their group. The first day of the meeting dealt with issues raised by each region and a modest budget was approved.

The second day usually consisted of a half-day session with the chief of aircraft maintenance and manufacturing at Transport Canada. The remainder of the year the "executive secretary" (president) of CFAMEA represented the federation at various regulatory issues meetings. Outside of those in the inner circle, a national AME Association did not really exist.

For many years, members of the AME Association of Ontario have expressed a desire that our regional group become part of a true national association that would not only protect our interests as AMEs, but would also interact with the government, other aviation groups, promote our profession in the eyes of the public and represent us with other international aviation agencies. It is our understanding that other AMEs across the country have the same wish. In fact, at each annual CFAMEA meeting this consensus was expressed, unfortunately during the remaining 363 days of the year, no action was taken to bring this to fulfillment.

This year our Ontario Association Board of Directors decided to take action. A plan was drawn up and our two delegates at the CFAMEA AGM presented an ambitious plan to convert the current CFAMEA model into something bigger and better.

There were suggestions as to how the new organization would be formatted, its relationship with the existing regional groups, financial concepts and an ambitious timeline for implementation. It was meant to be the basis of a discussion, but was not well received. Perhaps it was thought that we were trying to force our ideas upon the group, however, it was only meant as a starting point for development of the national concept.

It is our intention to pursue our goal of establishing this truly National Canadian AME Association. It will have a larger board of directors, it will be mandated to be more active and it will be a stronger voice for AMEs.

If you, as an AME or other aircraft maintenance professional, have similar views, contact your association's executive and express your concerns; consider discussing this at your association's annual meeting and instruct your directors to join us in our endeavors.

— Stephen Farnworth
Vice-President AME Association of Ontario

CENTRAL

Central AME Association

Manitoba Aviation Symposium 2017

March 1- 2, 2017
Victoria Inn, 1808 Wellington Avenue
Winnipeg, Manitoba

About CAMEA

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

www.camea.ca

Central Ohio PAMA

The Principles of Eddy Current

Our January meeting was held in the Lane Aviation Media Room at their John Glenn International facility, 4387 International Gateway, on the second floor. Vice President Jeff Gruber stood in for President Joe Lippert who was on the road with an aircraft in inspection. Jeff reviewed the Holiday Dinner event and announced the COPAMA Board for 2017.

The officers stay the same with Joe Lippert, President; Jeff Gruber, Vice President; Earl Redmond, Treasurer and Lowell Dowler, Secretary. Dave Fragale, Chuck Jenkins and Gene Sprang fill out the rest of the roster.

Nate Chicon of Aircraft Inspection Services gave the presentation and those in attendance received FAASTeam AMT credit. Nate's program focused on the eddy current technique of non-destructive testing and he started with the training and testing requirements for First, Second and Third Class NDT technicians.

He gave an overview of how eddy current equipment works, detecting disturbances in magnetic field flows by defects in the material being tested. He compared it to the eddy currents created in a stream when rocks or other objects are located in the main current flow or along the shoreline. He then showed photos of some of the aircraft where problems were found and gave examples of a few known problem areas. He finished up by demonstrating his test equipment on a wheel half and some other aircraft parts. We wish to thank Nate and Aircraft Inspection Services for an enlightening topic.

www.copama.org

PAMA SoCal Chapter

SoCal PAMA Sponsorship opportunities

As I am sure you are aware the Professional Aviation Maintenance Association (PAMA) is a national organization comprised of regional chapters of Aviation Maintenance professionals. These chapters represent the full spectrum of maintenance activities within the Aviation industry. We are proud to say that the Southern California (SoCal) Chapter is one of the most dynamic with in the PAMA organization. Our bi-monthly schedule has a goal to provide our members a Technical Forum /Dinner Meeting with a technical presentation by leading Aviation Maintenance Organizations. For the past 30 years SoCal PAMA has developed a close working relationship with 94th Aero Squadron Restaurant, which sets on the Van Nuys airport runway, as the location for our dinner meetings. This venue sponsored by our Technical Forum presenter, creates for an enjoyable evening for all the Aviation Maintenance Professionals in attending and allows the sponsor to reach an audience outside of the normal marketing arena.

Once a year in December we host the Southern California Chapter of PAMA Holiday Dinner Meeting so that as professionals we can enjoy each other's professional camaraderie and holiday spirit. Many organizations and members ask how they can be involved in the festivities so this year we are opening sponsorship opportunities.

All sponsors will be noted as sponsors on the SoCal PAMA website, as well in all PAMA notification of support of the SoCal PAMA organization/holiday dinner meeting.

Sponsorship opportunities are the following:

- Diamond Sponsor: $1,500 (15)*
- Platinum Sponsor: $1,000 (15)*
- Gold Sponsor: $800 (10)*
- Silver Sponsor: $500 (50)*
- Bronze Sponsor: $250 (2)*

Honourable Mention: All donations will be accepted.

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

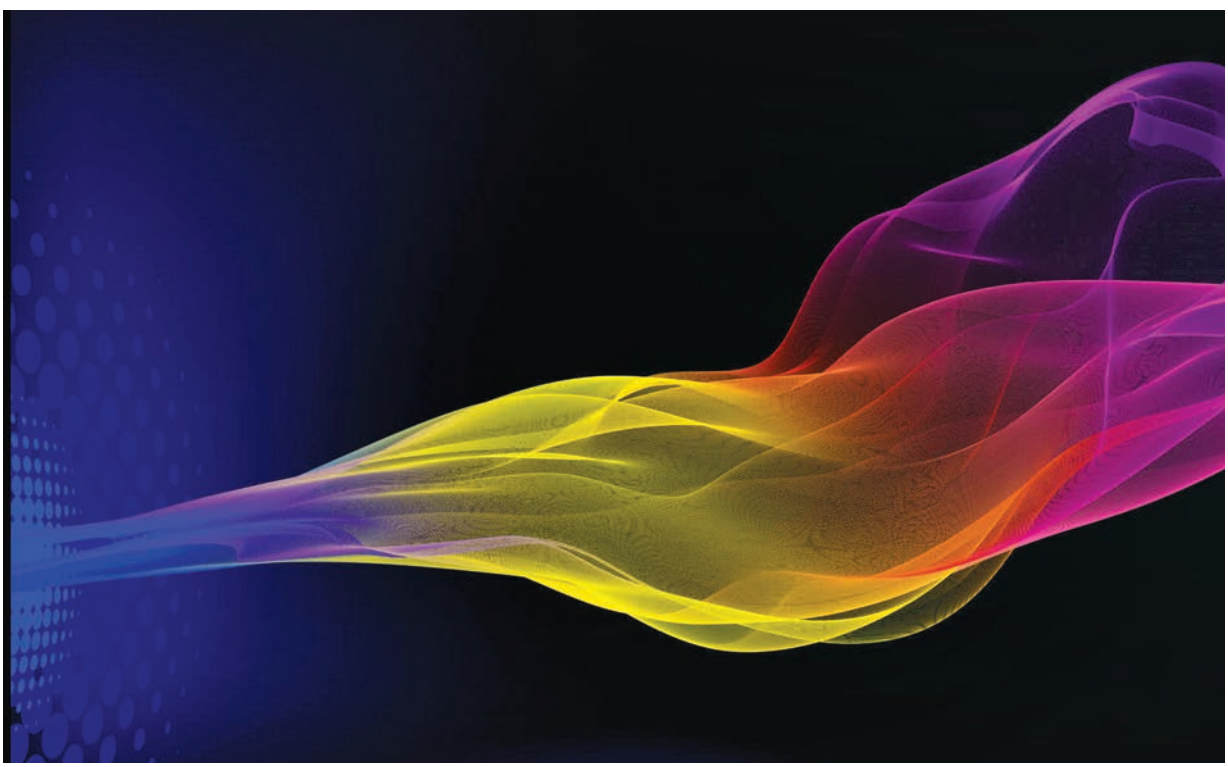
Contact: Chris Cancelosi: (818) 997-7667
chris@rotorcraftsupport.com
Contact: Bill Johnston: (805) 210-1873
wdjohn805@att.net

— Submitted by Dan Ramos

www.socalpama.org

A team at the University of Kansas is reinventing test-flight communications now that prime real estate in the electromagnetic spectrum has been auctioned off to mobile phone companies, leaving government users such as test-flight ranges with low-rent, weaker frequencies.

(Air) space for rent



Above: The mission of the National Spectrum consortium is to foster collaboration between government and industry to develop new technologies that broaden the use of the electromagnetic spectrum.

By Brendan M. Lynch

Imagine this engineering headache: Using a wireless transmitter, you need to send 40 megabytes of data every single second (about the same amount of data as 10 YouTube videos streaming at the same time) over a distance of 100 miles. To complicate matters, one of the transmitters can't be bigger than a pack of chewing gum. Oh, and it's going to be traveling onboard an object 30,000 feet overhead at double the speed of sound. What's worse, your miniaturized, high-powered transmitters must convey all that data on some of the trickier frequencies of the electromagnetic spectrum.

That's the challenge for University of Kansas researchers in the School of Engineering who just earned a $2.5 million contract from the National Spectrum Consortium to develop a new generation of communication technologies for airborne vehicles on United States test ranges. Their engineering work will help remake test-flight communications in the wake of a Federal Communications Commission auction of frequencies once used by the American government.

"The electromagnetic spectrum is a limited natural resource that, like other types of resources, is hotly

With equipment installed in a test Beechcraft C-12, researchers will optimize communications at about five gigahertz (GHz), roughly three or four times farther up the frequency dial than previous communications at US test ranges.

A pilot from the 489th Reconnaissance Squadron performs pre-flight procedures on a C-12 King Air aircraft in preparation for a training sortie at Beale Air Force Base, California.

contested, valuable, and there's not enough of it," said Erik Perrins, professor of electrical engineering and computer science at KU, who leads the project. "Some of it is more desirable, like beachfront property, and some is in the desert. The FCC had to deal with wireless companies, the ones we all pay $100-plus a month, saying, 'There's this spectrum that's not being used well, and we could use it better, and we're willing to pay.'"

The FCC sale at first was expected to bring in from $10 to $15 billion but earned the government more than $40 billion in the end. Of that, $500 million was as set aside to relocate some government users to less-desirable real estate on the spectrum, funding projects that include the project spearheaded by Perrins and KU colleague Andy Gill, along with collaborators at Brigham Young University and students at both institutions. Their task is to utilize higher frequencies that don't penetrate buildings as well as lower segments of the electromagnetic spectrum.

"It's similar to when you're at a stoplight next to a car playing music — you're going to hear the bass from their radio, not the high end," Perrins said. "Different frequencies penetrate differently, and those lower frequencies are a nice sweet spot for cellular.

"For instance, if I'm talking on a cell phone inside a building, light doesn't travel through a building, but radio frequencies do. Cellular companies were interested in these frequencies because they're quite good for their application."

The KU research will optimize communications at about five gigahertz (GHz), roughly three or four times farther up the frequency dial than previous communications at US test ranges. Initially, the work will take place in labs at KU and later will move to the Air Force Test Center at Edwards Air Force Base in California, perhaps most famous as the place where Chuck Yeager broke the sound barrier in 1947. There, equipment developed in Lawrence will be tested aboard a Beechcraft C-12 Huron, a twin-engine turboprop aircraft.

The most challenging aspects of the research arise from the smaller bandwidth available at the new home and its vulnerability to signal deterioration.

"The project has to deal with efficiency," he said. "We're trying to pack more information into the same amount of space as before. It's a little like putting a multistory building on a parcel of land instead of a single-level structure, using a more efficient type of modulation than they've used previously. The power consumption is going to be different, as it's going to take a more powerful signal to propagate through the airwaves."

Because transmissions at five GHz can be problematic, the KU researcher said a key element of the research is to combine higher efficiency modulation with technology known as forward error control codes.

"Error control coding is a way to protect the bits in the signal, so when errors occur they can be detected and corrected automatically," Perrins said. "It's an added redundancy. For instance, when we're speaking using the English language, not every sound is a word, and not all words form a valid sentence. Because of that structure, if a word gets erased from a

sentence, we still can guess what's missing. Or if someone calls out Derrick instead of Erik, I'll still raise my hand. That's what you do with error control coding. You add patterns that when they get disrupted you can correct them on the other side — and that allows you to communicate with a weaker signal."

The communications between test vehicles and ground-based receivers will carry much of the same kind of information that would be recorded to an aircraft's flight recorder, revealing aircraft performance and flight characteristics following a crash or malfunction.

"This will transmit the kind of data that a black box harvests, but in routine flight that data typically isn't sent to the ground because there are too many planes, there's not enough spectrum for that to take place," Perrins said. "But at a test range, because the test articles are in development, we'll need to get data to the ground immediately." ■

Its developers claim a new weather analysis technology takes bad weather avoidance to a new level.

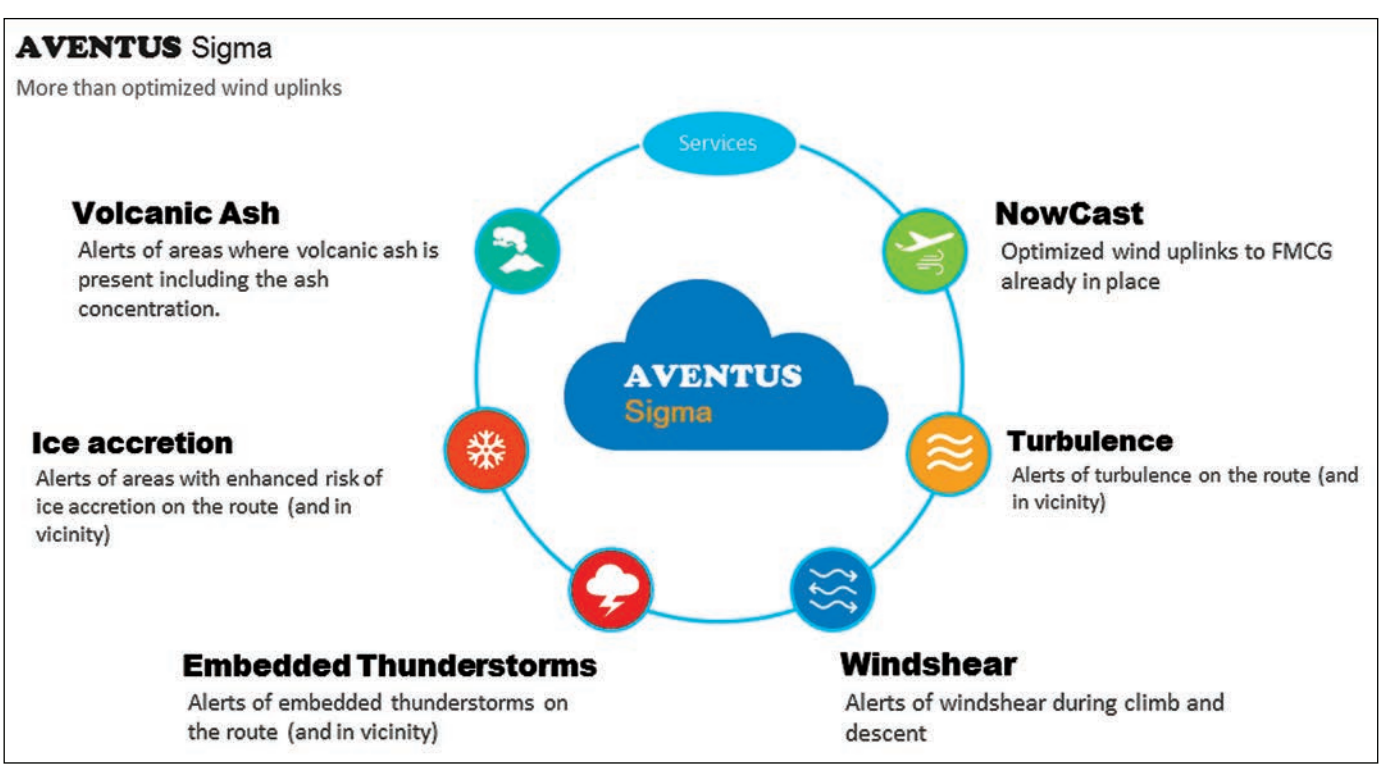
Spotting trouble in real time

Less turbulence, lower costs and increased flight safety are the touted benefits of Aventus SIGMA, a new product that delivers weather data in real time. Its developer AVTECH is a Swedish IT company specializing in the aviation industry. The NASDAQ-listed company AVTECH is also the developer of the Aventus NowCast system, a product targeted to save airlines fuel costs through the use of algorithms that the company claims provide more precise wind data for airplanes' navigational computers. NowCast, currently distributed in co-operation with the British Met Office, has been available on the markets since 2000 and is used by several major airlines, including Southwest Airlines, Lufthansa Cargo and easyJet. SIGMA is partly based on the technology of NowCast and can reportedly be added to the NowCast service as an add-on module. SIGMA combines the airplane's accessible data with real-time data from the Met Office.

AVTECH says that SIGMA can assist pilots in making better decisions concerning which flight path to take and the ideal altitude, which enables them to avoid problematic weather phenomena such as turbulence, ice build-up, thunderstorms and thunderclouds. Cockpit routines are simplified when complex data is presented in a more concrete form. In addition to a general flight weather forecast, SIGMA takes into account the flight path and flying time of the plane. Today, planes that are delayed or required to select an alternative flight path are forced to use historical weather data, while SIGMA continuously provides real time weather data for the actual route.

"Weather conditions can change suddenly, which makes relying on historical data in today's connected world increasingly outdated," says Bo Redeborn, chairman of the board at AVTECH, Sweden. "...[Aventus SIGMA] significantly reduces the risk of the airplane encountering turbulence and storms."

The company goes on to say that connected airplanes do not require any new hardware or software to install Aventus SIGMA, which as of next year may already be installed in commercial airplanes.



Engine failure during intial climb out

The undetected erosion of shroud cooling holes takes a big passenger jet out of the skies.

On May 28, 2012 at 1425 Eastern Daylight Time, the Air Canada Boeing 777-333ER aircraft (registration C-FITW, serial number 35298), operated as flight ACA 001, commenced the takeoff from Runway 23 at Toronto-Lester B. Pearson International Airport, Ontario. The aircraft, with 16 crew members and 309 passengers on board, was en route to Narita International Airport in Tokyo, Japan. During the initial climb-out, at approximately 1590 feet above ground level, the number 2 engine failed (GE 90-115B, serial number 906-456).

The flight crew followed the Quick Reference Handbook procedures and secured the engine. Air traffic control was notified of the event, and the flight crew declared an emergency. After jettisoning fuel to reduce the aircraft weight down to the maximum landing weight, an uneventful landing was carried out at Toronto-Lester B. Pearson International Airport. Emergency services stood by for the landing and escorted the aircraft back to the gate. There were no injuries, but the underside of the right wing received minor damage from engine debris ejected through the exhaust. Several automobiles on the ground were also damaged from the falling debris. There were no reported injuries.

History of the flight

The aircraft arrived at Toronto-Lester B. Pearson International Airport (CYYZ) after a seven-hour flight from Frankfurt, Germany. There were no reported engine defects. Air Canada line maintenance completed the pre-departure checklist and added 1.5 litres of oil to the number 2 engine. Normal oil consumption for this model engine is 0.34 litres per hour. Boarding was completed, and the aircraft was given taxi instructions for Runway 23. All engine parameters were normal when the aircraft commenced its takeoff from

Runway 23. At 1427, with the aircraft at an altitude of 2160 feet above sea level (asl) and travelling at a computed airspeed of 206 knots, the number 2 engine lost power.

Engine Indicating and Crew Alerting System (EICAS) parameters displayed rapid decreases in fan speed (N1), compressor speed (N2), fuel flow, and oil pressure. The exhaust gas temperature (EGT) increased and peaked at 1,252C within two seconds of the engine failure. EICAS indications for the number 2 engine included a discrete signal corresponding to the EGT redline being exceeded, accompanied by a rise in engine vibration levels.

Approximately six seconds after the engine failed, the crew received an EICAS engine fail warning when the N2 speed decreased below idle. The captain selected the autopilot to on and leveled the aircraft at 3,000 feet asl. The crew followed the engine severe damage checklist in the Quick Reference Handbook and secured the engine by moving the thrust lever to idle, the fuel control switch to cut-off, and then pulling the engine fire switch. Since there was no fire warning or indication, the crew decided not to activate the fire extinguishing bottles. The flaps were retracted, and the auxiliary power unit was started. The aircraft then climbed to 7,000 feet asl. After the aircraft was leveled off, the fuel jettison nozzle valves were opened and remained open for approximately 38 minutes.

The aircraft subsequently climbed to and leveled off at 12.000 feet asl. The total fuel load was reduced by 86.600 kg to bring the aircraft down to its maximum approved landing weight.

Upon its return to CYYZ, the crew reviewed the landing procedures when one engine is inoperative. Autobrake four was selected, and the flap lever was selected down to the 20 detent. Shortly after touching down on Runway 23, the crew activated partial thrust reverser on the operating engine, and the aircraft came to a stop on the runway. Emergency services personnel chocked the main landing gear wheels, and the brakes were released to reduce the temperature prior to the aircraft taxiing to the gate. The aircraft had been airborne for approximately one hour and 26 minutes.

After the passengers were deplaned, the aircraft was towed to the hangar, where the engine was examined. The weather was not considered a factor in this occurrence.

Preliminary examination

The aircraft received minor damage to the underside of the right-wing flaperon. The damage consisted of three punctures, approximately ¼ to 1 ¼ inches diameter in the carbon fibre surface. The engine exhaust cone contained pooled engine oil and small fragments of high-pressure turbine (HPT) and low-pressure turbine (LPT) hardware. Most of the damage to the LPT was located towards the outer periphery. This damage was consistent with excessive heat and impact from debris originating from forward of the LPT stage. The engine damage was contained, and there was no damage to the engine cowlings. However, there was heat damage to the HPT module near the HPT active clearance control panels. The fragments that fell from the aircraft while it was airborne were

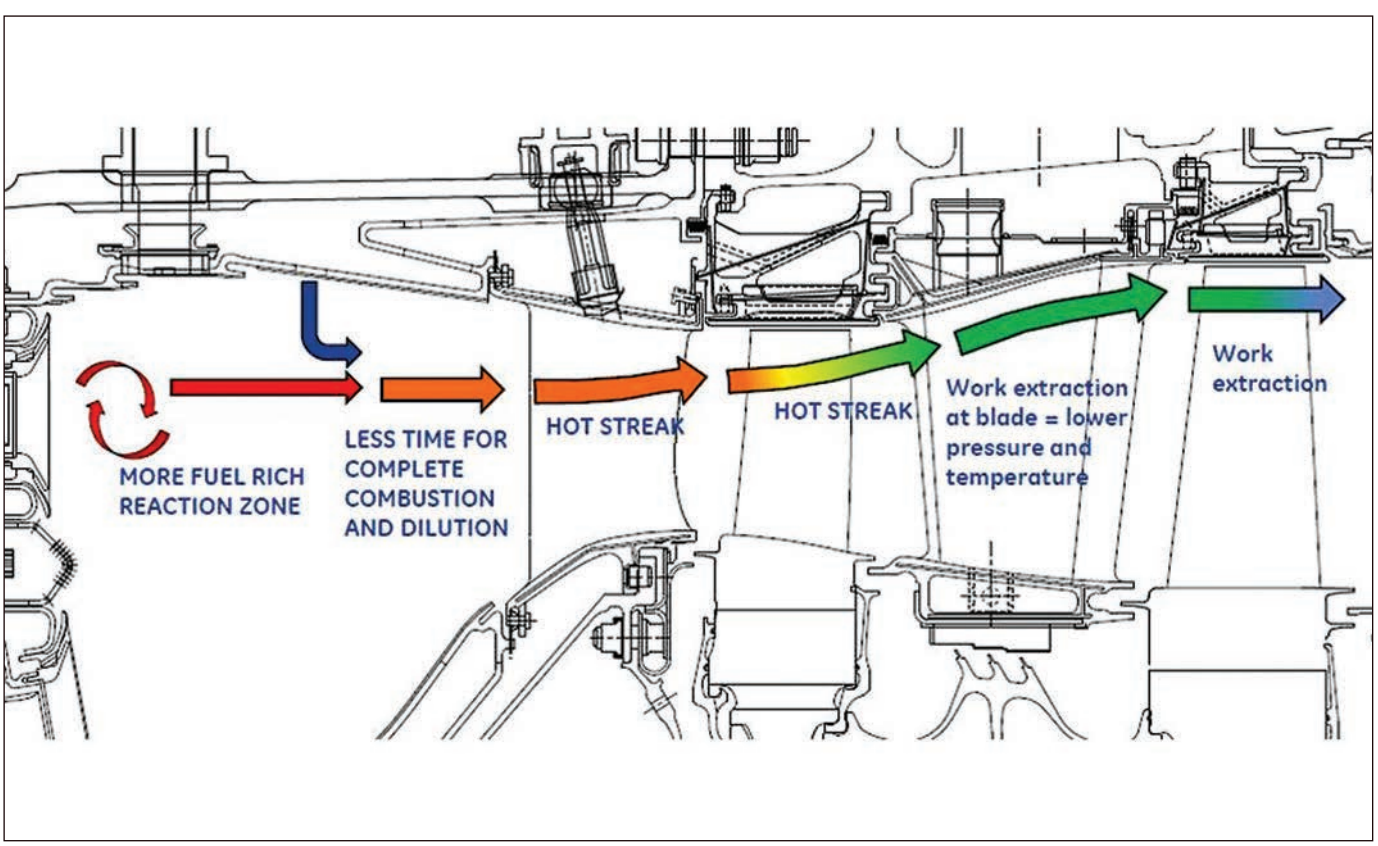
located and retrieved by local authorities. They were found to be identical in appearance to the fragments found in the engine exhaust cone.

The digital flight data recorder provided approximately 27 hours of flight information. The number 2 engine operational data was examined and compared to the number 1 engine data. The comparison revealed minor but acceptable operational differences, which were not considered abnormal. The data did not provide any indicators of deteriorating engine performance.

Preliminary engine and propulsor inspection

The propulsor core was seized by several HPT stage 2 nozzle fragments jammed in different locations, which prevented the core from rotating freely. There was no indication of a bird strike or component failure forward of the HPT module. A borescope inspection (BSI) was performed before the propulsor was shipped to Air France's overhaul facility in Orly, France, one of the only two overhaul facilities available for this type of engine.

The damage was observed on the HPT stage 1 stator shrouds and appeared to be more prevalent at the 11 o'clock position. Approximately 1 ½ of the stator shroud segments at this position were burnt, and the remainder were missing. HPT stage 1 blades were found in place; however, they displayed substantial damage to the leading and trailing edges, and to the blade tips. Three holes were located in the HPT



Above: Diagram shows fuel rich area, and coloured arrows show the gas flow through the HPT stages in the engine.

casing, which appeared to have been created by excessive heat exposure. There was no damage observed to the combustor, which was located directly forward of the HPT.

Engine serial number 906-456 service and maintenance history

Engine S/N 906-456 had been on wing at the number 2 position on Boeing 777-333ER (registration C-FIUW) when it was delivered to Air Canada. On April 4, 2009, it was removed and shipped to Air France due to leaf-seal liberation. On May 12, 2009, the LPT stage 6 blades were modified as per GE 90-100 Service Bulletin 72-0279. When the engine returned to Air Canada, it was installed in the number 2 position of C-FITW, the event aircraft. It remained in this position until it was removed following the occurrence. The engine had accumulated a total time since new of 19,216 hours and 2303 cycles. The engine had 96 cycles remaining before the next scheduled BSI of the HPT stage 1 shrouds as per Service Bulletin 72-0401.

High-pressure turbine stage 1 and 2 damage

In March 2010, another Boeing 777-300 series aircraft experienced a similar engine failure (S/N 906-435) during the take-off roll, which resulted in an aborted take-off. The disassembly of that engine revealed that the initial distress was located at the HPT shroud position number 33. This was verified when the most significant heat distress downstream from this location was in alignment with the shroud 33 position. In addition to this engine, there have been three other engines examined during scheduled in-shop visits that have displayed similar heat distress in this area. The reason for these shop visits was unrelated to the HPT shroud condition. The disassembly of S/N 906-456 was performed by Air France personnel with guidance and supervision from GE, and in the presence of the TSB.

The HPT stage 1 had extensive burn damage surrounding shroud number 33. Flame propagation (secondary flame) was suspected aft of the combustor location, in line with shroud number 33. The inspection also determined that damage to shrouds number 26 and number 27 was a long-term effect rather than the result of this single event, and may have been present during the previous BSI. The fuel nozzles were removed from the engine and identified by serial number in accordance with their position on the engine. The manufacturer then functionally tested these nozzles. The test results revealed no abnormalities that would have contributed to this event.

The information downloaded from the electronic engine control (EEC) non-volatile memory (NVM) was basically a replication of the information obtained from the DFDR and did not provide any indicator of engine performance degradation prior to the event.

All of the damage to stage 2 of the HPT was a result of failure in the HPT stage 1 region.

> . . . cooling holes eroded, resulting in degraded shroud cooling and a super-heated zone. This increased the erosion until the shroud integrity was reduced to the point of failure.

General Electric shroud distress investigations

After the engine S/N 906-435 failure, another investigation was initiated by GE. The engine teardown revealed that the initial distress was located between shroud number 31 and number 33. Testing of the fuel nozzles did not provide any findings that would directly contribute to the shroud distress. It is believed that, under the right operating conditions, a fuel-rich zone can exist downstream of the igniter. In normal hardware conditions, this fuel-rich zone would pass through the HPT and into cooler temperatures, following work extraction in the turbine stages, with no effect on engine operation. However, if a hole greater than 0.3 inches in diameter develops in an HPT stage 1 shroud, the hot fuel-rich air can be ingested in the region behind the shroud. The larger volume of air in this region can mix with the fuel-rich air and become a super-heated zone. The temperatures of this super-heated air mixture would be well above the melting point of the surrounding materials, which would quickly lead to rapid deterioration of the shroud hanger and stage 2 nozzle outer bands. This would lead to the release of a stage 2 nozzle and cause the resultant downstream hardware damage.

GE performed an investigation on engine S/N 906-449 in an attempt to recreate the flame propagation phenomenon. Because this engine had similar damage on shroud number 33, it was deemed to be a suitable engine for the planned testing. Testing on this engine was designed to create a profile of contributing factors leading to the flame propagation and the subsequent HPT stage 1 shroud failure. Probes were placed at various locations on the engine to collect temperature information under different operating conditions. After completion of these and several other tests, there were no reported findings that could definitively explain how the flame propagation developed. This phenomenon is most likely to occur at HPT stage 1, as temperatures are higher than anywhere within the engine. As the gas continues to flow aft, energy is extracted by the different turbine stages. Temperatures are relatively lower, reducing the possibility of a super-heated zone developing further aft of HPT stage 1. The condition that started the shroud deterioration was identified to be related to the laser-drilled cooling holes in the shroud. The subsequent shroud deterioration decreased the effectiveness of the shroud cooling and increased the rate of material loss.

Findings as to causes and contributing factors

During shroud production, a change to a higher-intensity laser resulted in a variation in the shape and size of the shroud cooling holes. Over a period of time, these cooling holes eroded, which resulted in both degraded shroud cooling and a super-heated zone. This, in turn, increased the rate of erosion until the shroud integrity was reduced to the point of failure. Damage to high-pressure turbine shrouds and hangers, which was likely present during the last borescope inspection, went undetected prior to the occurrence. As a result, the engine was not removed from service. The number 2 engine shut down during the initial climb-out due to a failure of the high-pressure turbine stage 1 shroud.

Safety action taken by Air Canada

Air Canada has taken a proactive approach in an effort to establish a baseline for all of its engines, regardless of their current cycle position in the inspection schedule. All borescope inspections were performed using a four-metre flex scope. After the fleet inspection, Air Canada identified 15 engines currently in service with shrouds that would qualify for the re-inspection program in accordance with service bulletin criteria. Three engines displayed sufficient shroud deterioration and were placed on a reduced cycle inspection interval. Two other engines displayed unserviceable shroud damage and were removed from service in order to implement either SB 72-0348 or SB 72-0363.

Air Canada performed its own risk assessment to evaluate the condition of the remaining engines affected by SB 72-0401 in order to assist with the prioritization of their removal and repair. The assessment considered engine time in service, current conditions of the high-pressure turbine (HPT) stage 1 shrouds, engine modification status and the pairing of affected engines on an aircraft, in an effort to reduce the probability of a double engine failure. After completing the risk assessment procedure and evaluating the results, Air Canada reduced the amount of cycles between inspections by 50 percent or more from the inspection schedule cycles documented in SB 72-0401, depending on its assessment of the shrouds.

Safety action taken by the Federal Aviation Administration

The United States Federal Aviation Administration (FAA) has issued Airworthiness Directive (AD) 2013-17-07, Borescope Inspections of the Stage 1 HPT Stator Shrouds, effective October 18, 2013. The AD applies to GE90-76B, -85B, -90B, and -94 B engines fitted with stage 1 high-pressure turbine stator shrouds part number 1847M52P14. It also applies to GE90-110B1 and -115B engines fitted with stage 1 high-pressure turbine stator shrouds part number 1847M52P16. The AD indicates that GE90-100 Service Bulletin 72-0528 R01 and Service Bulletin 72-1076 should be used for procedures and to determine unacceptable shroud hole limits.

(This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on November 6, 2013. It was officially released on December 13, 2013.) ■

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Rubbing salt in the wound

An industry expert believes that improper handling of de-icing fluid is directly responsible for a lot of financial pain, but training could change that.

Improved de-icing training and awareness of the impact of de-ice fluid could help prolong the life of aircraft brakes and save the airline industry millions, says industry specialist Phil Randell, managing director of World Aero, a provider of aircraft wheel and brake component repair. World Aero says it sees many brakes come through its EASA/FAA Part-145 certified repair station each year destroyed by de-icing fluid damage. The damage mainly caused by de-icing fluid is from the alkali-metal-salt fluid applied by airports to the runways, which can get transferred on to the wheels (and therefore brakes) when the aircraft is taxiing, taking off and landing. Unfortunately, no practical measures can be taken to avoid this damage caused by runway fluids, but if aircraft de-icing application methods are carried out correctly, the damage can be minimized as far as possible.

The contamination of aircraft carbon brakes by modern types of de-icing fluid can lead to oxidation of the brake discs, causing serious damage to the wear components. Discovery of an oxidized brake, seen by line maintenance technicians during routine wheel changes, mean the brake must then be removed from the aircraft altogether, with premature removal having costly implications for the operator, as well as an Aircraft on Ground risk. World Aero has seen a number of brakes where high remaining wear is left on the heat sink, but the oxidation is severe and the only option is to replace the carbon heat sink. It is of course a particular issue in countries affected by extreme, prolonged cold weather (hello Canada) where the use of de-icing fluid is more prevalent.

The vital process of de-icing ensures that aircraft are free of ice, snow or frost before takeoff. The one or two-step procedure involves the application of one or two types of fluid to the aircraft surfaces by hose from a de-icing vehicle. It is a time-sensitive task, with operatives regularly feeling under pressure to get the job completed quickly so that the aircraft can get back in the air as soon as possible after application. In addition to this, communication can be difficult, with operatives wearing ear defenders and often carrying out the task in the early hours of the morning. Furthermore, particular fluids must be reapplied if a certain time has lapsed before the pilot has taken off, meaning if there is a long queue for takeoff the process must be repeated, increasing the exposure of wheels and brakes to the harmful fluid.

Having previously worked as a line maintenance engineer certifying aircraft as ready for flight after de-icing, Randell knows first-hand the difficulty of the process and the temptation to over-apply aircraft with fluid in order to ensure that de-icing is effective: "The process involves covering the aircraft with de-icing fluid in order to minimize the risk of missed areas, meaning that wheels and brakes are often sprayed directly rather than avoided as they should be," he says. "The issue is particularly prevalent in Boeing 747-400 carbon brakes and World Aero has seen a large number of these prematurely removed from the aircraft and later scrapped due to oxidation."

This costs the airlines a considerable amount, with the replacement heat sink exchange ranging from $30,000 to $50,000 depending on the agreement in place with the OEM. It's often the difference between repairable and non-repairable on older generation aircraft due to the current market value of the brake.

"The issue can also be more prevalent in aircraft fitted with brake fans, including BAe146 and A320, due to de-icing fluid being sprayed and drawn into and across the brakes during turnaround," says Randell. "Fortunately, newer aircraft avoid complications as a more advanced type of carbon is used in the brakes, which can better withstand the destructive effects of de-icing fluid. 767-300 aircraft used to be badly affected however Honeywell released a new carbon heat sink with improved carbon elements. Of the 50-60 Messier-Bugatti-Dowty brakes we see annually, only a very small number of brakes have been removed prematurely due to oxidation."

Randell advises that simple improvements to de-icing training could create awareness of correct work practices and highlight the costly implications of the procedure being carried out incorrectly. "De-icing training often concentrates on the importance on covering the aircraft with de-icing fluid in order to ensure effectiveness," he says, "but when de-icing by hand, training could be improved by protecting the more sensitive parts of the aircraft, such as the pitot heads, equipment cooling inlets, engine inlets, and wheels and brakes."

As most aircraft wheels and brakes are under the body or wing, they have a level of protection, so if not sprayed directly, damage can be avoided, with a minimal amount of drip down to the wheels. Checking for damaged brakes is done when removing the wheels for tire change, when a check on the brakes can be performed to observe for crumbling of the carbon components, especially of the pressure plate located closest to the pistons, which indicates oxidization of the heat sink.

"With improved de-ice training and awareness of the effects of de-ice fluid on brakes, operators would be able to save significant sums over the lifecycle of an aircraft by having fewer, faster and more cost-effective repairs, ensuring a longer life for brakes and avoiding expensive replacement parts," says Randell. ■

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