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EVERYTHING we understood as "normal" about life has changed since COVID-19 reached our shores what now seems like a hundred years ago. But in times of crisis, people tend to step up and do what they can to help the next person, even if random acts of kindness aren't always easy to perform. Aery Aviation is a good example of this. Since June 2020, the Newport News, Virginia-based company has completed 23 flights carrying critical transplant organs from donors to recipients. These flight operations can occur at any time and the window for response is small, usually a few hours at most.

Individuals and families who have chosen to be organ donors obviously do not know when the time will come that they will be donors, and the organization they have selected for donation dutifully and respectfully fulfills those wishes. Aery has been part of that process for many by not just transporting organs from donors to recipients but also by flying surgical staff to do their jobs.

Those flights, whether day or night, fair or foul weather, save lives and Aery says it has had 100 operational successes at these critical times in people's lives. "While it is a somber event that brings about the availability of an organ, the opportunity to assist in saving a life may help ease the loss for those involved," says an Aery press release.

Founded in 2016 Aery Aviation is a commercial provider of aerospace design, engineering, systems integration, modifications, certification, maintenance and flight operations services. ■

— John Campbell, Editor

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Upcoming Events

CF Snowbirds/CF-18 Demo Team

Summer Flight Plans Filed

The Canadian Forces Snowbirds and CF-18 Demo Team both released tentative schedules for the 2021 show season, which are subject to change because of the ongoing COVID-19 pandemic. The Snowbirds in 2021 are celebrating their 50th anniversary with what currently includes 16 Canadian and one U.S. demonstration show, beginning in North Bay, Ontario in early June and lasting until September 19 in Mirabel, Quebec. The 2021 CF-18 Demo Team schedule following a similar timeline, currently kicks off in North Bay in early June and finishes in Mirabel, September 19.

COVID Cancels Competition

Due to ongoing travel and logistical challenges brought on by COVID-19, the Aerospace Maintenance Competition (AMC) Presented by Snap-on that was originally scheduled for April 27-29, 2021 in Orlando, Florida, has been cancelled. All team, event, and sponsor registrations will carry forward to the 2022 competition.

"The consequences of the COVID-19 pandemic have greatly impacted the aviation industry, as well as the AMC. As we evaluated hosting the competition in April, we heard from our sponsors and many teams that the timing just isn't right; it was clear to us that the industry is still in a recovery mode. As such, we made the difficult decision to cancel this year's AMC," said Ken MacTiernan, Chairman, Aerospace Maintenance Competition."We've already begun planning for the AMC's return to the MRO America's convention in April 2022 in Dallas, and are looking forward to once again hosting a world-class event for aviation technicians."

The AMC is an international annual event that attracts upwards of 90 maintenance teams from around the world, providing an opportunity for certified AMTs from major airlines, MROs and OEMs, as well as military personnel and students in FAA Part 147 schools, the chance to test their maintenance skills against their peers.

AMC Presented by Snap-On

Portland 2021

Maintenance Conference Will Relocate

Due to the COVID-19 pandemic and the ongoing protests in Portland, Oregon, the 2021 NBAA Maintenance Conference tentatively scheduled for May 11-13 will be relocated to another (yet to be determined) city. While the NBAA had hoped to be able to confirm location details in December 2020, the association says it is continuing to monitor developments related to vaccine distribution and will make an announcement regarding the 2021 conference as soon as it is able to do so.

nbaa.org/events/2021-maintenance-conference

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STCs & new products

Imager provides high-def views

The new 36-inch front view articulating imager from **Snap-on Industrial** rotates 180 degrees to provide technicians with high-definition views from the tightest of spots. It pairs with three Snap-on borescopes (BK8500; BK6500 and BK5600) to give detailed and up-close views. It features a three-foot long reach and high-definition camera outfitted with six bright mini-LED lights. The imager can navigate around a 31mm radius, enabling it to twist and turn around corners. **www.snapon.com**

Avionics STC covers multiple Bells

Astronics Corporation announced that an amended Supplemental Type Certificate has been approved for the Max-Viz 2300 enhanced vision system. Offered by subsidiary Astronics PECO and obtained in cooperation with AVIO dg in Calgary, the STC covers multiple Bell helicopter models, including 212, 412 and Bell 412EPI aircraft. With the U.S. Federal Aviation Administration and Transport Canada Civil Aviation approvals, images produced by the Max-Viz 2300 can now be presented on multi function displays, primary function displays, or on standalone displays depending on aircraft configurations. **www.astronics.com**

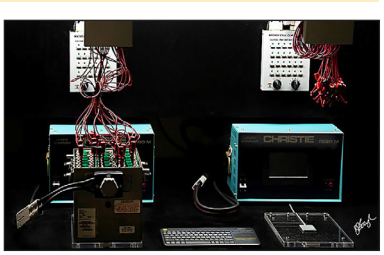
Rotor bearing receives approval

The Parker LORD Noise, Vibration and Harshness Division of Parker Hannifin Corporation has received the Federal Aviation Administration's (FAA) Parts Manufacturer Approval (PMA) for its enhanced main rotor spherical bearing for the AS350 helicopter. Parker LORD says customers using its PMA parts can reduce their aircraft-on-ground time and save on costs over a new purchase from the original manufacturer. **www.lord.com**

Piaggio mod can be quickly performed

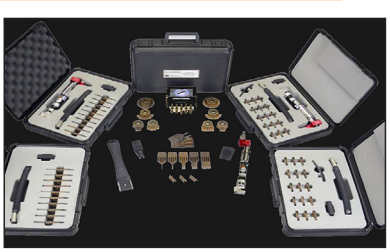
Becker Avionics has been awarded a Part 23 Supplemental Type Certificate for the installation of the AMU6500 Audio Panel. The STC covers the Piaggio P.180 Series aircraft (Avanti II and Avanti EVO). This STC was designed with simplicity and ease of installation in mind. The whole modification can be performed quickly and during a planned maintenance event. The obsolete Baker Electronics M1035/M1045 audio panels are removed from the instrument panel. By adding a new audio panel mounting bracket and a small harness adapter, the new AMU is installed. **www.becker-avionics.com**

Custom unit charges three batteries



Conair Aerial Firefighting has designed a custom built unit where three batteries can be charged simultaneously using an integrated computerized system. A specialized hydraulic cart lifts the batteries into the unit, an integrated overhead vent system evacuates damaging gases and excessive heat, and an automated clip-off module for each station monitors cell voltage and carries out the clip-off phase. A computerized system connected to the chargers controls the entire maintenance cycle. Real-time results are displayed on a large overhead screen. **www.conair.ca**

Scrapers hold superior edge



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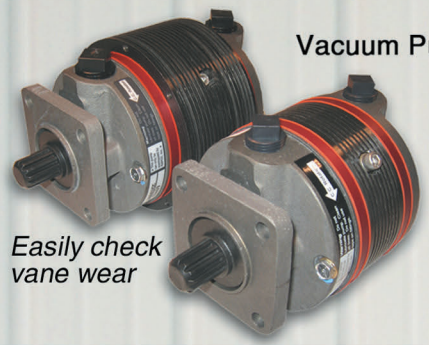

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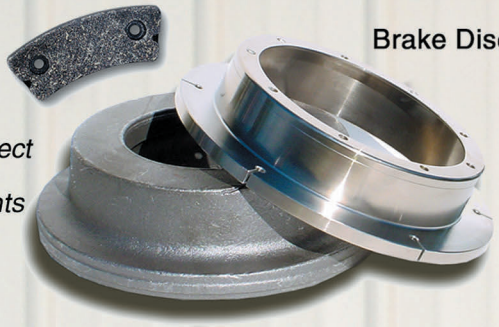

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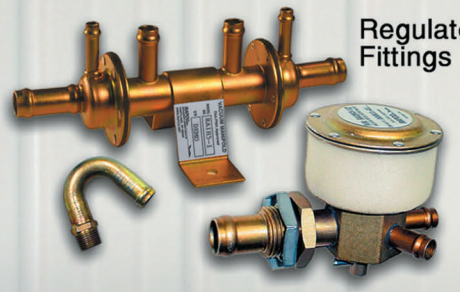

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STANDARDAERO MOVES OPS TO FLORIDA

With the start of the new year, StandardAero has moved its Rolls-Royce M250/RR300 and Pratt & Whitney PT6T Engine Accessory/ Line Replaceable Unit business from Winnipeg into two separate locations in Florida. The company says its Florida facilities are well established with all the necessary tooling, approvals, and trained workforce to manage these products. "We have established a strict timeline for this project," said a mid-December company news letter signed by StandardAero executives. "Effective January 1, 2021, all customers should begin sending field arising LRUs and Accessories to the appropriate Accessory CoE site."

WESTJET RETURNS 737 MAX TO SERVICE

In early January, WestJet announced its intent to return its fleet of 737 MAX aircraft to passenger service in a phased approach. The airline's plans follow an announcement from Transport Canada on December 17, 2020 where TC safety experts validated the aircraft design changes and outlined requirements for Canadian carriers. WestJet's phased approach to re-entry for its MAX aircraft began with non-commercial test flights in mid-January. The airline plans to operate three roundtrip flights per week between Calgary and Toronto. The schedule will remain in place for four weeks, while evaluating further routes and additional frequencies.

TESTBED 80 IS BIG AND SMART

Rolls-Royce has completed the first engine run on its state-of-the-art Testbed 80, which will be the largest and smartest indoor aerospace testbed in the world when it is officially opened in the coming months. With an internal area of 7,500 square metres, the systems inside Testbed 80 can collect data from more than 10,000 different parameters on an engine, using a web of sensors that detect even the tiniest vibrations at a rate of up to 200,000 samples per second. The testbed also has an x-ray machine able to capture 30 images per second and beam them directly to a secure cloud.

ANTI-TORQUE SYSTEM UNVEILED AT FORUM

Bell unveiled its electrically distributed anti-torque (EDAT) aircraft during Aéro-Montreal's 2020 Innovation Forum in Mirabel, Quebec. Bell's EDAT system is composed of four small fans within a tail rotor shroud in an offset two-by-two pattern. Each of the rotors contains four blades which are powered by four separate motors with the electrical energy provided through generators driven by turbine engines, effectively reducing noise and offering lower operational and maintenance costs compared to an aircraft with a conventional tail rotor.

BOEING CONDEMNS VIOLENCE AND DESTRUCTION

The January 6th pandemonium on Capitol Hill in Washington did not go unnoticed in Chicago as Boeing released the following statement: "We continuously assess our political action committee contributions to ensure that Boeing supports those who reflect

our company's values. Boeing strongly condemns the violence, lawlessness and destruction that took place in the U.S. Capitol on January 6, 2021. Given the current environment, we are not making political contributions at this time. We will continue to carefully evaluate future contributions to ensure that we support those who not only support our company, but also uphold our country's most fundamental principles."

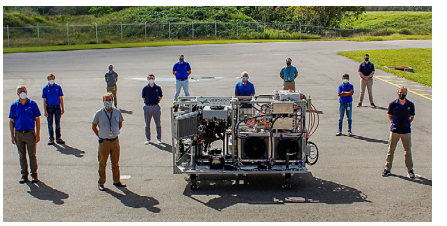
ELECTRIC EEL FLIES AN ACTUAL ROUTE

California-based Ampaire Incorporated has completed a demonstration flight of a hybrid-electric aircraft along an actual airline route. The company flew its Electric EEL aircraft on a 20-minute flight November 22, from Maui's Kahului Airport across the island to Hana and back on a single charge. Ampaire is now flying the route regularly in a one-month demonstration program with Hawai'i-based Mokulele Airlines. The Electric EEL is an upgrade of the Cessna 337, featuring a 300-horsepower piston engine in the rear and a 160 kW-capable electric power unit in front.

P&WC NAMED TOP INVESTOR

Pratt & Whitney Canada has been named the top 2020 investor in Canada's Aerospace Research & Development sector and the fourth largest R&D investor overall in the country, improving on its fifth place overall ranking the previous year. "Research and development investment has been a driving force in our company's growth," said Maria Della Posta, president of Pratt & Whitney Canada. "We are proud that our continued investments help to push innovation forward, while supporting the Canadian aerospace ecosystem from industry to academia. We are constantly integrating the latest technologies into our engines and services…"

PLANS TO HUSH E-AIRCRAFT NOISE



VerdeGo Aero and Florida-based Embry-Riddle Aeronautical University are teaming up to develop technology designed to mitigate electric aircraft noise. The technology would automatically adjust the pitch of rotating propeller blades, while also adjusting motor torque to maintain constant thrust. In this way, it is possible to reduce noise or increase efficiency, while maintaining substantially constant thrust, altitude and airspeed, according to VerdeGo Aero CEO Eric Bartsch. "Although electric aircraft show great promise for reducing carbon emissions, fossil fuel use and operating costs, the propellers or rotors can be relatively noisy," Bartsch explained. ■

By Roger Beebe

The Beginning

Aeroplane development was well underway before Aircraft Maintenance Engineering was even a thing. So where are the profession's historical roots? AME and author Roger Beebe has traced the timeline in a five-part series that begins this issue in the years leading into the First World War.

In 1911, Canadian J.A.D. McCurdy became the first pilot to attempt a massive 160-kilometre ocean crossing in a basic, single-engine wooden aircraft.

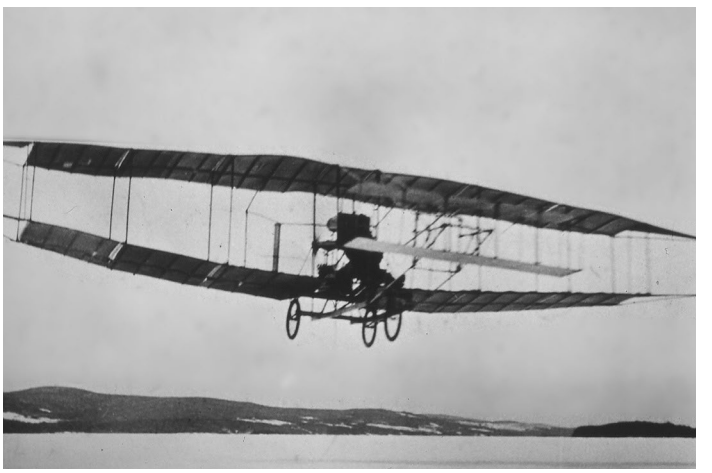
SO **WHERE DO WE GO** to find the start of the profession of Aircraft Maintenance Engineer? A lot of parallel aeroplane development work took place in Europe and North America before the First World War. The earliest designers were a combination of what we today call an engineer or scientist and machinist/mechanic. These individuals designed and build the items needed to make the machine work. They also worked to solve the technical challenges relating to engines, propellers and flight control. Unfortunately we do not have much information on who actually constructed all the bits and pieces.

We know that Charles Taylor, a machinist by trade working in a bicycle factory, built the engine for the Wright Flyer and maintained it. He apparently also completed the first repair so he in fact conducted one of the first aircraft maintenance actions. There were also many examples across Canada of farmers who were particularly mechanically inclined and adventurous mechanics and who elected to build experimental aircraft and engines.

Above: Avro 504 prototype after modification with conventional ailerons.

Right: Much of what was learned during aviation's early years came through trial and error.

Below: J.A.D. McCurdy tests the Silver Dart's controls.



The book, Voyageurs of the Air, by J. R. K. Main is a fantastic source of information on early Canadian aviation history. Much credit must go to the authors of the book which was commissioned by the Federal Ministry of Transport as a 1967 Centennial project to honour Canada's 100th birthday. I quote several paragraphs from this book to demonstrate the state of technical advancement in Canada before World War I. "One of the most striking sagas from this period concerns a man by the name of William Wallace Gibson. He was reared on a prairie farm in southern Saskatchewan. From an early age he had distinguished himself by designing and building kites and model aircraft. As a young man, Gibson moved to Vancouver where he made a small fortune in mining, after which, starting in 1908, he devoted his time and money to designing and building Aeroplanes and aero engines. The first engine was a failure, but his second, a six cylinder, air cooled, two stoke engine, is credited with the capacity to develop 60 hp.

The engine's weight was 210 pounds. The technology applied to these early airplanes was surprisingly modern. Two propellers of opposite rotation drove Gibson's Twin Plane so the torque was neutralized. Rupert Turnbull of New Brunswick is considered the father of aeronautical research in Canada. He did pioneering work on propellers and the matching of all components on an aircraft. He suggested dihedral wings as a way to gain better controllability. The Silver Dart had steerable tricycle undercarriage and a steering wheel rather than a "joy stick", a modern feature."

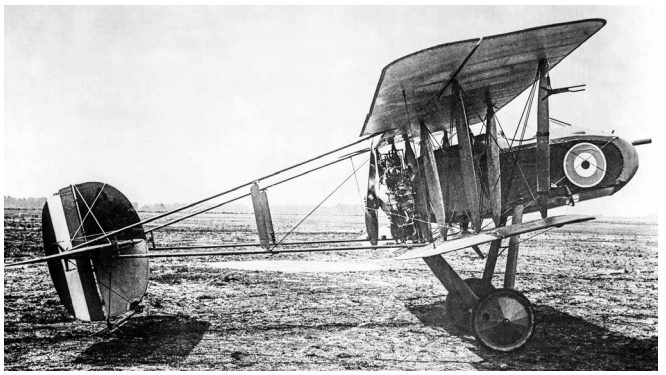
THE BELL FAMILY

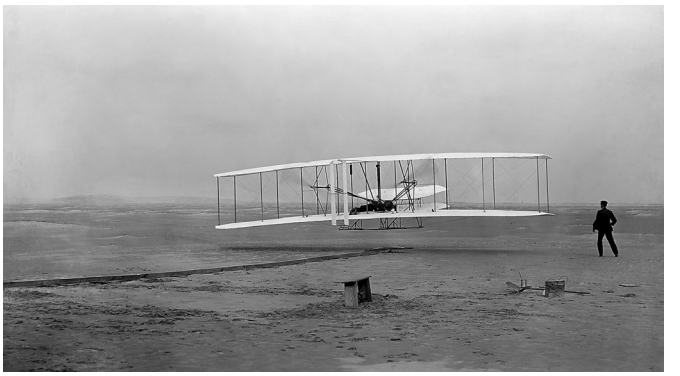
The Canadian military was not easily convinced of the potential of early aircraft.

Again I refer to Voyageurs of the Air to describe the equipment these early aircraft were equipped with: "They had few, if any, instruments for either engine or aircraft. McCurdy is known to have had a thermometer on the Silver Dart to indicate water temperature in the cooling system. They had experienced much difficulty with overheated engines, particularly the air-cooled ones. Indeed, the earliest engines could not be trusted to operate satisfactorily for more than about 10 minutes. For longer periods they overheated to the point where power dropped and there was danger of seizing up. One is startled to learn that a prospective purchaser of an engine specified that it must run full out for 30 minutes before overheating. A temperature gauge was therefore a must. The oil pressure gauge followed quickly thereafter. But instruments to tell the speed and altitude were still in the making. The pilot relied on his natural sense of balance, conveyed through the point of heaviest contact, his posterior, to maintain an even keel, and on the sound of the wind whistling through struts and wires, which were plentiful, to maintain a safe airspeed. he one great indispensable aid to flight was the horizon."

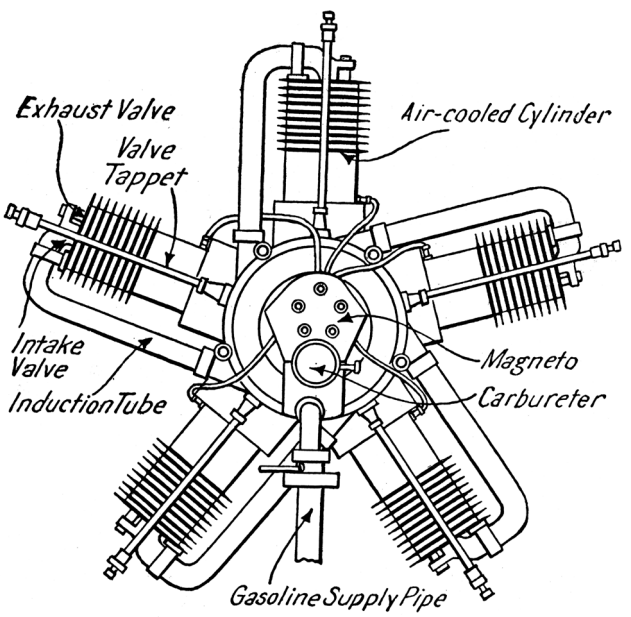
Trades people who were later to become known as Licensed Aircraft Maintenance Engineers were an outcome of the apprentice system of the 19th century. European nations had developed a system of trade apprenticeships, which were a natural growth from the medieval trade guilds. In classical times trades were passed down from family to family member. They had schools to teach reading and writing and other refinements; however it seems trade training was less formal. The medieval guilds instituted a formal training system across Europe. These systems formed the base of training for the industrial revolution, which by then required many skilled trades, and engineers. The title Engineer had not yet been developed to represent a class of university trained and professional association certified pers ons as we know it today.

Our ancestors used the term to mean anyone who made something mechanical work. Consequently, when ships went from wind and sails to steam engines and turbines they applied the term engineer to those who maintained them. The same sort of thing happened in railroads. Since early aviation borrowed so much from the marine world the term engineer was adopted in the British Empire for aircraft





Above: The first production Vickers FB12C A7352 with Anzani engine and modified nacelle.
Below: This illustration shows an Anzani Radial Motor with stationary cylinders.
Top right: The Wright Flyer's first flight at Kittyhawk in 1903.
Bottom right: United Air Lines mechanic roll-up tool set, from the late 1920s.



Anzani Radial Motor, with Stationary Cylinders.

maintenance technicians. Logbooks, navigator, captain, first officer, port and starboard all came from the same marine world. The Americans alone among English speaking nations tended to prefer mechanic, a term that is highly respected in the USA. Why they did so is difficult to understand unless they simply wanted to be different from the British Empire, with whom they had a falling out.

One thing that set the American approach apart from that of the British Empire and Commonwealth, and may provide a clue to the different terminology, was that the Americans have focused on the performance of work, while the rest of the English speaking world makes a distinction

A Le Pere biplane with a GE supercharger after making a record altitude flight in 1919.

between actually working on the machines and inspecting them for safety. In the Royal Flying Corps and Royal Air Force for example, the people who worked on engines and airframes were known as Fitters and Riggers, respectively, and initially this carried over into civil aviation. These titles concentrated on hand skills. When it became desirable to add an extra layer of safety it would have been natural to adopt the term engineer for this responsibility, just as in the marine world the ship's engineers oversaw the actions of the stokers and oilers. This difference still exists to a degree. American regulations still focus primarily on who can perform work, while the Commonwealth and European nations tend to put more stress upon who can certify that the work has been done correctly.

In the non English-speaking world the term engineer was not generally used as we know it today. The Anglo-Saxon world came to play major part in aviation and in the far flung British Empire the British model took hold and remains to this today. There has been a long and frustrating debate over these title terms which I will deal with in a later chapter.

Sometimes we forget that our predecessors in this world had the same talents as ourselves. They were skilled craftsmen and women of the past who were able to create all the necessary equipment to be able to fly. The idea of a wing was more easily understood; all you needed to do was to watch the birds. The facilities to make struts and wires and linen coverings were all there. Model gliders had been around for many years and even man-carrying gliders for some time prior to the Wright Brothers. The missing piece was a power source that was light enough to make it all happen. The invention of the internal combustion engine is what really made sustained flight possible.

Although the steam turbine was in use in the marine and locomotive sectors, the weight penalties were too great to have much effect on aviation. There were some people who realized that the principles of turbines could be applied to aviation and some theoretical and practical work was started. The skilled mechanics/engineers of the day were able to refine aluminum and machine engines from it. They also knew how to create radiators or sleeves filled with water to cool the engine if they did not go for air cooling. The industrial revolution had also created the mechanical means to provide feedback and control systems. Today we do most of that by electrical systems and electronics but before World War I it would be fair to say most controls were mechanical. So the technology existed and the skilled people existed. One group had to be created from the start and that was the pilots. Every early flight was by trial and error but gradually a body of flying knowledge was created.

Another change was taking place around this time, which would affect the early AMEs. Society was creating more and more access to higher levels of education for everyone. The effect of that was to create more research capability and a growing pressure to certify engineers in the same manner as doctors and lawyers. By 1914 we find many highly educated

and skilled engineers involved in aviation around the world.

Gradually there came to be a separation between skilled tradespersons educated through apprenticeships and/or on the job work, and those more formally educated. This eventually led to the aviation industry separating into three early classes in most countries: pilots, mechanics and engineers.

The final outcome of this was seen in Canada in 1921 when the government adopted Air Engineer for the title of the new licensed technician/mechanic. Fortunately for those AMEs who dearly love the present title, the profession of engineering was not legally recognized in Canada until later in the 1920s. So the practice of being called engineer continued in Canada and other British dominions. In the United States the term mechanic became an honoured term and has remained so.

So what was life like for the early AMEs? From what I understand they worked in small machine shops and probably blacksmith type forges. I remember how much could be manufactured by a small shop and forge in my hometown in the 1950s. The early AMEs would have worked with lathes and files to form most components. There would have also been facilities to prepare the fabric and cure it. Wires would have been manufactured and adjusted. They would have had to have some knowledge of the handling of fuel and oil products as well. They were probably not well paid. The first American mechanic who built the Wright Flyer was found penniless in his old age. The American aviation industry raised money to keep him in an old folk's home until he died and then he was buried in a hero's cemetery for aviators. I do not recall any Canadian early AMEs becoming rich and famous.

Resourcefulness and a sense of humour were required by the first AMEs. Their work was hard and at times dangerous. Engines were started by hand-swinging the props. One misstep or a backfire could mean maiming or death. Their tools were hand fabricated in many cases and maintenance manuals were rudimentary or non-existent. They learned from experience and from one another. The arrival of World War I and the heavy investment in research changed aviation rapidly. Governments also had to deal with replacing pilots quickly and training masses of mechanics. All of this forced them to adopt structured training and manuals, the effect of this effort were to last until today.

A century before the foundation of the Canadian Institute of Civil Engineers, the Montgolfier Brothers made the first balloon ascents in France. During the nineteenth century Lilienthal in Germany, Pilcher in England and Chanute in the United States experimented with gliders. These activities were the foundation on which our modern aviation was built. Canada took little part in this work. Though there is no doubt occasional balloon ascents were made, the only record of the design and construction of an original flying machine in Canada during the nineteenth century is that of Mr. Charles Pale of Montreal. His backer in the venture was Mr. R. W. Cowan, a retired merchant to the city. His invention was a dirigible, cigar-shaped balloon, from which was suspended a nacelle.

In 1900 the Wright Brothers began their work at Kitty Hawk, North Carolina, which led to the world's first power driven flight on December 17, 1903. McCurdy's "Silver Dart" was completed in November and assembled at the Bell laboratory for trials from the ice there. On the 23rd of February 1909, Dr. Bell was able to cable the London Times in part as follows, "First flight of a flying machine in Canada occurred here today." McCurdy, native of Baddeck, Nova Scotia, flew a distance of about one-half mile at an elevation of about thirty feet above the ice on Baddeck Bay in an aerodrome of his own design, named the "Silver Dart". The following day a flight of four and a half miles at a speed of 40 mph was completed. It made in a circle round Baddeck Bay.

Then on the 8th of March a distance of eight miles was covered in the fast time of eleven minutes. Aviation history was made rapidly in the little town of Baddeck that winter. The "Silver Dart" was without doubt an advance on any aircraft previously flown. It embodied several new and very important features, notably three-wheel undercarriage, tapered wings and the use of aileron control. After several rough landings and a series of early morning successful trial flights, both aircraft crashed on landing, fortunately without injury to its pilot. The military authorities remained unconvinced of the practical value of aircraft in military work and refused further assistance. It is unfortunate that the Militia Department refused to take cognizance of McCurdy's and Baldwin's 200 successful flights made under proper conditions and adopted a conservative attitude based on the reports of the trials made from rough ground at Petawawa. Their lack of vision had an influence detrimental to the whole course of Canadian aviation. Had their foresight been greater, a small aviation corps would have existed in the pre-war years. It would have been expanded to meet the war needs. The splendid record of Canadian pilots would have been made under a Canadian organization and the Royal Canadian Air Force and Civil Aviation would have had a continuity of experience, policy and direction through the war and afterwards in the peace reorganization.

The first aeroplane built and flown in western Canada was a 35-40 horsepower Anzani engine biplane constructed in 1911 out of Sitka spruce and ash. It was made with silk covered wings from the designs of William Templeton, William McMullen and Winston Templeton of Vancouver. This homemade aeroplane, after many weeks of trials, finally made a few successful though short flights from the racetrack on Lulu Island, B. C.

The work of many aircraft technicians, to use a modern day phrase, from that time has gone unrecorded. They did their job as best they could as part of a very new and exciting industry. Aviation was one industry that was to expand rapidly and change mightily during the First World War from 1914 to 1918. ■

Roger Beebe *is vice-president of the Canadian Aviation Historical Society (Medicine Hat Chapter), former Transport Canada regional director, AME, and current president of Plane Talk Consulting services* ***www.planetalkconsulting.com***

Placing IQ into Tool Boxes and Cribs

By John Ficcadenti

A tool control program can include setting up calibration schedules for tools such as torque wrenches to ensure compliance dates aren't missed.

Talking tool boxes that alert you when a tool hasn't been properly returned — tool boxes and cribs are doing this and much more, all in an effort to reduce FOD concerns.

TOOL CONTROL has always had added importance in the aviation industry. While a missing tool in an automotive bay can lead to inefficiencies, plus the cost for tool replacement, a tool that gets left behind on an aircraft or dropped on a ramp can lead to much more devastating consequences. Despite the high stakes, the onus has generally been placed upon individual organizations to ensure accountability for their tools. Of course,

Creating a tool control program means eliminating the hodge-podge of technician-owned boxes.

some accomplish that better than others.

Some MROs require technicians to bring their own boxes to the hangar, creating an environment where it's nearly impossible to implement any sort of comprehensive uniform tool control guidelines. However, there is hope. Technology today is making tool control a more effective concept to obtain. Innovations are taking tool control to the next level by working to improve technician performance and

Deploying a well-designed tool control system will work toward consolidating tools in your facility.

productivity, saving MROs money, all while greatly reducing foreign object damage (FOD) concerns. These advances are driving the industry to develop safer maintenance practices, and in turn allow MROs to become proactive in meeting safety standards the aviation industry demands.

Implementing a Tool Control Program

Some people still don't associate technology with tool control … and past perceptions may have something to do with that. It wasn't that long ago that foam cutouts in a box constituted adequate oversight. Using foam gave technicians a quick visual check that tools were in their proper spot, and it certainly was a better option than a box with no foam where tools scattered throughout drawers.

However, a proactive tool control program has become a much more interactive endeavour. Technology and tool control are linking together, and the level of functionality it provides to users surpasses previous options.

The goal of a credible tool control program is to minimize the FOD threat to aircraft and equipment. To accomplish that effectively, any credible system should meet five criteria: organization, visibility, access control, asset management and automation. These factors, when added together, work to provide a detailed process of tool inspection and accountability, both before and after a job is completed, as well as a process that is repeatable.

Questions you should ask yourself in designing a tool control program include:

- What is the goal of a tool control program for your organization?
- How extensive will the program be?
- What materials will be monitored?
- Who can perform a general inspection of the area?
- What forms, if any, should be required?
- Will all the tools in the flight department be monitored?

Considering these questions will help you begin evaluating the scope of your tooling needs and get you started correctly on the path to success.

The case for Tool Control

Creating a tool control program means eliminating the hodge-podge of technician-owned boxes and deploying company-

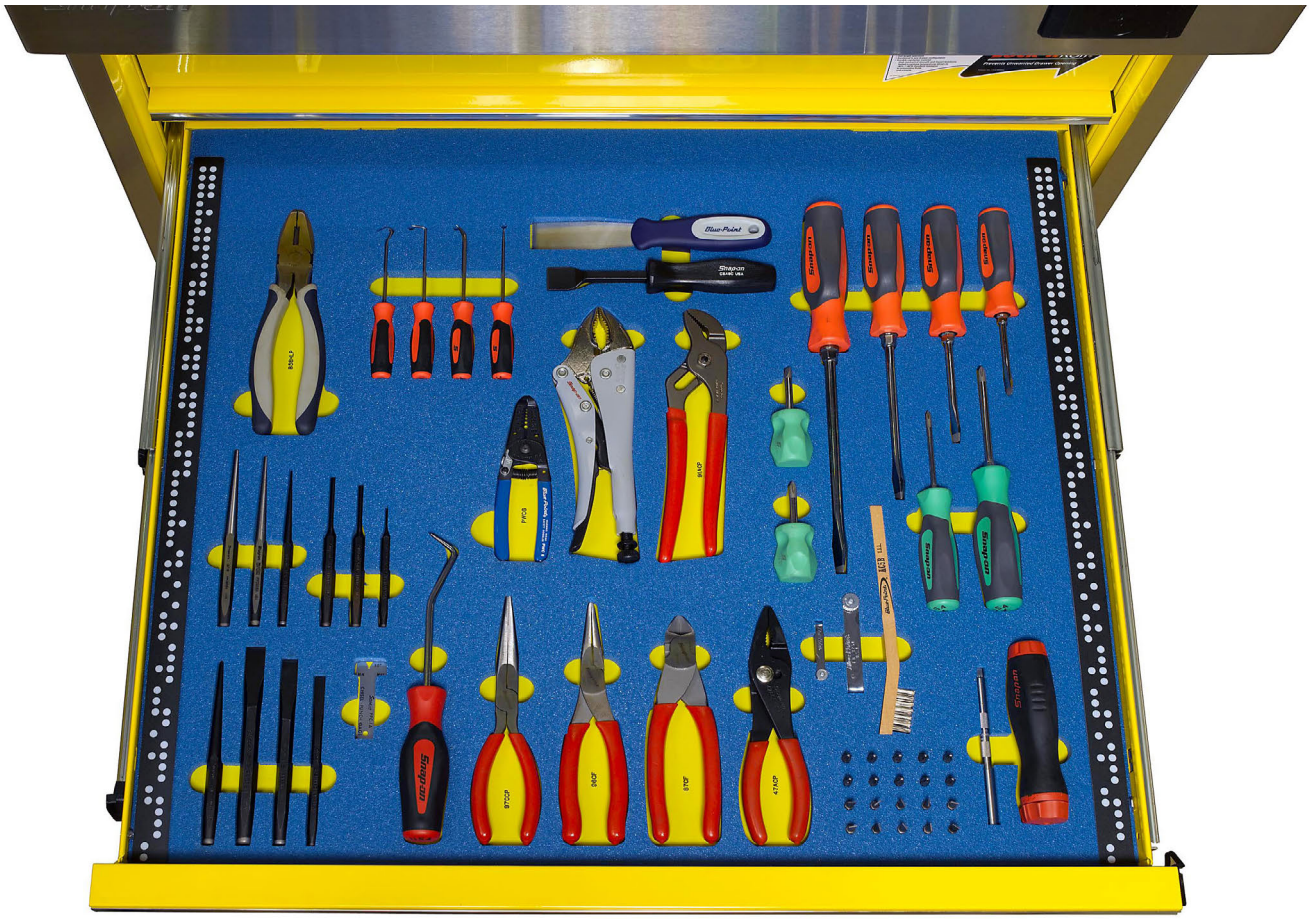
supplied tools for consistency in the hangar. There needs to be a uniform benchmark for tools, as well as a method to accurately track and monitor them; a lack of standardization and control over the number and type of tools can result in accidental oversight and unnecessary risks — such as what happened several years ago when a Boeing 737 lost an engine in flight.

After the aircraft made an emergency landing, investigators examined the engine and were surprised to learn the culprit was a tool mistakenly left behind. The investigation revealed that while performing maintenance on the engine, an engineer and technician left a tool behind in the engine cavity. The technician tightened bolts after servicing the engine, but failed to notice a small gap that was created when the covering didn't sit properly on the engine. That gap was caused by an expander tool overlooked in the engine. The friction during flight created a hole in the covering, which began leaking oil and led to the engine shutdown. Fortunately, the aircraft landed safely and everyone walked away, but the incident clearly illustrates the danger lost or forgotten tools can pose to the aviation industry.

The friction during flight created a hole in the covering, which began leaking oil and led to the engine shutdown. Fortunately, the aircraft landed safely and everyone walked away, but the incident clearly illustrates the danger lost or forgotten tools can pose to the aviation industry.

Automation in the Boxes

Digital imaging technology is one way to bring standardization and accountability to tool boxes. This technology provides



the ability to monitor and track tools as they are removed and returned from boxes throughout the day — all in real time. It works by scanning each tool in the drawer to determine its status. If tool status is questionable, an interactive monitor affixed to the box can display the disputed tool transaction, or it can be identified in the audit image at the administrator's PC. User log and data time/date information is available for every transaction.

Digital imaging technology offers several advantages to the aviation industry. For starters, it reduces FOD concerns. If a technician checks out 15 tools and later returns 14 tools, the system announces not only that a tool is missing, but which one, and the technician now knows to go back and find that tool.

Additionally, the digital imaging software allows the box's designated administrator to add or delete users, assign various levels of user access and lock permissions, and track individual tool usage. The system can be synchronized to individual or multiple boxes and can pull data and images from each selected tool box. Data logs and audit image files are available for inspection in the administrator's program following synchronization with the box. It also allows people who are connected to the box throughout the network to know the status of all controlled tools and equipment. This means technicians will know that the tool they need is on hand and available immediately, and supervisors have an extra measure of confidence that tools and other critical assets are being well supervised.

Opposite (left) : It wasn't that long ago that foam cutouts in a box constituted adequate oversight for tool control.

Linking Tool Boxes to Tool Cribs

The level of accountability is now extending to the tool crib as well. This is valuable because in the past, organizations didn't have an efficient way to move tools and equipment within their inventory, or accurately keep track of them. While tool boxes were being monitored with a system like digital imaging, there's wasn't an effective complimentary program for the tool crib. More importantly, there wasn't an efficient network linking the tool crib to toolboxes and lockers. Innovations are making this happen today, and the benefits are plentiful.

With a quick scan, tools and equipment checked out from a tool crib can be tracked; enabling administrators to know which technician has possession of that particular item. Other capabilities include setting up calibration schedules

The goal of a credible tool control program is to minimize the FOD threat to aircraft and equipment.

for tools such as torque wrenches to ensure compliance dates aren't missed, and administrators can be alerted when consumable items, such as drill bits, fasteners, PPE, and other products are running low and need reordering.

This enables airlines and MROs to connect the tool cribs with the boxes and lockers — linking all critical components of tool control under one central platform. Administrators can see everything that's happening with their tooling program through a network that's speaking the same language. Tools and assets can be viewed and tracked in real time from mobile devices anywhere in the world.

Deploying a well-designed tool control system will work toward consolidating tools in your facility. It's also going to reduce FOD concerns, improve accountability, as well as promote an atmosphere for crib attendants and technicians to be more productive. Tool control is fast becoming an area that works for you — and that's all thanks to automation and connectivity. ■

(John Ficcadenti is the product manager for the Level 5 Tool Control program at Snap-on Industrial.)

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PACIFIC

Pacific AME Association

AME licence recency requirements: how do you prove it?

By Jason Kobbero

If you were laid off near the beginning of this COVID-19 situation, and you don't think you'll get called back this year, you could have a recency issue with your AME Licence.

Some plain word definitions

Validity: If today's date is between the issue date and expired date on your AME licence then your licence is valid. (the new validity period is 10 years)

Recency: (Comes from CARs 403.05 and Standard 566.05 Recency Requirements) Have you done at least one, or combined, of the following three jobs for 6 months within the last 2 years?

(a) performed aircraft maintenance; (worked on an Aircraft using the TC definition of "Maintenance", doesn't mean signed a Maintenance Release)

(b) supervised the performance of maintenance, either directly or in an executive capacity; (DOM, or Accountable Executive, QAM, Production Manger, ETC.)

OR (c) provided aviation maintenance instruction within an ATO, or an approved training program in an AMO or directly supervised the delivery of such instructions. (easy one)

Privilege: the privilege referenced here is the privilege to SIGN the Maintenance Release. To exercise your privilege of using your Licence, to Sign a Maintenance Release, your licence has to be valid and you need recent experience (doing, supervising or teaching Maintenance on an aircraft).

Most of us will fall under (a) Performance of Maintenance, as most AMEs are not management nor work at an ATO, so, how do we prove this? How do you prove you've worked on an aircraft for 6 months in the last 2 years? AMEC/PAMEA has asked TC for some clarification on this question, I'll keep you posted with their reply once we get it.

This is a very tough thing to prove with the vague regulations we have to work from. 6 months, is that consecutive? is that working full time or one day a week? What if you've worked 12 hour shifts do you only need 4 months?

I've asked TC about this 6 month question in the past, verbally during a PVI or PRM interview, my PMIs said the idea behind the reg is that if a regulatory change happens an AME needs to know about it, and if you are working on an Aircraft you are regularly checking the regs, and the CARs changes come in 6 month cycles. So if you are working you'll know that a regulation has changed, that's the idea at least. What if you were working and then you got an 18 month layoff, you've missed 3 cycles of CARs changes, but you tick the box for this regulation, 6 months within the last 24.

One option an AME can do if they haven't worked in the last two years, is ensure they have a valid Licence and work on aircraft without signing a Maintenance Release, after 6 months you'll be able to sign again, could be controlled with issuing ACA through an AMO. A possible way, use the wording within CARs 403.05

(1) "No holder of an aircraft maintenance engineer (AME) licence shall exercise the privileges of the licence unless

(a) the licence was issued within the preceding 24 months; or"

(b > d) The 6 months within the last 24 months jobs as stated above.

If you've renewed your licence in the last 2 years or you get a new one issued, would that not meet the recency requirements? My AME Licence says it was issued back in 2015, it was a renewal but it says issued. I'm going to get another renewal this summer, give the 75 dollar fee and sign the paper that says I haven't moved and all of a sudden I'm current, doesn't make sense but that's what the words say.

To finish, the regulations are unclear and the intent of the regulation, as I've been told, doesn't appear to line up with the words. Hopefully TC can answer with some clarity. **www.pamea.ca**

WESTERN

Western AME Association

About Our Assosiation

The Western AME Association is one of five similar associations across Canada, the others being the Atlantic, Ontario, Central and Pacific associations. These associations represent regional interests as well as concerns of national importance.

The Western AME Association is run by a volunteer group of AMEs who are elected by the member AMEs to the Board of Directors. The membership is comprised of AMEs, non-licensed personnel working in the industry, students, apprentices as well as corporate members.

A separate committee, under the auspices of the association, runs an annual symposium/workshop. This workshop is a two-day event which features speakers on a variety of related topics, as well as an industry tradeshow with over fifty booths from various companies, suppliers, manufacturers and other organizations. Attendance at this and our various other smaller workshops may be counted towards the recurrent training requirements required by Transport Canada.

Aviation insurance for AMEs

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

AME Association of Ontario

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Annual General Meeting

The Annual General Meeting (AGM) of the Association was held in an on-line format on Wednesday, November 25th at 7 PM. A PowerPoint presentation, similar to that of previous years, was used to show attendees the latest updates and information from our executive.

The 2019 AGM Minutes were approved, the 2019-2020 financial statement was accepted along with the appointment of the auditor, and nominations for positions on the board were ratified. John Longo was voted in as President and Louis Anderson becomes Vice-President. Shawn Warboys becomes a director for the Central Area and Jamie Milks joins the board as Area Director for the GTA.

At the following Board of Directors meeting on November 30th, the Directors confirmed Jasper Megelink as Treasurer and Stephen Farnworth as Secretary.

Looking at 2021

The outlook for the coming year may look bleak to some, yet it should be considered a challenge that we look forward to confront. Like unblocking the lav on a 737 – it is a nasty, smelly, gross job – but put your mind to it and go with the plan and that aircraft will fly off with a load of happy passengers and a relieved flight crew.

Aircraft maintenance is continuing by the airlines and third-party providers and, in fact, despite the reduction in fleet, maintenance procedures have become more arduous. In both the airline and general aviation world there are new and different ways to do things. The YouTube generation is here and it is time for us and the regulator authorities to look a new training methods and maintenance practices. We saw demonstrations of this in the AMEC/TEAC Conference we sponsored last October.

COVID-19 has been hard on Canada's aviation and aerospace sector, both in terms of business and the workforce. With promising vaccines in the works and a year's worth of experience operating in a pandemic environment, is getting back to business, and starting on the road to recovery a possibility? What will the recovery in the workplace and for the workforce look like? Is the industry ready? We need to prepare ourselves.

The changes to working methods have shown the requirement for improved IT skills. Although 77% of college aviation sector graduates end up working in the industry, a 44% decrease in grads is expected for 2022. IATA is forecasting that we will be back to pre-covid levels in 2024.

Furloughs and layoffs have impacted differently in each region of the country. Airline operations and MROs were also impacted in different ways with MRO work being less negatively affected and in some cases increased employment occurred. At the CCAA National Labour Market Strategy Forum that our association attended, participants polled felt that there will again be significant labour shortages in 2 to 5 years with 57% predicting a return in 2 years and 40% expecting a 5-year recuperation.

Recovery is just around the corner. We should be preparing for it.

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

Atlantic AME Association

President's Message
By Bob Pardy

With the coming of 2021, we are all looking forward to a medical breakthrough that will allow us to get back to our normal, or new normal, life and back to the business of long days and nights of aviation maintenance.

This year has seen our association and that of the national association conduct business in a different and new way. As you all know, the annual in-person conferences that are part of all the regional AME associations were all cancelled this year. The national association, AMEC/TEAC, (Aircraft Maintenance Engineers of Canada/Techniciens D'Entretien D'Aéronefs du Canada) through an organizing committee of the Ontario AME Association, held a Virtual AME Conference on October 22, 2020. This conference was attended by approximately 300 people from coast to coast and was considered a great success.

You can still register for this conference and access the presentations that were presented. The address for registration is: https://www.ineventors.com/2020amec/ There may be more of these virtual events as we await the moment when we can get back together and have a face-to-face conference.

The AMEC/TEAC Annual General meeting was held on November 4, 2020 with all regional AME Associations represented. Peter Kwan and I represented the AME Association (Atlantic). At that meeting the current President, Sam Longo, advised he would be stepping down as President after January 1, 2021. Nominations for the position of President were called and the only nominee was Paul Carter of the Ontario AME Association. Paul was elected by unanimous vote. Congratulations, Paul.

During the AMEC/TEAC AGM, there is normally a meeting between AMEC/TEAC and Transport Canada. This year the meeting with TCCA was held virtually on December 2, 2020. Questions from the regional membership have been posed to TCCA prior to this meeting, which they answered during the meeting. These questions and answers were made available to our membership when received.

The association presented bursaries to students of the two

ATLANTIC

regional AME colleges. One was a one-time memorial bursary in the name of Ben McCarty, given to the student with the highest marks at graduation. This bursary was gifted to the association by Tony Soulis. Thank you, Tony, for your generous gift. The second was our annual AME Association bursary, given to the student selected by a committee of three members of our association.

News from the Rock: Farewell Mel

It is with heavy hearts that we inform the membership of the passing of our 'News from the Rock' contributor, **Melvin D. Crewe**. Mel was a one of the original members of the AME Association (Atlantic), serving many years on the Board of Director and as Chairman of the ARAMC in St. John's. Mel will be missed by all of his friends and colleagues.

www.atlanticame.com

CENTRAL OHIO

Central Ohio PAMA

October 21st Board Meeting

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

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

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

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

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

www.copama.org

SOCAL

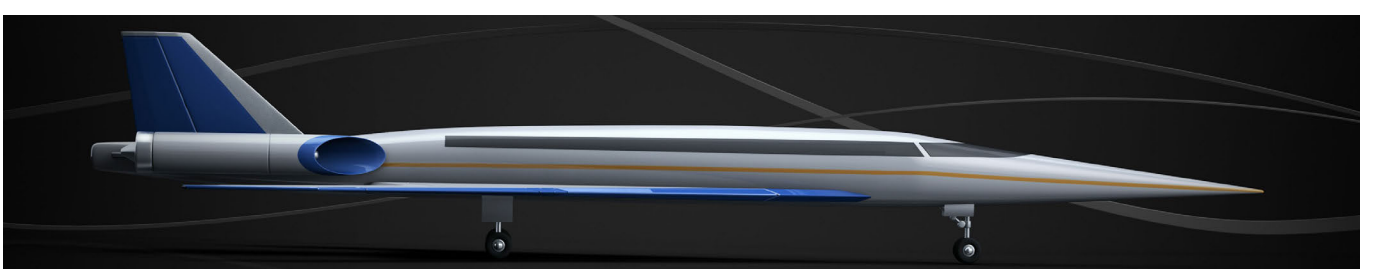
PAMA SoCal Chapter

Suspension of Chapter meetings

In light of on-going Covid-19 restrictions, the SoCal PAMA Board Of Directors voted to suspend all Chapter meetings as well as the Chapter Scholarship Program until 2022. The BOD has been meeting regularly via teleconference and will keep the membership apprised of any developments. **Thank you!**

We'd like to extend our sincere thanks to Aero-Nasch Aviation & Aircraft Window Repairs for their generous donations to the Chapter Scholarship Fund during this difficult time.

www.socalpama.org

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Mach 5: Cruising Speed

New York to London in two hours? Yes, supersonic passenger aircraft are coming and here aviation insurance expert Global Aerospace explains why.

Pictured here and above: The Aerion AS2.

THE original Concorde supersonic passenger jet may have been retired in 2003, but the desire to dramatically reduce the travel time on treks like New York to Paris and Sydney to San Francisco lives on. Today, a number of companies are seeking to make supersonic travel safe, reliable and affordable.

One of the more well-known names among them is Richard Branson's Virgin Galactic. Also a company that is leading the way in space tourism, Virgin hopes to have similar success in developing an aircraft that it says will be a Mach 3-certified delta-wing vehicle that can cruise at 60,000 feet and carry up to 19 people from London to New York in two hours rather than the 7.5 hours required for the trip today—or perhaps more impressively, from Sydney to London in four hours rather than 19.

Branson's company is working with Rolls-Royce to develop the engine propulsion technology for its supersonic jet. More widely recognized for its luxury cars, Rolls-Royce has extensive experience in advanced propulsion systems. "We are excited to partner with Virgin Galactic and The Spaceship Company (TSC) to explore the future of sustainable high-speed flight," said Rolls-Royce North America Chairman & CEO Tom Bell. "Rolls-Royce brings a unique history in high-speed propulsion, going back to the Concorde, and offers world-class technical capabilities to develop and field the advanced propulsion systems needed to power commercially available high-Mach travel."

Virgin has just announced the completion of Mission Concept Review and unveiled the initial design concept for its jet. The company is also working with NASA and the FAA on its designs as it seeks to make high-speed air travel a viable option for consumers. Its goal is to develop an aircraft that is compatible with existing airport infrastructure and services, and that can take off and land like any other jet. One unique characteristic, however, is that Virgin is planning to use a new form of sustainable fuel. While the company says it is making significant progress on the project, it has not given estimated dates for the jet to be operational or transporting passengers.

Virgin Galactic is not alone in looking to enable supersonic travel, of course. Other companies are working toward that same goal. They include Boom Supersonic, Aerion Supersonic, Spike Aerospace and Boeing. Boeing's

Boom Supersonic's XB-1 test aircraft will have a cruising speed of Mach 2.2

Left: Boom's Head of Manufacturing Mike Jagemann leads all aspects of the XB-1's design process.

In March 2020, the XB-1 team conducted three days of wing bend tests that simulated the most extreme flight conditions imaginable.

Below: Not only did 3D printing save time and resources during the build, it also reduced the weight of XB-1— a game-changer for all aerospace engineers.

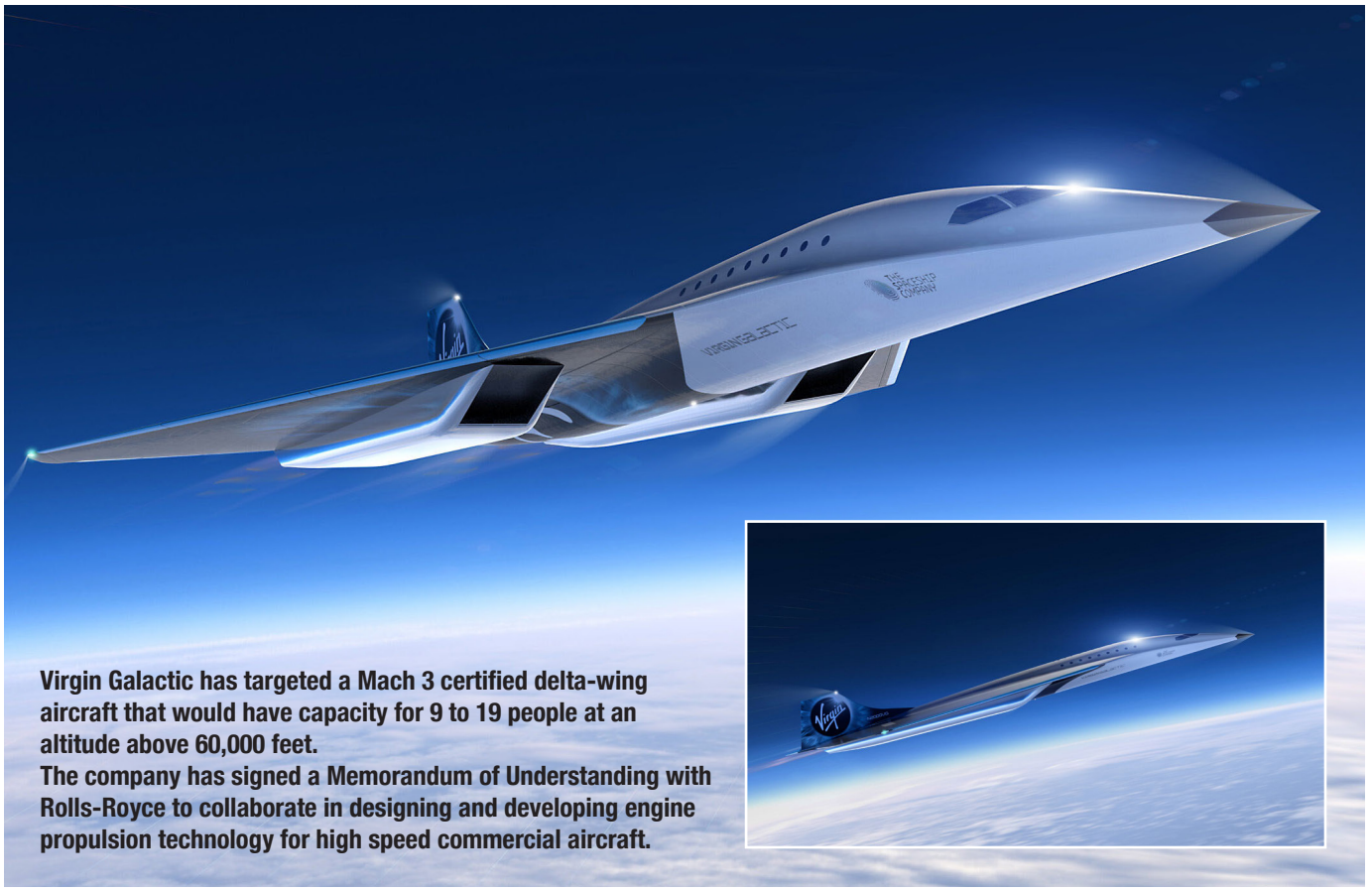
Above: Spike Aerospace says its S-512 Quiet Supersonic Flight Technology enables overland flights with no sonic boom.

goal of a cruising speed of Mach 5 (3,836 miles per hour) is especially intriguing. That speed would make it the first "hypersonic" passenger jet—a term not as clear-cut as "supersonic" but that is commonly applied to objects traveling Mach 5 or faster.

Not as fast but likely to be operational sooner, Boom Supersonic's XB-1 test aircraft will have a cruising speed of Mach 2.2. The company passed an important milestone in October 2020 when it completed the jet and began preparations for the vehicle's first flight, which is expected to take place over a Mojave Desert testing ground in summer 2021. The single-seat XB-1 will help the company test design elements that will ultimately be used in its Overture jet, which will have a 65-passenger capacity.

Aerion's aircraft at Mach 1.4 and Spike's at Mach 1.4 and Spike's at Mach 1.6 don't have proposed cruising speeds as high as the Overture or Boeing's unnamed jet but they still get travellers to their destinations in a fraction of the time of conventional jets.

Another key to the success of



Virgin Galactic has targeted a Mach 3 certified delta-wing aircraft that would have capacity for 9 to 19 people at an altitude above 60,000 feet.
The company has signed a Memorandum of Understanding with Rolls-Royce to collaborate in designing and developing engine propulsion technology for high speed commercial aircraft.

supersonic passenger jets is reducing or eliminating the sonic boom that the faster of these aircraft will produce. The anger and frustration of people living near airports who objected to the noise was problematic for the Concorde. The answer for some manufacturers may be that pilots won't accelerate to boom-producing speeds until the jet is at an altitude where the sound is reflected upward off a dense layer of atmosphere and is never heard on the ground.

Time will tell if supersonic travel, and later hypersonic travel, will be safe for consumers and profitable for airlines. But watching researchers and manufacturers pursue those objectives will certainly be interesting for aviation observers. Aerion Chief Executive Officer Tom Vice has said that the company's vision is ultimately to enable people to travel between any two airports on the planet within three hours. Couple that with the goal of Virgin Galactic and others to take tourists into space, and clearly the next few decades will be a period of unrivalled aviation and aerospace innovation. ■

Question of Procedures

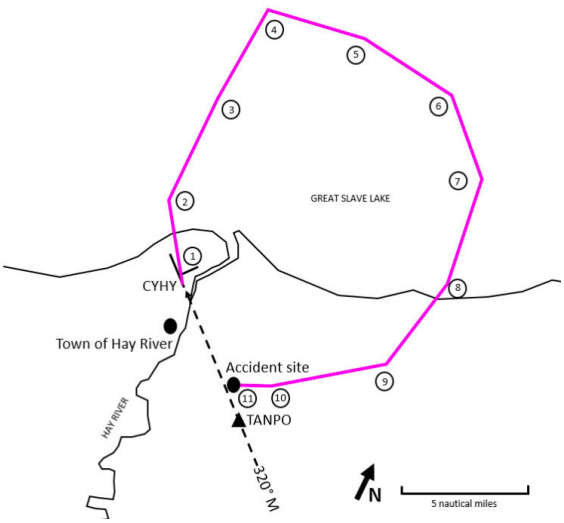
Engine power loss brings on a forced landing into the Northwest Territories.

Aerial photo of the accident site looking northwest. The green arrow indicates the aircraft's path on touchdown.

At **0741 ON 03 MAY 2019**, the Douglas DC3C-S1C3G (registration C-GJKM, serial number 13580), operated by Buffalo Airways Ltd. (Buffalo Airways), departed Hay River/Merlyn Carter Airport (CYHY), Northwest Territories, on an instrument flight rules flight for a scheduled cargo flight to Yellowknife Airport (CYZF), Northwest Territories, with 2 flight crew members on board. The captain was the pilot flying (PF) and the first officer (FO) was the pilot not flying (PNF).

Visibility at the time of departure was 4 statute miles (SM) in light snow. A few minutes later, the visibility decreased to 1½ SM in light snow, with a ceiling of 3500 feet above ground level. After departure, while the aircraft was climbing through 1200 feet above sea level (ASL) on the way to a cruising

Point	Time	Ground speed (knots)	Track (degrees magnetic)	GPS altitude (feet ASL)
1	0741:11	52	317	525
2	0743:10	108	14	1345
3	0745:10	114	6	1969
4	0747:10	112	56	1969
5	0749:10	119	130	1903
6	0751:10	101	59	1345
7	0753:10	118	158	1214
8	0755:10	120	177	1148
9	0757:11	103	211	1181
10	0759:11	85	259	820
11	0801:01	42	215	525



Above: Satellite tracking information retrieved from the occurrence flight. The magenta line is the aircraft's track.

altitude of 5000 feet ASL, the flight crew completed the after-takeoff checklist and applied carburetor heat to 20 °C.

While the FO was applying the carburetor heat, oil pressure was observed decreasing on the left engine (Pratt & Whitney R-1830-92). Moments later, rising cylinder head temperature and oil temperature indications were also observed on the left engine. The captain directed the FO to contact the area control centre to declare a PAN PAN emergency and request a return to CYHY, which the FO then did. The aircraft flight manual (AFM) does not contain any procedures for abnormal engine indications.

Right: Relevant gear-related standard calls.

Phase of flight	Condition	Pilot flying	Pilot not flying
Take-Off & Climb	Airborne, Positive Rate of Climb	"Positive Rate, Gear Up"	"Gear in Transit", then "Gear up"
Descent and Approach	1 Dot Above Glideslope	"1 Dot Above, Gear Down" "Landing Checks", "Flaps ¼"	"Check, Gear Down Selected", "Gear Down, Pressure UP, Green Light", "Flaps set ¼" (Complete Pre-Landing Checklist), "Pre-Landing Checks Complete"

Below: The incident aircraft is operated by Buffalo Airways Ltd.

The aircraft was equipped with a satellite tracking unit that reported the following information every 2 minutes: Average ground speed, Average track, Average global positioning system (GPS) altitude.

As the aircraft reached an altitude of 1969 feet ASL, the captain set the left engine to a reduced power setting and increased the power on the right engine to maximum except takeoff (METO) power. The flight crew began to set up for an instrument landing system approach to CYHY via TANPO.

At 0747, while the aircraft was in a right turn proceeding towards TANPO, smoke and oil were observed, and abnormal sounds were heard coming from the left engine. Using the engine failure checklist, the flight crew then

The incident aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures.

shut down the left engine and feathered the propeller. At 0748, because the situation had escalated, a MAYDAY emergency was declared. Moments later, the flight crew completed the descent checklist and initiated the approach checklist. However, due to the escalating emergency, the flight crew was not able to complete the approach checklist, which included the landing briefing.

At 0753, the aircraft levelled off at 1214 feet ASL. The FO observed zero hydraulic pressure on the landing gear DOWN gauge. Thinking this zero pressure was an issue, he mentioned it to the captain, who then directed the FO to "prep the gear." The FO extended the landing gear, which the captain did not expect because the aircraft had not started its final approach and the airport had not been visually acquired.

At 0755, as the aircraft continued towards TANPO, the altitude was between 1200 and 1300 feet ASL, and the airspeed was maintained at approximately 100 knots indicated airspeed (KIAS). When the aircraft was abeam TANPO, the captain began a right turn to intercept the localizer for the final approach. The aircraft's airspeed decreased from 100 KIAS to 80 KIAS, while its altitude decreased to 1100 feet ASL. With the reduced airspeed, the aircraft's flight control response became sluggish and the captain directed the landing gear to be raised.

After the landing gear was raised, at 0759, the flight crew heard abnormal sounds and felt vibrations from the right engine. The aircraft's airspeed was 80 KIAS, and its altitude began to decrease to below 800 feet ASL. In an attempt to maintain altitude, the right engine was increased to maximum takeoff power, but this had no effect. The flight crew then prepared for an emergency gear-up landing, and the aircraft's flaps were lowered on short final to reduce speed for touchdown.

At 0801, the aircraft landed in muskeg on K'atl'Odeeche First Nation land, approximately 3.5 nautical miles southeast of CYHY. After the aircraft came to a stop, the FO exited the aircraft through the right-hand crew window, while the captain remained in the cockpit to secure the right engine and aircraft systems before evacuating via the forward door.

The FO contacted the flight information centre to notify them of the crew's status and aircraft location. The emergency locator transmitter had not activated during the forced landing, so the FO activated it manually to assist search and rescue in locating the aircraft. The flight crew was uninjured. The aircraft received substantial damage. There was no post-impact fire. First responders arrived at the accident site at 1114.

Aircraft information

The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The weight and balance were within the prescribed limits. The aircraft was not equipped with a flight data recorder or cockpit voice recorder, nor were these required by regulation.

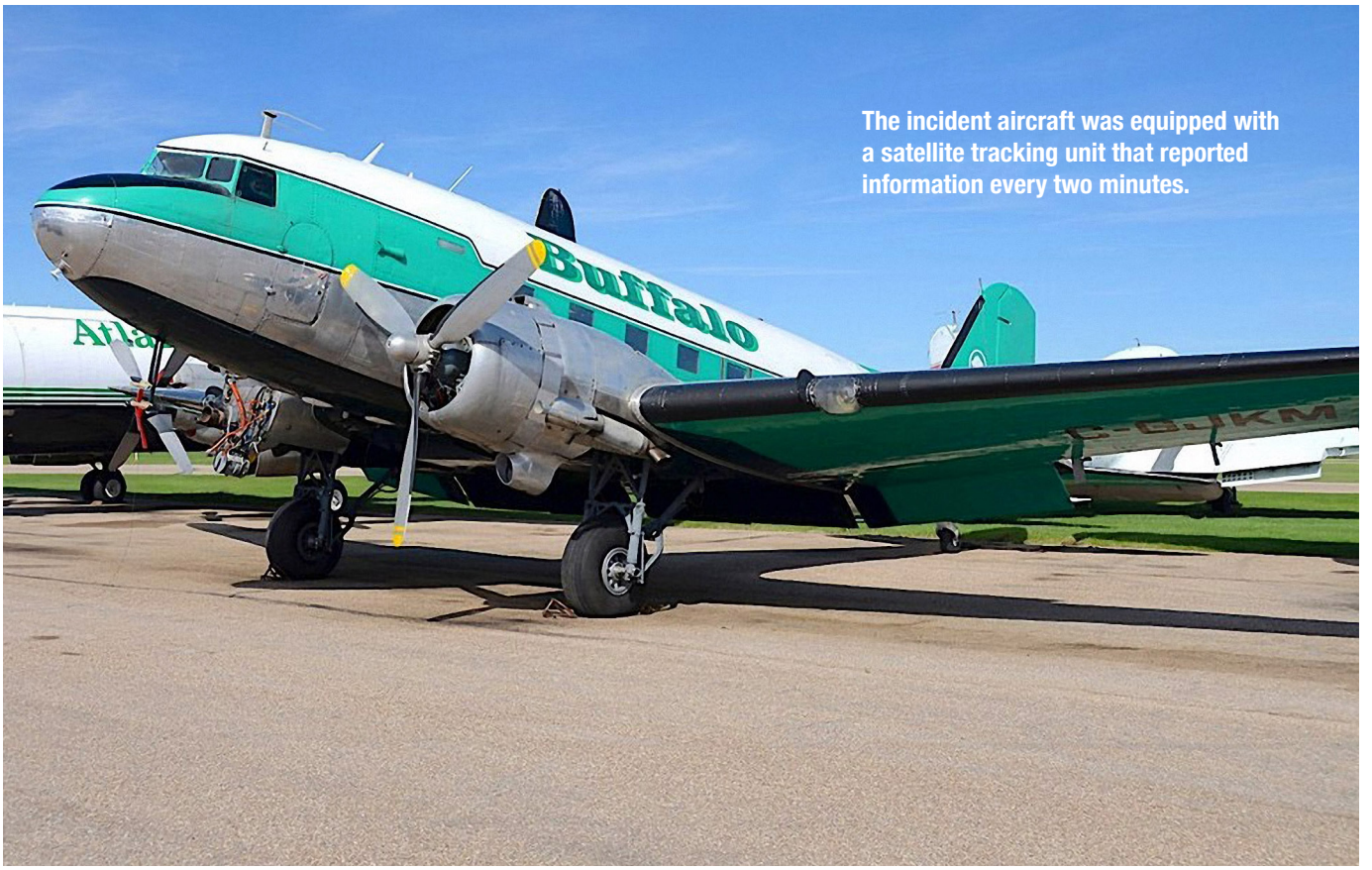
Due to the limited scope of this investigation, the cause of the oil discharge leading to the left engine being shut down was not determined. Similarly, the source of the abnormal sounds the flight crew reported hearing from the right engine was not identified.

Standard operating procedures and checklists

Buffalo Airways has developed normal and emergency checklists to use when operating the company's Douglas DC3C-S1C3G aircraft. Items related to the landing gear are included in various checks on the normal checklist, including the following:

AFTER TAKE-OFF CHECKS
GEAR & FLAPS……UP & NEUTRAL

PRE-LANDING CHECKS
GEAR……UP THEN DOWN
GEAR……DOWN, PRESSURE UP, GREEN LIGHT, POSITIVE LOCK



The incident aircraft was equipped with a satellite tracking unit that reported information every two minutes.

Buffalo Airways' standard operating procedures (SOPs) expand on the normal checklist items by describing challenge and response drills.

The emergency checklist includes challenge and response drills that require immediate action, some of which are to be completed from memory. The drills to be completed from memory are indicated by a box around the items on the checklist. The engine failure emergency checklist includes the following item related to the landing gear:

ENGINE FAILURE
POWER ON LIVE ENGINE
LANDING GEAR……UP

The AFM contains single-engine landing procedures that require the landing gear to be lowered when the aircraft is on final approach and at a safe altitude. The Buffalo Airways emergency checklist procedure for approach with 1 engine inoperative is consistent with the AFM requirement, and states:

APPROACH WITH ONE ENGINE INOPERATIVE
LANDING GEAR……(ON FINAL AT SAFE ALTITUDE) DOWN

The Buffalo Airways SOPs for an engine-out landing include the following instructions:

Prior to extending the landing gear, be sure all other hydraulic systems are off.

Extend the Landing Gear at such a point that the drag will not cause undershooting

(about 25 seconds are required to extend the landing gear).

Single-engine performance

The AFM states the following with respect to single-engine performance:

Minimum Airspeed: With one engine inoperative and METO power or less on the operating engine, the minimum airspeed for controllability is 73 knots IAS [KIAS]. With take-off power, minimum IAS [indicated airspeed] for controllability is 76 knots. Control of the aircraft will be easier if it is flown with 2 - 3° bank on the operating engine side.

Single Engine Climb: The rate of climb of the DC-3, with the landing gear down and full flap, is practically zero. With the landing gear up and 1/2 flap, the rate of climb is very low, therefore, during climbing operation on a single engine the flaps and landing gear should be fully retracted.

Cruise: Up to METO power may be used for cruise with

one engine out. Air speed depends on gross weight, and should be maintained at 110 knots at 26,000 lbs., and at 105 knots at 24,000 and below.

This aircraft departed with a weight of 26,000 pounds.

Crew resource management

Buffalo Airways has a Transport Canada–certified crew resource management training program,nwhich includes information on effective communication. Both flight crew members received this training. The captain completed the training on 01 May 2019, and the FO on 28 December 2018.

The preamble to the Buffalo Airways SOPs states that "[s]tandard phraseology must be used to reduce the likelihood of an incorrect interpretation of a request or command and to initiate corrective action for undesirable circumstances."

In Chapter 10, the SOPs indicate that "[e]mergency operating procedures are designed to follow, as close as possible, to [sic] normal operating procedures so as to reduce any confusion brought on by an abnormal occurrence." The SOPs go on to say that "during an emergency situation, the PF will continue flying the aircraft and call for the appropriate actions and checklist. Which [sic] will be called or read out by the PNF."

With regard to standard phraseology, Chapter 10 of the SOPs states the following:

During abnormal/emergency situations it is imperative that the flight crew not only understand and complete the applicable procedures, but also ensure that effective communication is maintained. The standardization of calls and actions removes the unexpected and enhances communication.

Safety message

In this occurrence, the aircraft's airspeed and altitude could not be maintained, primarily because of the increased drag when the landing gear was extended early in the approach. This highlights the need to follow SOPs and use standard phraseology, as well as the importance of checklist discipline, during an emergency. ■

(The preceding were excerpts from the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 11 December 2019. It was officially released on 20 December 2019.)

Aviation Services

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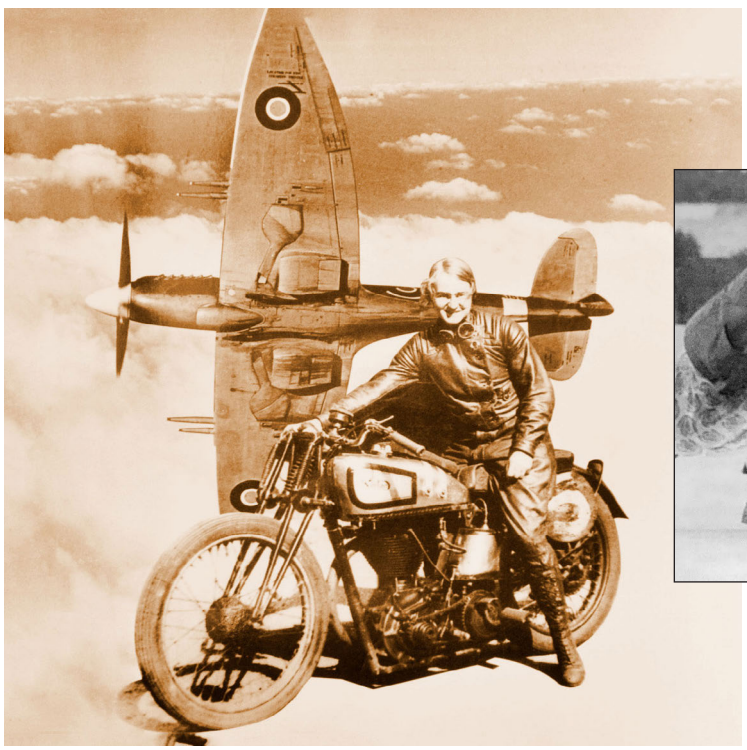
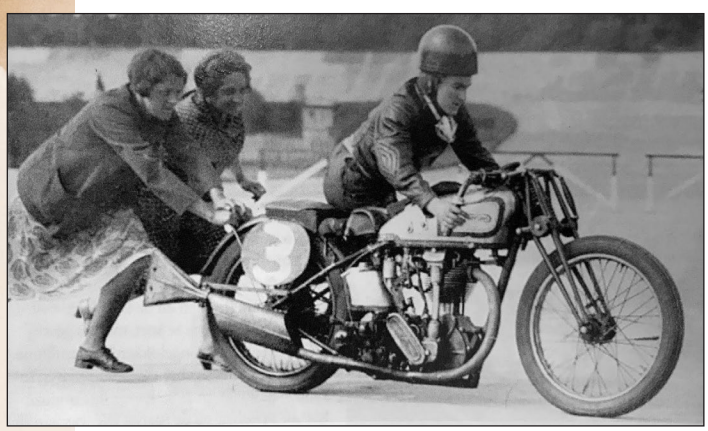
Miss Shilling's Orifice





Eighty years ago this remarkable woman saved the Merlin engine fitted to the Hurricane and Spitfire.

SKINNERS UNION CARBURETTER COMPANY is best known for its automotive applications but during the Second World War SU paused road car carb production to help with the war effort and its single-point fuel injection pump became standard fitment to the Rolls-Royce Merlin engine. The Merlin engine was used extensively in the Hurricane and Spitfire fighters, but once air battle became more commonplace it became apparent the engine would suffer a 'fluff' caused by fuel starvation when in a steep dive.

Late in 1940 an engineer named Beatrice Shilling introduced a modification that allowed the Merlin engine to overcome this issue. In December 2020, the aviation industry celebrated a remarkable mechanical mind and her invention, 80 years after it was initially introduced.

Beatrice Shilling, once described as "a flaming pathfinder of women's lib," was born in 1909, and awarded a gold star in the 1930s for lapping the legendary Brooklands race course on her Norton 500 motorcycle at over 100 mph. Later, she would gain an engineering degree at Manchester University and was recruited as a scientific officer by the Royal Aircraft Establishment, a position she held until her retirement in 1969. During her RAE career she led investigations into the aquaplaning of aircraft during take-off and landing on wet runways but was always best known for her Merlin engine modifications.

The Spitfire and Hurricane aircraft used in the early stages of war had a Rolls-Royce Merlin III engine fitted and when 100-octane fuel became available it allowed for increased boost, taking power to 1310 hp. At this time all Hurricane and Spitfire engines were fitted with an SU AVT35/135 carburetor.

As the battle intensified it highlighted a problem with the SU carb when it was subject to negative G. Entering into a steep dive the Merlin engine suffered a fluff caused by the fuel level at the jets momentarily being thrown to the top of the float chamber, starving the jet of fuel for 1.5 seconds. Despite this being a potentially disastrous situation, the carburetors were able to function normally after the floats had regained control.

The solution credited to Tilly comprised of a restrictor (or orifice plate) with a calibrated aperture in the centre that was fitted to the fuel line before the carburetor. It limited the fuel flow to a volume only slightly less than the engine demanded at full power and while it did not stop the momentary weak hesitation, it did prevent the 1.5 second rich cut. This modification was known as Miss Shilling's orifice. ■

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