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AMU

AirMaintenance UPDATE

The Magazine for Aircraft Maintenance Professionals

Transport Canada Approved for R/T

2015 Recurrent Training Exam

The evolution of a light jet

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En route and in style

NHL analyst Craig Simpson was on Toronto sports talk radio in mid-May sharing an anecdote from his playing days with the Edmonton Oilers. The team was on another playoff run, and to ease the tension, Wayne Gretzky decided to book a private jet to Las Vegas for himself, wife Janet, Mr. Simpson and his female companion who was "a friend of Janet Gretzky." Consider that for a minute — a weekend in Vegas with pro hockey millionaires and a pair of (then) Hollywood hotties. Kind of makes the old fishing trip to Mud Lake with "the boys" look a little tame, eh? But for the sake of this magazine if nothing else, I need to draw your attention back to the private jet mentioned by Simpson. His comment was timely because the private business jet market is likely to heat up now that the HondaJet has officially come on stream. (Read our retrospective of the development of Honda Aircraft's first offering in this issue.) Overall, the topic of private jets has been a lively one of late. The Engel & Völkers Group, which specializes in the sale and rental of luxury real estate and yachts, recently announced it has expanded its portfolio to include private jets. The Hamburg, Germany-based firm says it is merely pursuing opportunity as an uptick of well-heeled clients with expensive tastes now enters the market. "Engel & Völkers clients are wealthy, with sophisticated demands and expectations," said the firm's CEO Christian Völkers. "They lead luxury lifestyles and enjoy traveling. We are seeing a growing need for this service amongst our real estate and yachting clients."

Meanwhile, TAG Aviation has confirmed it will begin operating a customized Boeing 757-200 on luxury around-the-world trips on behalf of TCS World Travel. The 757-200 usually has capacity for 233 passengers, but this one has been reconfigured with 52 flat-bed leather seats and hand-woven woolen carpeting. Amenities include onboard Wi-Fi, complimentary iPads at each seat, and a specially trained crew. All of which is worth considering, but I can't stop thinking what that trip to Vegas with the Gretzkys must have been like.

— John Campbell
Editor

Departments

4 **Upcoming Events**

6 **STCs & New Products**

8 **Industry Forum**

22 **AME Association and PAMA News**

39 **Classifieds**

42 **AMU Chronicles**
By Sam Longo

Features

The Evolution of a Light Jet 10

No Word Yet 18
By Norm Chalmers

Sense-Able Troubleshooting 26
By Gordon Walker

Merely a Matter of Millimetres 32
Raising the Bar: Bell 206L, C-GDQH

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Upcoming Events

Silent running: the future of rotorcraft?

LORD Corporation — a company involved in the management of vibration, noise and motion control — recently received the 2015 American Helicopter Society (AHS International) Grover E. Bell Award as part of the Hub Mounted Vibration Suppressor (HMVS) team. Comprised of LORD, the US Army and Sikorsky Aircraft, the team received the award in early May during AHS International's 71st Annual Forum and Technology Display in Virginia Beach, Virginia. The award was given for research and contributions to the field of vertical flight development. Designed to reduce weight, eliminate vibration and deliver a smoother helicopter ride, the HMVS system seeks to actively cancel rotor-induced vibration at its source. Compared to traditional hub-mounted passive treatments, HMVS technology provides superior vibration control performance at a greatly reduced weight.

"HMVS technology has now been successfully tested and validated on an aircraft as a means to provide enhanced vibration suppression compared to the legacy passive systems, at significantly less weight," said senior staff engineer Russ Altieri, who served as the project lead at LORD. "HMVS is a major milestone for rotary-wing aviation as this technology will pave the way for jet-smooth ride on both legacy and future rotorcraft."

The Grover E. Bell Award is given for an outstanding research and experimentation contribution to the field of vertical flight development brought to fruition during the preceding calendar year.

CANADA

Northern Air Transport Association Conference
June 20 – 21, 2015
Saguenay, Quebec
www.saibagotville.com

Wings over Wasaga
July 3 – 5, 2015
Wasaga Beach, Ontario
www.wingsoverwasaga.com

Vintage Wings & Wheels Show
July 19, 2015
Hamilton, Ontario
www.warplane.com

Abbotsford Air Show
August 7 – 9, 2015
Abbotsford, British Columbia
www.abbotsfordairshow.com

HAC Annual Conference and Trade Show
November 13-15, 2015
Vancouver, BC. www.h-a-c.ca

UNITED STATES

ALEA Expo 2015
July 13 – 18, 2015
Houston, Texas; www.alea.org

NBAA 2015
November 17 – 19, 2015
Las Vegas, Nevada; www.nbaa.org

INTERNATIONAL EVENTS

Helitech International
October 6 – 8, 2015
London, UK
www.helitechevents.com

AIRTEC International Aerospace Supply Fair
November 3 – 5, 2015
Munich, Germany
www.airtec.aero

Advertisers Index

APS Brakes / Aero Incorporated 13
Aeroneuf Instruments Ltd 35
BKD Aerospace 5
Canadian Aero Accessories Ltd 43
Canadian Propeller Ltd 20
Casp Aerospace Inc 27
Concorde Battery 16
Eagle Fuel Cells Inc 15
Gregoarsh Aviation 44
Hartwig Aircraft Fuel Cell Repair 11
MARSS 36
NAASCO 28
ProAero Engines Inc. 19
Progressive Air 19
Propworks Propeller Systems 12
Rapco Inc 2
Schweiss Bi-fold Doors 29
Superior Oil Coolers 14
U.S. Air Tool Company 21

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STCs & new products

Build your own door kit from Schweiss

Schweiss Doors has designed a Build Your Own Door Kit for customers to build their own hydraulic doorframe while still incorporating Schweiss components, methods and build qualities. The system involves a uni-body hinge design that wraps around steel doorframe members, making it the strongest, most reliable hinge design in the door industry. It also includes the first-of- its kind hydraulic hinge on the market with grease zerk fittings, where hinges can be greased from inside the building. With the kit, there is a complete set of new design heavy-duty end and center hinges, a factory wired Red Power hydraulic unit and all the necessary seals. **For more information visit** www.bifold.com

Pliers with a long, hard bite from VamPLIERS

Vampire Tools' new VamPLIERS have specially designed concave shaped jaws with vertical serrations on the inside jaws that make it possible to grab on to a stripped/rusted/ corroded screw, bolt or nut for extraction. VamPLIERS work even on screws with special, unique or tamper-proof heads. They are made from treated high-quality carbon steel from Kobe, Japan, have a smooth varnished finish, and have environmentally friendly elastomer ergonomic handle grips.

For more information visit www.vampiretools.com

Eastman's turbine oil achieves optimum balance of properties

Eastman's newly branded Turbo Oil 2380, formally BPTO 2380, is designed to achieve an optimum balance of properties as turbine oil. The balance of cold ambient temperature viscosity, load-carrying capability, cleanliness and elastomer compatibility is at the forefront of the considerations in its design. The product features exceptional accessory performance, and has the best low-temperature viscosity in the sector. Eastman Turbo Oil 2380 was among the first turbine oils to be approved for MIL-PRF-23699 STD (Standard) class and subsequently SAE AS5780 SPC (Standard Performance Capability) class.

For more information visit www.eastman.com

Long-lasting battery from Saft reduces cost

Saft is now offering its all-new 435CH6 ULM battery that reduces airplane operational costs by extending the standard flight hour maintenance interval by more than nine times compared to previous options. Per the Instructions for Continued Airworthiness, (ICA), the battery is approved to be operated for 1,800 hours in flight before requiring maintenance as a result of a testing program aboard WestJet Encore's Bombardier Q400 NextGen fleet. Prior to this, the timeframe for battery standard operation was 200 hours. The new Saft 435CH6 design is a direct form-fit replacement for the legacy battery that is currently used on the aircraft.

For more information visit www.saftbatteries.com

Composite props now available from Hartzell

Through its Top Prop program, Hartzell is now offering a three-blade structural composite carbon fibre propeller as an alternative to the OEM metal propeller of the Cirrus SR22 series aircraft. This is the same ASC-II composite propeller that is incorporated on all new SR22T single engine aircraft that Cirrus delivers to customers. Hartzell and Cirrus Aircraft have an exclusive supplier agreement to provide propeller systems and governors for Cirrus Aircraft's new prop-driven airplanes.

For more information visit www.hartzellprop.com

Locking flex-head ratchets offer nine lockable positions

GearWrench's new locking flex-head ratchets build upon the company's original 84-tooth ratchet design, and feature a locking lever mechanism for multiple-angle access. This offers technicians nine lockable positions, as the locking mechanism keeps the handle secured in position when the head is angled and a load is applied. The low profile head may also be left unlocked for applications where a range of positions is needed. The 84-tooth gear provides a 4.3-degree ratchet arc and the ratchets themselves are available in 1/4-inch to 1/2-inch drive with various handle lengths ranging from seven to 24 inches.

For more information visit www.GearWrench.com

To announce your STC or new product, email a JPG photo and a product description to amu.editor@gmail.com or amumag2015@gmail.com

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AVIATION PRODUCTS TEAMS WITH WILDCAT AEROBATICS

You know you're good when daredevils begin relying on your products. The Red Bull air-racer European Wildcat Aerobatics team employs a pair of iconic Pitts Special biplanes and an Edge 360 high-performance monoplane that will now be fitted with Aviation Products Systems' BlackSteel brake discs and linings.

"We have been very impressed with the braking, but equally as impressed with the pad life," said Wildcat spokesperson Edward Ludlow. "We put our lives in the hands of APS BlackSteel brake discs and linings, and we actively want to promote the brands we rely on."

WANTED: OLDEST ACTIVE ROTAX AIRCRAFT ENGINE

To celebrate 40 years of Rotax aircraft engines, Quebec-based Bombardier Recreation Products (BRP) has launched a contest to find the oldest active certified Rotax aircraft engine in operation.

"We are proud of 40 successful years of Rotax aircraft engines; our customers are brand ambassadors and an important part of our success story," said Thomas Uhr, vice-president BRP-Powertrain and general manager BRP-Powertrain GmbH & Co KG. "To thank them for their loyalty, we decided to open the doors to where over 175,000 Rotax aircraft engines have been produced."

The owner of the oldest active certified Rotax aircraft engine will be invited to visit, all expenses paid ($5,465 CAD), the Rotax factory in Gunskirchen, Austria, where BRP develops and produces the engines. The contest began in April and runs through December 31, 2015. Participants must provide a copy of the logbook and latest proof of maintenance. With more than 175,000 engines sold in 40 years, Rotax aircraft engines are staples of the light sport and ultralight aircraft market, and BRP supplies engines to more than 80 per cent of all aircraft manufacturers in its segment.

ONTARIO RAISES AVIATION FUEL TAX TO HIGHEST LEVEL IN CANADA

National Airlines Council of Canada , the industry trade association representing Canada's largest passenger air carriers, expressed disappointment with Ontario's continuing increase to the province's aviation fuel tax. In early April, the tax was increased to 4.7 cents-per-litre, making it the highest in the country. The increase is the second phase of the 148 per cent hike introduced by the Government of Ontario's 2014 Budget.

"Canadian air carriers reiterate that the Ontario government's decision to move forward with the aviation fuel tax increase is harming Ontario's economy," said Marc-André O'Rourke, Executive Director of the NACC. "Ontario's aviation fuel tax is now the highest in Canada ..."

NEW TRAINING CENTRE OPENS IN PETAWAWA

In 2013 and 2014, the Royal Canadian Air Force (RCAF) took delivery of 15 new Boeing-built CH-147F Chinook helicopters, among the most capable and advanced variants of the legendary Chinook family. Now, the RCAF and Boeing have unveiled an equally advanced training facility for those helicopters. The Medium-to-Heavy Lift Helicopters (MHLH) Maintenance Training Centre at Garrison Petawawa, Ontario is a world-class facility that has already begun enhancing the skills of maintenance personnel responsible for the readiness and support of the RCAF's CH-147F fleet. The formal grand opening comes shortly after an initial class of 18 technicians graduated from the centre's first RCAF-led training courses.

"Boeing's training suite equips the RCAF with essential aircraft maintenance knowledge, preparing their technicians for a wide range of operational missions," said Tony Barnett, Boeing project manager, Canadian Medium-to-Heavy-Lift-Helicopter training systems.

CRANE TO EXPAND MANUFACTURING CAPABILITIES IN WASHINGTON STATE

Crane Aerospace & Electronics has announced the expansion of its manufacturing capabilities in Lynnwood, Washington. A new facility will be built at the Lynnwood location and will be designed for testing and manufacturing mass fuel flow transmitters, one of the product lines manufactured at the Lynnwood site. Construction of the 12,000 squarefoot facility will begin this summer. Production requirements for Crane Fuel Flow Transmitters are expected to grow rapidly beginning in 2017 due to several recent program wins, including the CFM LEAP engines for the Boeing 737 MAX, Airbus A320neo and COMAC C919 aircraft, as well as the Pratt & Whitney PurePower engine for the Airbus A320neo, Bombardier CSeries aircraft, Mitsubishi Regional Jet and others.

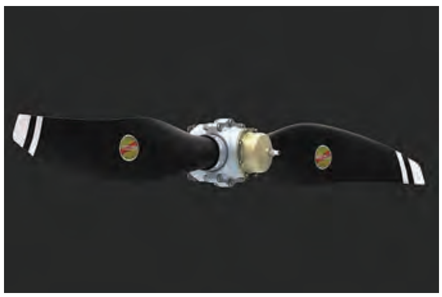
"We anticipate doubling our production volume of fuel flow transmitters over the next five years," said Brendan Curran, President of Crane Aerospace & Electronics. The new facility will permit testing at fuel temperatures up to 325F (162C) and at the operating pressures of new engines. The facility expansion is expected to result in the employment of about 60 skilled workers.

NACC CONGRATULATES MANITOBA ON AVIATION FUEL TAX REBATE

The National Airlines Council of Canada welcomed an announcement in early May by Manitoba Premier Greg Selinger that the province will rebate its aviation fuel tax for international flights from Manitoba to destinations beyond North America.

"[This] announcement is great news for passengers, communities and businesses across Manitoba because it will create jobs, stimulate trade and help maintain strong air linkages," said Marc-André O'Rourke, Executive Director of the NACC. "It is these types of forward-looking decisions that make Winnipeg and Manitoba more attractive for investment and expanded service." In recognition of the value of the aviation industry as an economic engine and an enabler of trade, travel and tourism, Manitoba follows British Columbia, which eliminated its aviation fuel tax on international flights as part of its 2012 Jobs Action Plan and Alberta which axed its tax in 2004.

HARTZELL BANTAM PROP NOW TYPE-CERTIFICATED



Hartzell Propeller has received a Type Certificate from the Federal Aviation Administration (FAA) for the company's new two-blade lightweight Bantam propeller for use with the Rotax 912 and 914 four-stroke engines series, used mostly for light sport and ultra light aircraft.

"The Rotax 912 and 914 series of four cylinder four-stroke engines perform even better with Hartzell's new two-blade Bantam prop," said Hartzell Propeller Joe Brown. "This will become the propeller of choice for many light sport and ultra light aircraft."

The Hartzell Bantam propeller series consists of lightweight two- and three-blade propellers with a thin, wide chord and swept high performance airfoils. The recent approval covers installation of Hartzell's two-blade Bantam propellers, featuring carbon fibre structural composite blades, hard nickel leading edges and composite spinners. The new propellers weigh a factory-spec 25 pounds (11.35 kilograms), including spinner.

TC CERTIFIES SIKORSKY S-92 RIG APPROACH

Sikorsky Aircraft Corp. has announced the certification by Transport Canada Civil Aviation (TCCA) of its Rig Approach for the S-92 helicopter. Rig Approach provides helicopter operators with an automated approach to offshore rigs and platforms and is a feature that can be retrofitted to aircraft already in operation. PHI, Inc., an important Sikorsky customer that operates S-92 and S-76 helicopters in the Gulf of Mexico providing transportation to offshore oil workers, flew the first operational Rig Approach flight in November 2013. In 2014, Sikorsky celebrated the 10-year anniversary of the S-92 helicopter, which was first delivered in 2004. The fleet has reached more than 800,000 flight hours, with over 90 per cent of those hours providing offshore oil and gas worker transportation.

AMERICAN AIRLINES DEBUTS BOEING 787 FOR NEW ROUTES

American Airlines has become the second U.S. carrier to introduce the new Boeing 787 Dreamliner for international long haul flights. The aircraft is starting off on a domestic route between Texas and Chicago and was scheduled to make its international debut on the new Dallas to Beijing route on June 2nd. American Airlines has placed a firm order for 42 of the latest Boeing 787s.

The Center for Aviation has reported this that for the first time ever more Chinese airlines are flying to the U.S. than American carriers are to China.

Delta (DAL) and United are also introducing new China routes this year. American Airlines will be using the Dreamliner on direct flights to Buenos Aires, Shanghai and Tokyo by August this year. ■

The Evolution of a Light Jet

From the earliest research in 1986 to a triumphant world tour this spring, the HondaJet has been a long time coming, and some say it's now poised as the world's top performing light business jet. Here, we take a brief look back at its technical development.

The HondaJet is said to be the fastest, highest-flying, quietest, and most fuel-efficient jet in the light business jet aircraft class, incorporating many technological innovations including an Over-The-Wing Engine Mount (OTWEM) configuration that Honda claims dramatically improves performance and fuel efficiency by reducing aerodynamic drag. Powered by two GE Honda HF120 turbofan jet engines, and equipped with an all-glass avionics system composed of three 14-inch landscape-format displays and dual touch-screen controllers, the composite fuselage HondaJet is a project that traces its roots to1986 when Honda initially started research in Japan on both small aircraft and jet engines. After decades of product development, testing, and certification processes the HondaJet launched a world promo tour in late April with the advanced aircraft traveling more than 26,000 nautical miles and making stops in 13 countries along the way.

And now Honda Aircraft Company CEO Michimasa Fujino offers a glimpse inside the development of a very special aircraft. The following is a summary of the engineering thought that went into the design of the Hondajet.

The business jet is becoming a common tool for business people. In particular, the small business jet that is more efficient in operation is expected to become more popular. Market surveys and focus-group interviews, conducted in five major cities in the United States, show that demand for comfort,

On the HondaJet assembly line in Greensboro, North Carolina.

in particular, a large cabin, as well as high fuel efficiency are critical to the success of small business-jet development. The HondaJet is designed to satisfy these needs. A unique configuration, called an over-the-wing engine-mount configuration was developed to provide a larger space in the fuselage than that of conventional configurations. By mounting the engines on the wing, the carry-through structure required to mount the engines on the rear fuselage is eliminated, which allows the fuselage internal space to be maximized. It was a technical challenge to employ an over-the-wing engine-mount configuration for a high-speed aircraft from both aerodynamic and aeroelastic standpoints. Extensive analytical and experimental studies, however, show that an over-the-wing engine-mount configuration reduces the wave drag at high speeds and achieves higher cruise efficiency when the nacelles are located at the optimum position.

To reduce drag and thereby achieve higher fuel efficiency, a new natural-laminar-flow (NLF) wing and a natural-laminar-flow fuselage nose were developed through theoretical and experimental studies. By employing these advanced technologies, the specific range of the HondaJet is far greater than that of existing small jets. To achieve natural laminar flow on the wing, surface waviness as well as steps and gaps in the wing structure must be minimized. Appropriate criteria were derived from flight tests. The upper skin is a machine-milled, integral panel that maintains the contour necessary for the achievement of laminar flow. The actual wing structure was tested in the wind tunnel to confirm that laminar flow

A cockpit built for pilots features the new all-glass Garmin G3000.

is achieved on the actual wing surface. To reduce weight and manufacturing costs, an advanced composite structure is used for the fuselage, consisting of a combination of honeycomb sandwich structure and stiffened panels.

Two Honda HF-118 fuel-efficient turbofan engines, each rated at 1,670-pound thrust at takeoff power the aircraft. The engine is controlled by the Full Authority Digital Engine Control system. The aircraft is a low-wing configuration with the engines mounted over the wing. The aircraft is 41.14 feet (12.5m) long, has a wingspan of 39.87 feet (12.2m), and is 13.21 feet (4.1m) high at the top of the T-tail. Design maximum takeoff weight is about 9,200 pound (4173 kg). The estimated maximum speed is about 420 knots at 30,000 feet (9,144 m), and the maximum range is about 1,100 nautical miles (2,037 km).

Engine location was the major design decision in the development of the HondaJet configuration. In general, locating the engine nacelles over the wing causes unfavorable aerodynamic interference and induces a strong shock wave that results in a lower drag- divergence Mach number. Theoretical studies were conducted using a three-dimensional Euler solver to investigate this configuration. A transonic wind-tunnel test was conducted in the Boeing Transonic Wind Tunnel to validate the theoretical predictions.

It was found that the shock wave is minimized and drag divergence occurs at a Mach number higher than that for the clean-wing configuration when the nacelle is located at the optimum position relative to the wing. The over-the-wing engine-mount configuration exhibits lower drag than does the conventional rear-fuselage engine-mount. The final aircraft configuration is based on this result. By employing this optimum over-the-wing engine-mount configuration, the cruise efficiency is higher than that of a conventional rear-fuselage engine-nacelle configuration, and the cabin volume is maximized.

The main goal for the aerodynamic design of the wing is to achieve minimum drag while maintaining good stall characteristics. Detailed design studies were performed to minimize the induced drag with minimum wing weight. The study showed that the takeoff weight is minimized for a 1,100-n mile-range aircraft when the wing geometric aspect ratio is 8.5 and a winglet having a height of nine per cent of the wingspan is installed. Because of the over-the-wing engine-mount configuration, the stall characteristics were carefully studied by theoretical analysis and low-speed wind-tunnel tests. From the theoretical analysis using a vortex-lattice method combined with a critical-section method and a three-dimensional, panel method combined with the pressure-difference rule, a taper ratio of 0.38 and a washout of 5.1 degrees were chosen to provide good stall characteristics with minimum induced drag penalty. The wing stalls first around 55 per cent semispan. The separation propagates inboard, although the root region of the wing between the fuselage and the nacelle is not stalled at the aircraft stall angle of attack. Thus, the over-the-wing engine-mount configuration exhibits good stall characteristics. In addition, there is adequate stall margin over the outboard portion of the wing. The zero-lift angle of the over-the-wing engine-mount configuration is about 1.2 degrees higher than that of the clean-wing configuration. The maximum lift coefficient of the over-the-wing engine-mount configuration is about 0.07 higher than that of the clean-wing configuration. Thus, there is no disadvantage with respect to the lift characteristics because of the nacelle installation over the wing.

To satisfy the requirements of the HondaJet, a new natural-laminar-flow airfoil, the SHM-1, was designed using a conformal-mapping method.

The HondaJet is powered by two GE Honda HF120 turbofan jet engines, which enable the aircraft to climb at 3,990 feet per minute to a maximum cruise altitude of 43,000 feet.

Honda Aircraft Company President and CEO, Michimasa Fujino.

The pressure gradient on the upper surface is favorable to about 42 per cent chord, followed by a concave pressure recovery, which represents a compromise between maximum lift, pitching moment, and drag divergence. The pressure gradient along the lower surface is favourable to about 63 per cent chord to reduce drag. The leading-edge geometry was designed to cause transition near the leading edge at high angles of attack to minimize the loss in maximum lift coefficient caused by roughness. The upper-surface trailing-edge geometry was designed to produce a steep pressure gradient and, thereby, induce a small separation.

By the incorporation of this new trailing-edge design, the magnitude of the pitching moment at high speeds is greatly reduced.

The wing is metal and constructed in three sections: the left out-board wing, the centre section, and the right outboard wing. The torque box contains three spars, the ribs, and the skin with integrated stringers forming an integral fuel tank. The upper skin is a machined, integral panel to maintain the contour required by laminar flow. By using integral, machined panels, the material can be distributed in the most efficient manner, and the number of parts is minimized. The leading-edge structure and the main torque-box structure are mated at about 13.5 per cent chord to reduce the disturbance to the laminar flow. The leading edge is equipped with an anti-ice system that uses engine bleed air ejected through a piccolo tube that directs the hot air against the inside of the leading-edge skin. The pylon structure is attached to a reinforced wing

Melvin Taylor, manager of the FAA's Atlanta Certification Office, signs the provisional type certificate for the HondaJet on March 27, 2015.

The private lavatory of the HondaJet is externally serviceable.

rib by four bolts. The main landing gear is also attached to the inboard end of the same reinforced rib to concentrate the heavy loads in one reinforced structure. The wing is mounted under the fuselage by four links and two thrust rods. The vertical loads are transmitted to the front- and rear-fuselage main frames by the links and the lateral loads are transmitted by the V-shaped links. The drag loads are transmitted to the fuselage by the two thrust rods.

The fuselage is constructed entirely of graphite composites. The material is a 350F cure epoxy pre-preg reinforced by carbon fibre.

The cockpit as well as the tail section is a honeycomb sandwich construction to maintain the compound curves, which are especially important for the laminar-flow nose. An integrally stiffened panel structure is employed for the constant cross-section portion of the cabin, which maximizes the cabin volume. The frames and stringers have identical dimensions in the constant cabin section so that the number of molds for the frames and stringers are minimized.

The constant fuselage section can be easily extended to satisfy future fuselage stretching. A feature of the fuselage fabrication is that the sandwich panel and the stiffened panel are co-cured integrally in an autoclave to reduce weight and cost. It was a technical challenge to cure the honeycomb sandwich structure under the pressure (85.3 psi) required for the stiffened panel, but a new method called the "picture-frame stabilizing method" prevents core crushing.

The aircraft employs compound-curved windshields to obtain better aerodynamic characteristics. The windshields are two plies (outer and inner) of stretched acrylic material with a polyurethane interlayer, which has superior low-temperature ductility, a higher allowable operating temperature, and higher adhesive properties. The outer surface of the outer acrylic ply and the inner surface of the inner acrylic ply are hard coated for abrasion and chemical resistance.

The windshield is electrically heated for anti-ice protection. The windshield and its support structure were designed

HondaJet's Garmin G3000 avionics suite with new 40/60 display configuration.

to withstand the impact of a four-pound bird strike at Vc (structural design speed) at sea level.

The empennage is a T-tail configuration. The horizontal tail is a conventional, two-spar, aluminum structure. The fin is also a conventional, two-spar structure. The front spar of the fin is, however, joined to the fuselage by a pin support and transmits only the forward, vertical, and lateral loads to the fuselage. The rear spar is cantilever mounted to the rear-fuselage canted frame and transmits all bending moments to the fuselage. The fin first torsion frequency is very critical for the T-tail flutter mode, and, therefore, relatively heavy-gauge skin (0.04 in.) was employed to provide adequate torsional stiffness. Shear buckling is not allowed up to the limit-load condition to prevent torsional-stiffness reduction.

In terms of avionics, the aircraft employs all-glass flight-deck, which is a modular design having open architecture. All information—from flight and engine instrumentation to navigation, communication, terrain and traffic data, etc.—is integrated and digitally presented on the dual, large-format, high- resolution primary flight displays (PFD) and the multi-function display (MFD). The PFD contains the airspeed indicator, vertical-speed indicator, adjustable altimeter, direction indicator, pitch and bank indicator (artificial horizon), slip/skid indicator, dual navigation/communication, etc., and the MFD contains the engine indication display, fuel flow, fuel quantity, generator current, global-positioning-system map, etc. This cockpit configuration provides a high degree of integration for enhanced situational awareness, functionality, ease of operation, redundancy, and flight safety.

After the ground tests were completed, the first flight was performed on December 3, 2003, at the Piedmont Triad International Airport in North Carolina. The flight-test program began in January 2004. The prototype was fully instrumented with a data-acquisition system and a telemetry system to maximize the efficiency of the flight-test program. More than 200 sensors, which measure air data, attitude, acceleration, control-surface deflection, and control force, etc., were installed on the aircraft, and all data was transmitted to the ground. In phase one of the flight test program, in-flight system-function tests such as landing gear and flap operation were conducted. The tests were performed under different flight conditions (e.g., airspeed, sideslip angle, etc.), and the function was confirmed. Emergency gear operation was also conducted to validate the extension of the landing gear simulating electrical- and hydraulic-system failure.

In phase two, stability-and-control and performance tests were conducted. Static and dynamic stability, such as short-period, phugoid, and dutch-roll modes, were evaluated by measuring the undamped natural frequencies and damping ratios at various flight conditions.

To evaluate the cruise performance, the speed-power method was used. Tests were conducted to determine the drag, fuel flow, and range for various airspeeds, altitudes, and weights. A sawtooth test, in which a series of timed climbs is made over an altitude band bracketing the selected pressure altitude, was used to determine the climb performance. The results were compared to analytical estimates, and agreement was found.

In late March of this year, the HondaJet received provisional type certification (PTC) from the United States Federal Aviation Administration indicating the FAA's approval of the HondaJet design based on certification testing, design reviews, and analyses completed to date. For a first-time aircraft manufacturer to receive its first type certificate, the event was nothing short of remarkable. Now, as Honda Aircraft's first child embarks on its seminal voyages around the globe, what's yet to be determined is how it will be received in the open market. The future holds promise of bright days ahead. ■

No Word Yet

Each country has its own regulatory structure. Under the EASA umbrella, France dictates the process to the men and women who govern the French turbine engine manufacturer, Turbomeca.

A simple request for supporting details from TC-penalized companies goes unanswered.

BY NORM CHALMERS
Pacific Airworthiness Consulting

For those of you new to the aviation industry, or new to AMU Magazine, I use many abbreviations including:

AD: Airworthiness Directive
AME: Aircraft Maintenance Engineer
AMO: Approved Maintenance Organization as approved by TC
CAR: Canadian Aviation Regulation which is a law of Canada
CAA: Civil Aviation Authority
EASA: European Aviation Safety Agency
FAA: Federal Aviation Administration
MCM: Maintenance Control Manual (of commercial operators)
MPM: Maintenance Policy Manual (of AMO)
SB: Service Bulletin
STC: Supplemental Type Certificate
TATC: Transportation Appeal Tribunal of Canada
TC: Transport Canada (or minister) Canada headquarters in Ottawa

Below you will note that the Italics denote a quotation. I do this in some cases because of the large amount of material that I quote. Please be aware of this as you read on.

When discussing SBs and ADs, it is important to understand who the key participants are.

Good day my friends. During my discussions with industry members, some of the same old topics keep coming up. Two of these are the requirements regarding ADs and SBs. For these topics we go back to one of my old columns, which is still valid.

When discussing SBs and ADs, it is important to understand who the key participants are. The CAAs are the most obvious participants. The others are the type certificate holders. In Canada we used to call these entities the Type Approval Holders but now we use the term Type Certificate Holder (TCH) to conform to the FAA and EASA formats. For most of aviation history, the TCH has been required to provide ongoing technical support to operators of their products. This support includes providing corrective actions to unsafe conditions. The TCH must spend the time, effort and money required to develop the necessary corrective actions, which are often SBs. The CAA then approves and mandates the SBs by putting out ADs.

Regarding SBs morphing into ADs, the CAA and the TCH usually work hand-in-glove. The relevant CAA may decide there is a need for an AD; however the TCH usually has greater product knowledge and expertise to provide corrective actions. Sometimes an SB has been available for some time but the AD requires a revised version.

Each country has its own regulatory structure that dictates the process. In Canada, the CARs make foreign ADs mandatory per 605.84(1)(c) if the AD issuing country approved the type certificate. For Boeing it is the USA, for Embraer it is Brazil, for Turbomeca it is France (through EASA) and so on down the list. When those countries issue an AD, it is mandatory in Canada. On the other hand the USA regulatory structure requires the FAA to issue an AD for it to become mandatory in the USA. As a result, for every AD, whether Canadian or other, the FAA usually issues an AD with identical technicalities.

In Canada for aircraft and other products such as engines that are from Canada, such as the PT6 or DHC6, only Canadian ADs are applicable to Canadian aircraft. The hook here is if a Canadian aircraft such as the DHC6 has a USA Supplemental Type Certificate (STC) or Part Manufacturing Approval (PMA) part subject to an AD issued by the FAA, you must comply because the USA is the approving state for the STC or PMA. For a Eurocopter France airframe with a Honeywell (USA) engine, you must comply with only the French airframe ADs and the FAA engine ADs.

On another note (see sharp?), those of you who have been reading this column for a few years may remember that we have been following the conflict between TC and Mr. B. who was a helicopter owner and pilot. The decision of the full three-member TATC hearing was to raise the previous TATC decision from $100 up to $700. That decision stated that there were mitigating factors but decided to raise the fine as a de-

For aerospace conglomerate Embraer, Brazil is the country that provides regulatory structure.

terrent anyway. To me, that seems to be a conflict in reasoning but that's government for you. That $700 cost us (taxpayers) more than $7,000 and less than $70,000.

In our last AMU issue, I did a survey of companies including aircraft operators and maintenance organizations that have been penalized by TC. This was to gain information regarding violation of the requirements stated in the TC approved manuals. These are the MCMs and MPMs. I went back several years and sent out requests.

The TC internet site provided information listing fines ranging from $2,625 up to $5,000. The current penalties listed in the CARs range from $5,000 to $25,000. The information provided does not include the nature of the violations. To get that information, I asked the companies for the specifics of the violations so that I might pass them on to you, AMU readers. None of those companies replied to my e-mails.

For your reference, the TC Aviation Enforcement Summaries can be found at this TC internet site: http://www.tc.gc.ca/eng/civilaviation/standards/

standards-enforcement-publications-menu-2963.htm. This internet site also lists non-corporate enforcement actions which are penalties levied against AMEs and pilots. These are people operating privately or that were viewed as violating their employer's policies and procedures. Again, there is little information provided.

Still on the topic of TC enforcement actions, there is one action that is a reminder to all of you who certify maintenance. Your signature can survive a long time. Back in 2007 an AME *signed maintenance releases in respect to maintenance performed on an aircraft on two separate occasions when he did not have the authority to do so.* That enforcement action was listed for March 2015 eight years after the AME's signatures. TC haunts us.

As a parting safety note, remember to replace your incandescent inspection lights with LEDs because of the fire hazard. The price of LED light bulbs and inspection lights is getting lower every year.

That's all for now folks. Until next time be good and do right. Please be aware that I am not a lawyer or legal expert. What I write in my column is not legal advice or legal opinion. If you face a legal issue, you must get specific legal advice from a lawyer and preferably one with experience in the aviation matters in your own country/state.

NORM CHALMERS *worked with Transport Canada as an Airworthiness Inspector for 25 years. Before this, from 1967 to 1983, he worked in the aircraft maintenance industry in and around Western Canada and in the Arctic. His industry experience includes the operational maintenance of normal and commuter category aircraft and smaller transport category aircraft in the corporate sector as well as several years working in major repairs in the helicopter sector. As an Airworthiness Inspector, he has been responsible for most duties related to the position, including the approval of all aspects of maintenance, manufacturing, training, and responsibilities related to distribution organizations. Norm now operates Pacific Airworthiness Consulting; www.pacific-airworthiness.ca.* ■

Western AME Association

About Us

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 Canadian Federation of Aircraft Maintenance Engineers Associations (CFAMEA) is a national body which is supported and financed by all the regional associations and which represents the associations at the national level.

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 and 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 50 booths from various companies, suppliers, manufacturers and other organizations. Attendance at this and our various other smaller workshops may be counted toward the recurrent training requirements required by Transport Canada.

Aviation Alberta 11th Annual General Meeting

Aviation Alberta's Annual General Meeting is scheduled to run June 24-26 and will be hosted by the Sawridge Inn and Conference Centre, Fort McMurray, Alberta. The theme of this AGM is Aviation, Airports & Oil: Partnering for Success. Email: info@wamea.com

A message from the President of the Helicopter Association International

I've noticed that when we talk about training in our industry, we tend to focus on the pilots. Don't get me wrong; pilot training is a cornerstone of HAI's safety initiatives. A pilot is the final safety gate for all flights, shouldering the ultimate responsibility for the safety of crew, passengers, and aircraft. While we recognize the benefits of pilot training, it is shortsighted to think that training belongs only in the cockpit. For example, maintenance staffers are absolutely critical to achieving safe and successful operations, yet their training often does not receive the same attention as that for pilots. We should look at training and development for every staff member, including flight crews, maintenance technicians, flight dispatchers, aircraft schedulers, administrative support, and management, as well as pilots. This approach is aligned with the principles of safety management systems (SMS). First, safety and operational performance are linked: when you improve one, you improve the other. Increased safety and performance in turn affect the financial viability of your organization.

Second, all staff members are key to the success of an organization's safety program. While pilots are the final safety gates, we now recognize that each staff member contributes to a safe flight. Accordingly, training should be developed and implemented for all staff members of an organization, from the entry-level employee up to and including the executive management and owner.

At a minimum, all staff members of a business should be schooled in that organization's mission, policies, and procedures. This may seem too basic to mention, but this foundation is necessary for everyone to work in a coordinated, interdependent, and supportive manner. Unless you have a payroll of one, every business depends on the teamwork of various departments and specialists working together.

Subsequent training would focus on individuals' specific duties, the technical requirements of their positions, and how they can contribute to their own safety and that of their co-workers and customers. When you step back and look at how each individual contributes to the success of the operation, the value of a structured training program for each individual becomes apparent.

When assessing training needs for your organization, don't forget to look in the mirror. Owners, executives, and management personnel all need to be involved in professional development programs too. In building your professional development program, you'll have many choices. But I urge you to always train to a higher level, beyond the minimum legal and regulatory requirements. Train your personnel to conduct their responsibilities as though every detail matters—because in our industry, it does.

Just as we have initial and recurrent training for pilots, you should consider the life cycle of professional development for all employees. Training isn't just a box to check off; many employees will benefit from periodic refresher or advanced courses. The benefits of a well-developed, comprehensive training program are many. The most notable are the prevention of accidents, injuries, and death. However, both commercial and general aviation/private operations can also reap enhanced operational efficiencies that will translate into improved financial performance. If you are one of those people who think you already know everything and therefore don't need professional development, think again. You probably need training more than anyone. As the great basketball coach John Wooden said, "It's what you learn after you know it all that counts."

Some of you may put off training because of cost concerns. This is understandable. My readers who maintain an aircraft for personal use have already sunk considerable sums into their passion. And for business owners, the financial health of their operation is always top of mind. However, if you think training costs too much money, let me assure you, that expense will pale in comparison to the cost of an accident. To really analyze training costs, you should also look at how much you are losing because of operational inefficiencies, not to mention the revenue lost to your competitors. Well-trained, safety-oriented employees have the best chance to produce the safest, most efficient operations. There is a solid business case for training, and it's time for us all to get on board.

That's my story and I am sticking to it. Let me know what you think: tailrotor@aol.com.

— *Matt Zuccaro, President and CEO of HAI*

www.wamea.com

Atlantic AME Association

Young gun makes good

Exciting news! One of our very own is making headlines on the World Stage. Ryan Leedham who won gold in Skills Canada for aircraft maintenance and will represent Canada in the Worlds in Sao Paulo Brazil this summer (August 11-16), and who took the Aircraft Maintenance Course at NSCC in Dartmouth, Nova Scotia, is now permanently employed with Clearwater Aviation Department. Good luck Ryan! Congratulations from all of us at the Atlantic AME Association.

www.atlanticame.ca

Central AME Association

About Us

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 five similar associations across Canada that collectively supports the national body CFAMEA. Our organization works with Transport Canada in the formulation of new rules and regulations and provides a collective viewpoint for all AMEs. CAMEA is a not-for-profit organization run by a volunteer group of AMEs. We elect members of our organization to be part of our Board of Directors. Members of CAMEA are comprised of AMEs, AME apprentices, students, non-licensed persons working in the industry and corporate members.

email: camea@mymts.net

AME Association of Ontario

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tel: 1-905-673-5681 fax: 1-905-673-5681
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Clarification of Parts Documentation

Last fall, as part of our annual CFAMEA meeting, our association representatives were briefed by Jeffrey Phipps, Transport Canada's Chief of Operational Airworthiness and Standards, about several TC projects. One of these was for an updated Advisory Circular for parts documentation. Our representatives passed this information on to our members. At our AME Association of Ontario Annual General Meeting we gave a brief outline of what we had been presented; this was followed by a detailed report to our members in our emailed newsletter in January.

In April, Transport Canada published Advisory Circular AC 571-024 titled "Documentation Required for the Installation of Parts onto Canadian Registered Aircraft." This circular gives detailed information regarding the documentation required for new and used parts that have been obtained from either domestic or international sources. Should you have any questions or suggestions for amendments, you can submit them directly to Airworthiness Standards at the address provided in the AC, or submit them to your AME Association who will handle them on your behalf. Advance notice of new documentation and procedures, along with representation at the top levels of Transport Canada.

Annual AME Workshop and AGM

Our workshop committee continues to work diligently to present another exceptional AME Symposium and Trade Show. Please join us September 30 to October 2. Again this year we will be having two days filled with educational sessions as well as a full house of displays from industries supporting aircraft maintenance. Check our web site at www.ame-ont.com for the latest details.

— *Submitted by Stephen Farnworth for the Board of Directors*

CENTRAL OHIO

Central Ohio PAMA

Hartzell tech talk highlights meeting

Our April 14 meeting featured a presentation by Hartzell Tech Rep Alex Krauskopf titled "Hartzell Propeller Basic Maintenance and New Technologies." The evening started with a social gathering at 5:30 with a light dinner around 6:00 and the presentation immediately following. The meeting was posted on the FAASTeam website and attendees who are registered there will receive AMT Award credit. COPAMA President, Joe Lippert, had a short presentation on next month's meeting, the 2015 Golf Outing and upcoming events over the spring and summer. Those events included the Champaign Lady Gala at Grimes Field on April 18, the Youth Aviation Adventures Spring outing on May 23 and their Hangar Fest fundraiser on August 22. The Central Ohio Aviation Golf Outing will be held Friday September 11 at the Kyber Run Golf Course in Johnstown, Ohio. More information will be posted as details become available.

Alex's presentation included documentation that is included with every new propeller purchase, an overview of the data available on the Hartzell Propeller website and many photos showing examples of common damage, corrosion, repairs and conditions that can cause the scrapping of blades, hubs and the whole propeller. He also presented how to identify the features of each prop from their part number and explained the benefits and features of their offerings of composite blade. He discussed items that can be performed by an owner /operator, an A&P technician and some defects and conditions that require the prop to visit a certificated propeller shop.

He also advised the group of Hartzell's technical support group, their in-house repair shop and the chance for visitors to their Piqua, Ohio manufacturing facility to take the factory tour that takes about an hour. Call ahead and pre-arrangement is appreciated but drop-ins during their normal working hours are also welcome. We wish to thank Alex and Hartzell for his presentation and the handouts and items he provided for the evening raffle.

www.copama.org

SOCAL

PAMA SoCal Chapter

Tech talks highlight February meeting

The SoCal Chapter would like to thank Greg Piland, Repair Station General Manager, Mike Struble, A&P Mechanic/Inspector, Aircraft Window Specialist and all at Lee Aerospace for their time and generosity in hosting the February 2015 Chapter dinner meeting and excellent technical presentation and demonstration on "Aircraft Window Inspection & Construction" at the 94th Aero Squadron Restaurant in Van Nuys, California. To learn more about Lee Aerospace, visit www.leeaerospace.com or contact your local S. CA rep Mike Struble directly at (316) 689-1236.

www.socalpama.org

PAMA DFW

PAMA Dallas – Fort Worth

About Us

The DFW Chapter of PAMA is a non-profit association dedicated to promoting professionalism and recognition of the Aviation Maintenance Technician through communication, education, representation and support, for continuous improvement in aviation safety.
email: curtislandrum@charter.net

www.pamadfw.com

Sense-Able Troublshooting

When sight, sound, and touch don't quite cut it as diagnostic tools, it's then that veteran AMEs rely on their innate sixth sense of what an engine needs.

Common sense isn't necessarily an inherited commodity. More often than not it's a skill that's been developed over time and through repetition.

BY GORDON WALKER, AME 'E'
Professor of Avionics, Centennial College

Two of the most common complaints I hear from employers of newly graduated AME students are that the graduates lack common sense, and troubleshooting skills. I have always felt that while these comments may be valid, they also indicate a somewhat unrealistic set of expectations. Troubleshooting skills, like all "skills", are developed over time, with repetition and experience. It's unreasonable to expect students who are fresh out of school to have developed a high level of expertise. It's much easier to diagnose a problem when you've encountered the same snag multiple times and seen what the most common "fix" is. The notion of people not having any "common sense" is one that applies universally to ALL inexperienced people, not just those in the aviation maintenance industry. The truth, however, is that nobody has "common sense". It's really a term that means "things you have learned and are easily and instantly retrievable." Once again, the degree of one's common sense per se will improve with time and experience. Pondering this phenomenon, it occurs to me that it might be interesting to consider "sense" and "troubleshooting" and give thought to "Sense-Able Troubleshooting": That is to say troubleshooting using our various senses.

While aircraft manufacturers are diligent in providing troubleshooting guides and technical support, it is up to the individual technician to employ his or her expertise and experience on the flight line to determine the cause and solution to unserviceablity scenarios. In addition to referencing technical documentation and drawing on past experience, using our sensory capabilities can be an invaluable aid in troubleshooting aircraft snags. Let's examine each of those senses, and how they might be utilized to determine the causes of various snags.

First and foremost, eyesight is probably the most valuable of our senses when it comes to snag analysis. The naked eye can detect a multitude of problems, but the astute technicians will arm themselves with a flashlight, mirror, and magnifying glass. Obvious things to look for would be integrity breeches such as broken wires, cracked pipes, conduits and tubing, discolouration from things such as contamination or overheating, as well as general condition and security. Extra care should be taken when performing visual inspections during conditions of limited light, such as night shifts and dimly lit hangars or flight line ramps and gates.

Taking a moment to view something from different angles or perspectives can also reveal visual clues that might otherwise be overlooked. Keep in mind the danger of complacency when making visual inspections and approach the task thinking "I AM going to find something" rather than "I never find anything".

As well as causing discolouration, overheating scenarios can lead to other sensory clues of an olfactory nature. Burning or overheating of wiring can cause pronounced and distinct odours. The same is true of overheated motors, pumps, actuators, and so on. Our sense of smell can be a vital aid in detecting problems and analyzing their causes. Contamination can often be detected by means of a probing proboscis. A tell tale whiff of fuel in an oil sample, for example, can be a clue towards analyzing engine problems. The proximity of avionics compartments to forward lavs can also provide distinct and unpleasant clues of a nasal nature, regarding contamination.

My first experience using the sense of hearing to maintain a vehicle was not aviation related, but rather automobile oriented. Anyone who has ever dabbled with British sports cars has undoubtedly,

A bundle of wires might be just a bundle of wires, but there are times when there's an important story they're trying to tell.

Apprentices learn by doing, but sometimes the most useful tips are among the most basic. For example, keep your flashlight and mirror handy. You're going to work in a lot of tight places where young eyes may not be all you need.

It might be noisy as hell in there, but an experienced AME is picking up all kinds of clues in the pitch and intensity of sounds.

at some time, stuck a tube in their ear, in order to adjust those old SU carburetors. I can also recall, as a young child, my father's dismay at hearing the sound of his beloved Jaguar the day after he had his ears syringed. A tune-up promptly followed, and he soon had his cat purring and growling. Listening for anomalies in terms of engine sounds, pressurization leaks, (a recent flight from Chicago had my wife's knuckles white with terror once I explained that the unpleasant whistling sound was a leaking door seal on the emergency exit we were seated beside) motor and pump operation, brush and bearing wear is an effective device in our sensory troubleshooting toolbox.

The sense of touch is a handy supplement when visual conditions are less than ideal. Sometimes it is impossible to gain access to an area for visual inspection, but running a hand along a wire bundle or heating duct can alert us to things such as cracks, chaffing, breakages, leaks, wear and fatigue. That ever-so-common overheating scenario can also be detected using (careful) application of the hands to determine temperature; whether it's heat or, in some cases, a lack of heat.

I once worked with an elderly chap who referred to himself as an "electrician" rather than "Avionics Technician". He would check for power on wires and terminals by using his hands, rather than a voltmeter. He claimed that his skin was so dry that the electric shocks didn't hurt him. I, however, believed him to be totally insane, and I STRONGLY recommend AGAINST doing this! It takes far less than one ampere of current to kill a person, so it is essential that all precautions be taken to avoid touching exposed wiring and electrical contact points.

So we've looked at how we might determine the source of maintenance snags by using our senses of sight, smell, sound and touch...that just leaves "taste".

Okay, I admit it...I've got nothing here! I guess if the coffee tastes foul, you might consider looking in the potable water tank for contamination, but that's a bit of a stretch. However, perhaps we should make mention of the so-called "Sixth Sense". Sometimes, you just have a feeling about a particular problem.

The young tech in your hangar might have the advantage of recent training, but an intuitive knowledge of when to proceed with a procedure or when to pull the plug is gained only through experience. Be patient with youth. Once, you were there too.

Maybe it's from past experiences with similar problems, a subconscious calculation of the likelihood of a particular fix being effective, or just a good old "gut feeling" that you know what's wrong, and how to fix it. I'm a firm believer in listening to those inner voices whether it's concerning an aircraft snag or a sketchy looking guy hanging around the ATM I'm about to use.

At the end of the day, I guess when it comes to troubleshooting aircraft maintenance problems, you should always use your common senses!

Q: What are three common tools that can be used to assist the maintenance technician in performing visual inspections?

Answer to previous issue's question:

Q: What is the primary difference in the theory of operation between surveillance radar (ATC Transponder) and ADS-B?

A: Secondary surveillance radar sends interrogation pulses from an ATC facility to transponder-equipped aircraft in the vicinity. The transponders send reply pulses from the aircraft BACK to the ATC centre, and they show up on the air traffic controller's screen. ADS-B allows each aircraft to send and receive information pulses. This information is shared with all suitably equipped aircraft in the vicinity, allowing each aircraft access to traffic information previously only available to the ATC facility.

GORDON WALKER *entered the avionics industry after graduating from Centennial College in 1980. His career with Nordair, Air Canada, CP Air, PWA, and ultimately Canadian Airlines took him to many remote corners of Canada. Since leaving the flight line to pursue a career as a college professor, Walker has continued to involve himself in the aviation/avionics industry by serving on several CARAC committees concerned with the training and licensing of AMEs. As well, he has been nominated to the CAMC Board of Directors, and has been elected President of the National Training Association (NTA).* ■


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ARCHIVE
EVENTS
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JOBS
AMU Chronicles
Aviation Terms – Part 2
HIRF Explained
Human Factors
The Regs
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Merely a matter of . . . Millimetres

A miniscule crack on a defective blade creeps along undetected until it's too late.

On November 2, 2011, Bell 206L helicopter C-GDQH, operated by Sunrise Helicopters Inc., departed Kapuskasing, Ontario, in daylight visual meteorological conditions. The aircraft was chartered by a forestry company for a local timber survey flight to the south of Kapuskasing. Two passengers, employed by the forestry company, and one pilot were on board the aircraft.

At approximately 1048 Eastern Daylight Time, about 15 nautical miles south of Kapuskasing, an in-flight separation of one of the helicopter's main rotor blades occurred. As a result, the helicopter struck terrain. All occupants received fatal injuries, and the helicopter was destroyed. There was no post-impact fire. The emergency locater transmitter activated upon impact, and a search and rescue team was deployed. The helicopter was however located by a civilian helicopter prior to the team's arrival.

History of the flight

After departing Kapuskasing, Ontario, the occurrence helicopter flew southbound, performing an aerial survey of several pre-selected areas. During the flight, the helicopter was operated at low altitudes and, at times, in slow and hovering flight. The final recorded data from the aircraft's global positioning system (GPS) indicated that at 1047, the helicopter's altitude was 917 feet above sea level (asl) [82 feet above ground level (agl)], its ground speed was five knots, and it was flying a track of approximately 270 degrees magnetic. The wreckage was located at an elevation of 825 feet asl, on an old logging road, approximately 25 feet to the west of the last recorded GPS position. The area surrounding the crash site had been previously logged and was therefore sparsely forested. The helicopter struck the ground at approximately a

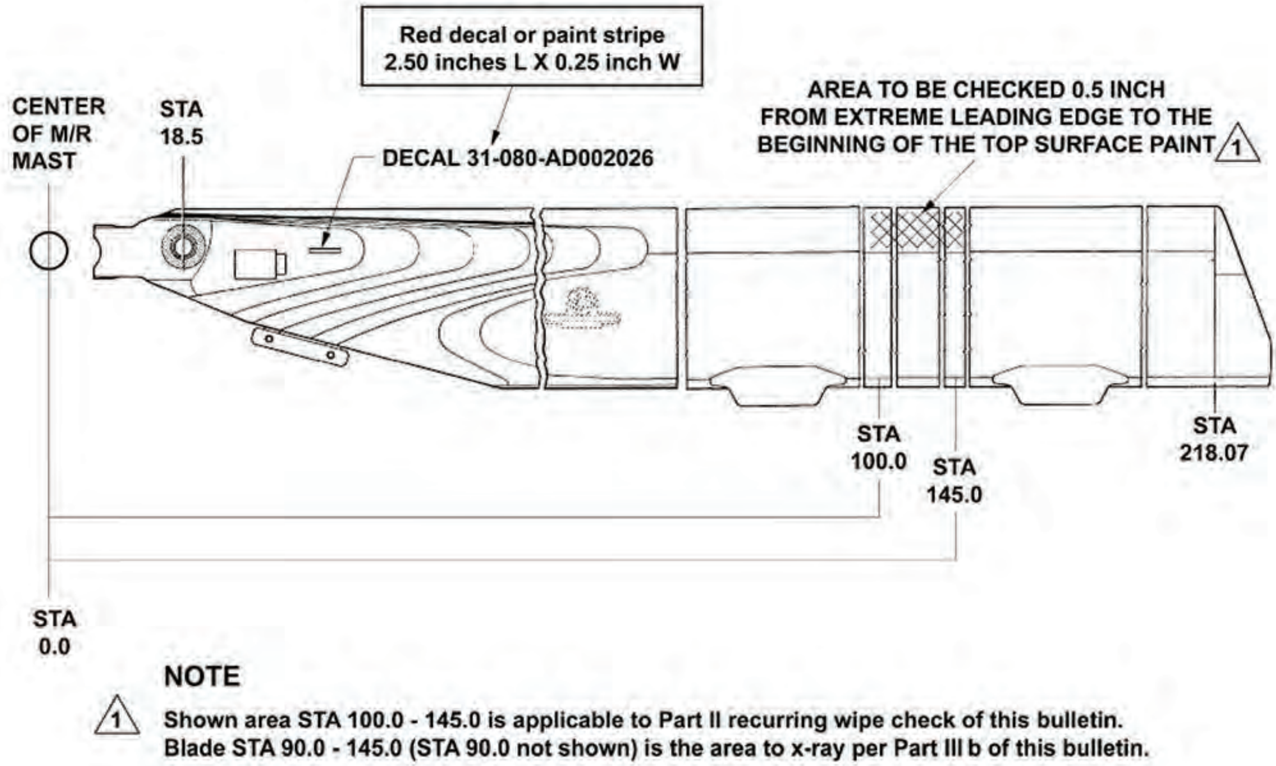

Figure 1: Main rotor blade area to be checked

40-degree nose-down angle and a 52-degree left-bank angle. The main rotor system, including the transmission, and the top of the fuselage separated as a unit in flight, prior to impact, and came to rest approximately 140 feet west of the main wreckage. The engine also separated from the airframe prior to impact and came to rest 170 feet north of the main wreckage. Various other components, which separated in flight, were strewn about the area.

Both main rotor blades remained attached to the hub. One blade was significantly damaged, but was not fractured. The other blade was fractured, and approximately eight feet of the outboard end was missing. An extensive search was conducted for the remaining outboard section, but it was not located.

Aircraft

The Bell 206L helicopter has a two-blade semi-rigid rotor system. At the time of the accident, the helicopter was equipped with main rotor blades part number 206-015-001-115, serial numbers A-4705 and A-4753. The manufacturer designates the lifespan of these blades as 3,600 hours. The blades were installed on two other helicopters prior to being installed on C-GDQH on May 12, 2011. At the time, the helicopter journey log indicated that the helicopter had 14,642.7 hours, and the main blades had 3,367.8 hours. At the time of the accident, the helicopter journey log indicated that the main rotor blades had 3,592.1 hours total time.

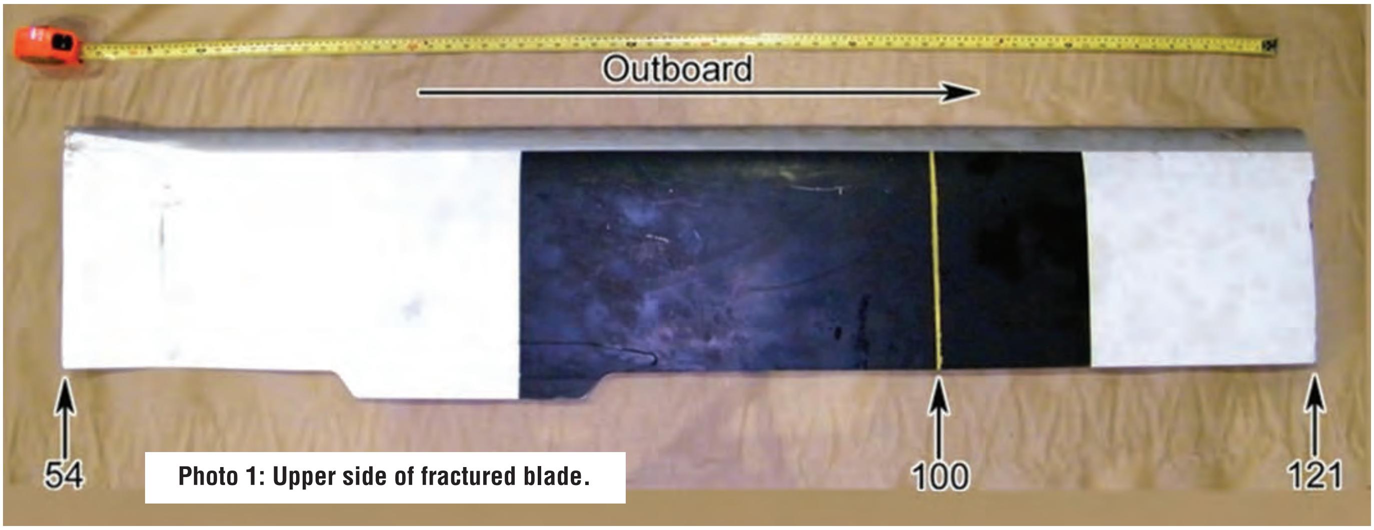

Photo 1: Upper side of fractured blade.

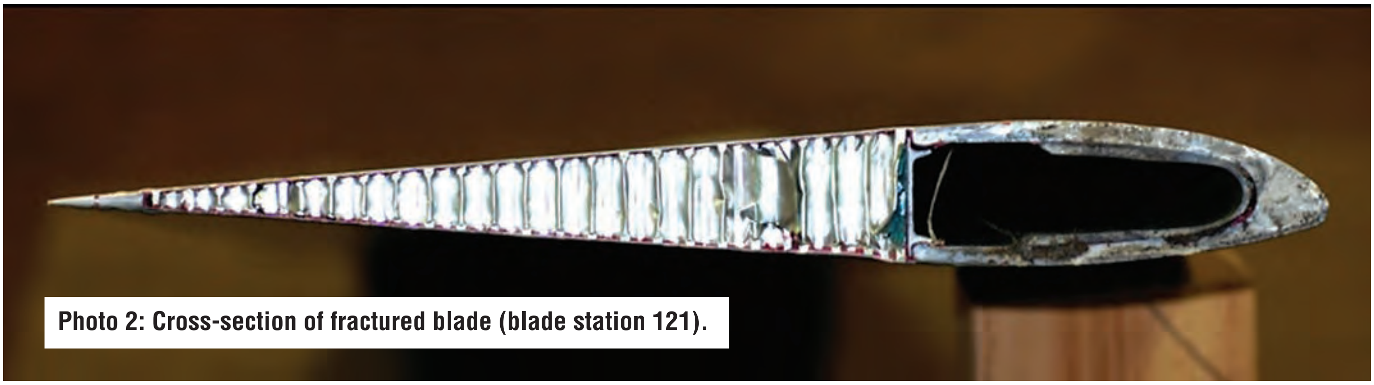
Photo 2: Cross-section of fractured blade (blade station 121).

Main rotor blade A-4705 examination

The main rotor blades on the B206L are an all-metal bonded assembly consisting of three structural members: an aluminum spar, a spar closure, and a trailing edge strip. Skins, stabilized by a honeycomb core, are bonded to the major section by adhesive applied under heat and pressure. Reinforcing doublers, grip plates, and drag plates are bonded to the blade butt end. A lead weight runs along the length of the spar, beginning approximately at blade station 100, and continues for 115 inches to the blade tip. During the manufacturing process, the lead weight is attached to the spar with adhesive.

The fractured main rotor blade and the mating main rotor blade were sent to the Transportation Safety Board of Canada (TSB) Laboratory for further examination. The fractured blade (part number 206-015-001-115, serial number A-4705) exhibited a complete chord-wise fracture approximately 100 inches (eight feet four inches) from the tip, about at blade station 121 (Photo 1).

Visual examination of the occurrence blade revealed that the fracture that led to the blade separation had initiated in the blade leading edge spar. The fractures of the blade skin, spar spacer, trailing edge wedge, and aluminum honeycomb structure were all secondary due to overstress. No deficiencies were found with the blade spar material. The spar material was 2014-T6, with a Rockwell B hardness of 78 HRBW, as specified by the manufacturer.

The lead weight was bonded to the aluminum spar with adhesive (reddish material in Photo 3). There was a large void in the adhesive at station 121 (location of fracture). The span-wise length of the void in the inboard direction from the fracture surface was about 13 inches. The total length of this void is unknown since the outboard portion of the blade was not recovered. The cross section of the void measured approximately 9.5 millimeters (mm) x 1.5 mm (0.374 x 0.0591 inches).

The blade spar fracture initiated on the inner surface of the spar, at the location of the void in the adhesive used to bond the lead weight to the spar at station 121. The fracture initiation location was a visible fingernail-shaped region, which is typical of fatigue cracking, and was clearly identifiable, even in the condition in which the blade was received. The fingernail-shaped region (Photo 3) in the fracture initiation area had a different appearance than the rest of the fracture surface. This region appeared dark, which suggested a corrosion deposit on the surface. In addition, the fingernail-shaped region had a relatively flat and smooth surface, which is typical of stable crack growth. The fracture surface in this area was oxidized with corrosion scale.

The fatigue crack located at blade station 121 had grown upwards, under the blade surface. The direction of the crack growth in this area (see red arrow in Photo 4) was consistent with the out-of-plane bending of the blade (helicopter start/stop cycles). The fatigue crack grew to such a size that in-flight high-frequency loads began to significantly contribute to its progression. When the crack was approximately 6mm from its origin site, a chord-wise acceleration of its growth occurred (see blue arrows in Photo 4).

Eventually, the crack propagation direction changed so that one portion of the crack started to advance towards the leading edge, and the other portion, to the trailing edge of the blade (see green arrows in Photo 4). The general direction of the crack propagation at this stage was consistent with cyclic, predominantly in-plane bending of the blade (high-frequency loading). The crack growth became unstable and it accelerated, eventually leading to blade separation. It was impossible to accurately determine the number of cycles required for the initial fatigue area (red arrow) to grow to its observed size because striations in this region had been obliterated by rubbing and corrosion damage.

There were numerous secondary fatigue cracks originating from the inner surface of the blade spar, at the location of a large void in the adhesive used to bond the lead weight to the spar (Photo 5). These cracks grew upward under the surface of the blade and were observed between blade station 110 and the main fracture surface (blade station 121). The cracks revealed a pattern typical of progressive (fatigue) cracking (Photo 5). These secondary cracks were similar to the initial, fingernail-shaped portion of the main fracture, but smaller.

The lead weight was not completely sealed at its edges due to micro-cracks in the adhesive material adjacent to the lead weight (Photo 6—large black arrows within dashed areas). Therefore, moisture penetrated through the gap between the lead weight and the spar. This allowed corrosion of the inner surface of the spar where there was a void in the adhesive, as well as corrosion of fracture surfaces while the fatigue cracks were growing.

The appearance of the corrosion scale was consistent with a long-term exposure of aluminum to moisture. Corrosion can accelerate fatigue by providing sites suitable for crack nucleation (corrosion pits) and by increasing the crack propagation rate. The corrosion scale on the fracture surface diminished with distance from the fracture origin. The corrosion may have contributed to the initial crack growth, but unlikely played any role in the crack propagation in the chord-wise direction during the faster, unstable growth.

The lead weight edges of the mating blade were completely sealed. Therefore, unlike the adhesive in the occurrence blade, the voids in the adhesive were not connected with the inner cavity of the blade and there were no signs of corrosion. The mating blade spar did not have any cracks, even though there was a large void in the adhesive between the spar and the mid-span lead weight.

Previous occurrence

On August 31, 2008, near Greensburg, Indiana, an in-flight separation of a main rotor blade occurred on Bell 206L-1 N37AE operated by Air Evac EMS Inc., followed by a collision with terrain and a post-impact fire. The three occupants suffered fatal injuries. The United States National Transportation

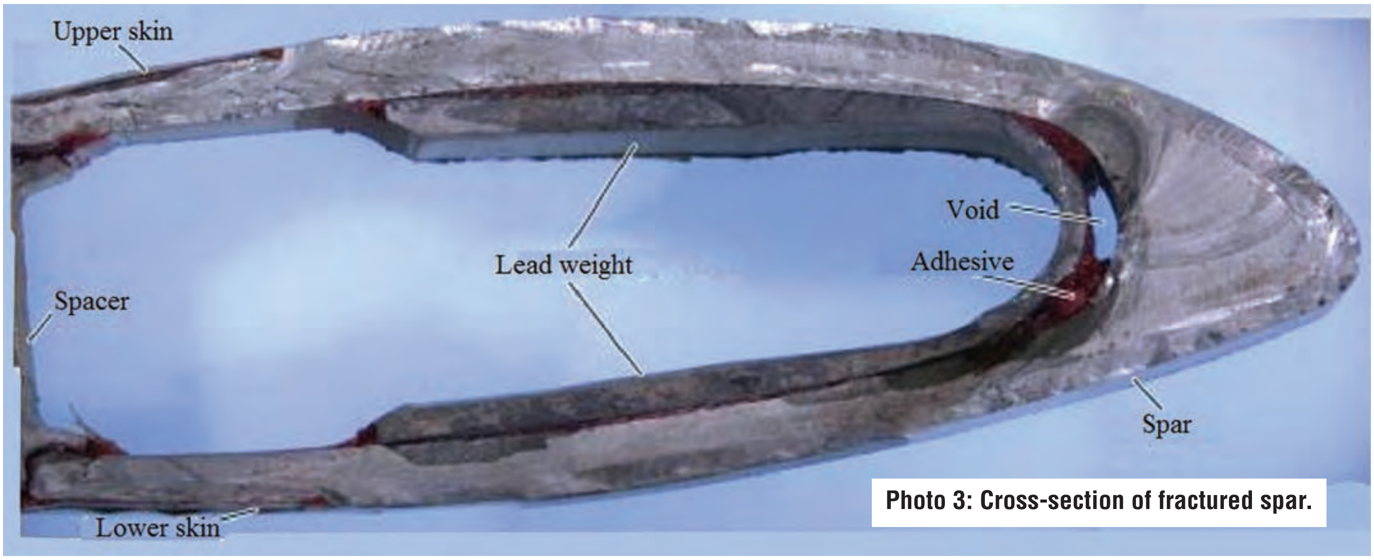

Photo 3: Cross-section of fractured spar.

Safety Board (NTSB) investigated the occurrence and found that the failed blade fractured at about 96 inches (eight feet) from the tip, which corresponded to blade station 126.5. The profile of this fracture was oriented directly across the blade, from leading edge to trailing edge.

Examination of the fracture surfaces revealed ratchet marks and fine elliptical clamshell marks, typical of fatigue cracking. These marks emanated from the inner face of the spar, at the transition radius between the leading edge and the upper wall. The crack propagated upward through the wall of the spar and to both sides of the fatigue origin area. The fatigue crack had grown to encompass approximately 50 per cent of the cross-sectional area of the spar prior to the ultimate failure. The surface of the spar at the fatigue origin exhibited no evidence of corrosion or previous mechanical damage; however the overall fracture pattern was very similar to the pattern in this occurrence.

The origin of the fatigue crack coincided with a large void in the adhesive between the inside surface of the spar and the lead weight.

Bell Helicopter determined that a number of spars manufactured by a vendor did not meet manufacturing specifications, which stipulated that any mechanical straightening of the spar (extruded aluminum) must be within a specific time period after solution heat treating. A number of spars were straightened outside of this time limit, and as a result, may have had a residual stress incorporated into them.

In addition to the residual stress, a discrepancy was noted during the assembly process of some rotor blades at the Bell Helicopter facility in Fort Worth, Texas. Bell Helicopter found voids of unacceptable dimensions in the adhesive between the lead weight and the spar. According to Bell Helicopter, the combination of the residual stress and an unacceptable void in the adhesive could lead to a fatigue crack in the spar.

As a result of the August 2008 occurrence, Bell Helicopter developed Alert Service Bulletin (ASB) 206L-09-159, which came into effect in July 2009 and was followed by a revision in November 2009. The ASB affected 2,542 main rotor blades, including the occurrence helicopter's blades. The ASB stated that a fatigue crack could occur if there was a combination of both residual stress in the spar and a larger than acceptable void in the adhesive applied between the blade's internal lead inertia weight and the spar, between blade stations 100 and 145.

If such a condition exists, a fatigue crack may be induced by the centrifugal force variation that occurs during the helicopter start/stop cycles. The ASB also advised that for the blade to be considered at risk of developing a crack, both of the above-mentioned conditions had to be met.

There were three parts to the ASB:

Part I contains instructions to identify affected main rotor blades and mark the top surface with a permanent ink marker to identify blade stations 100 and 145;

Part II introduces a recurring blade spar wipe to check for a surface crack in all affected blades, between blade station 100 and 145; and Part III presents an optional provision to perform a one-time X-ray inspection of affected blades.

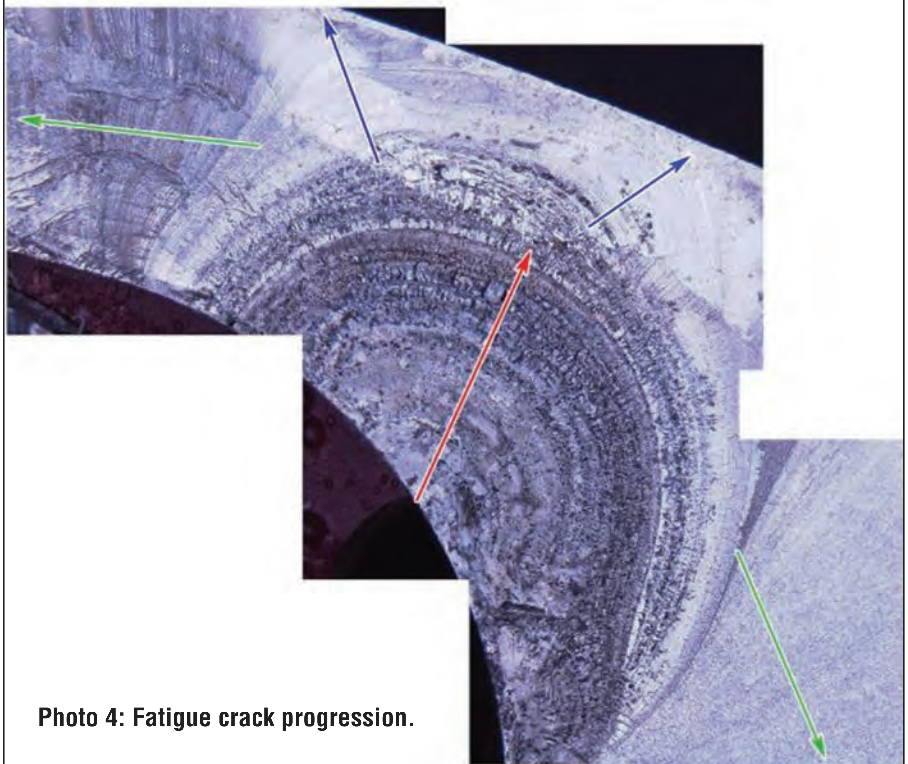

Photo 4: Fatigue crack progression.

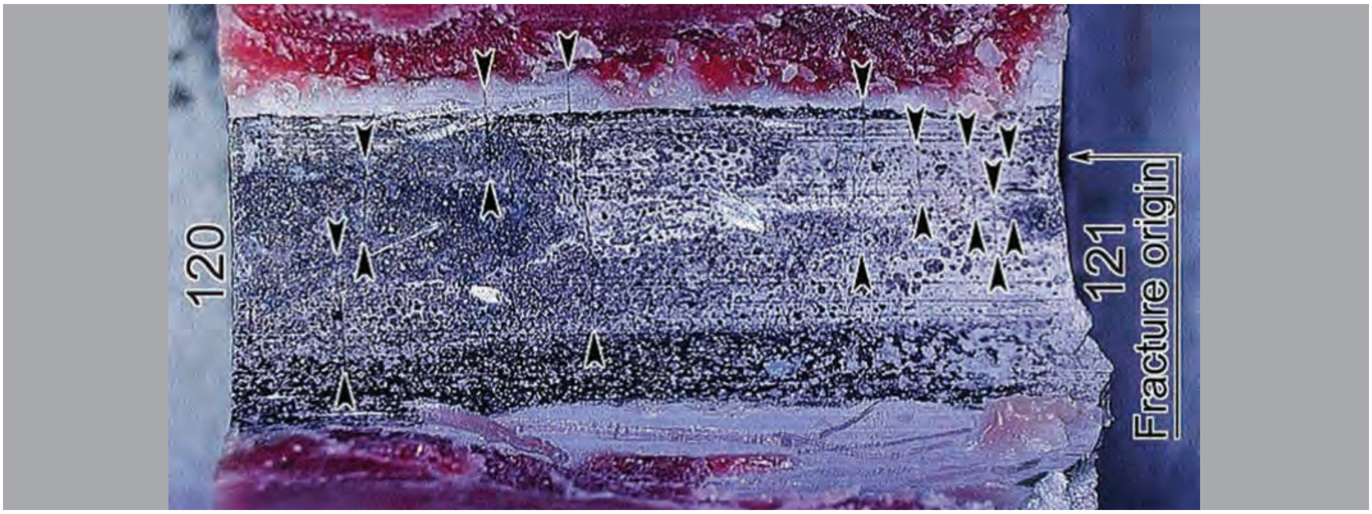

Photo 5: Spar inner surface with lead weight and adhesive removed (arrowheads showing secondary cracks).

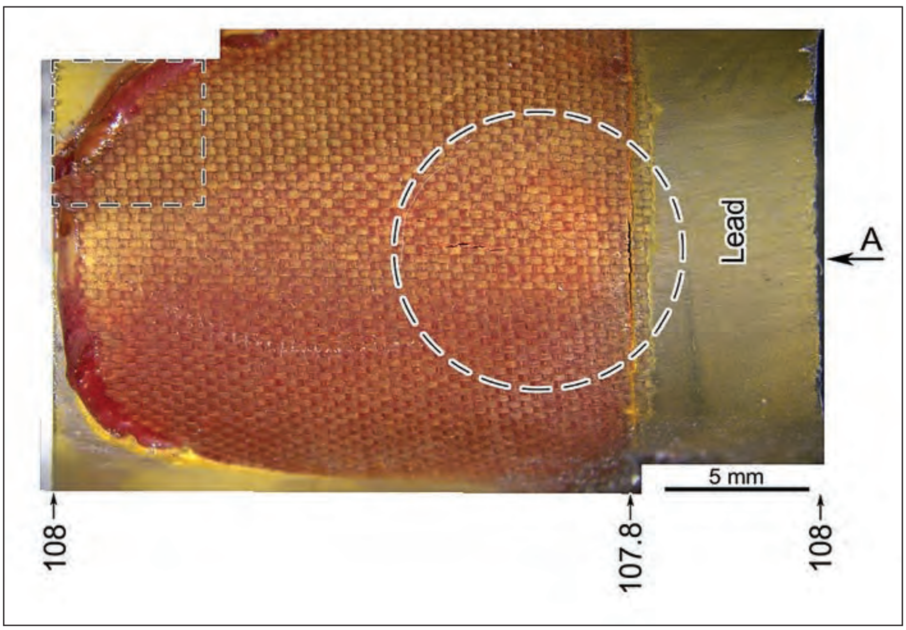

Photo 6: Inboard end of the lead weight and adhesive.

This inspection consists of taking X-rays of the blade spar and forwarding them to Bell Helicopter for review.

The wipe check (part II) was required on blades that had accumulated more than 800 flight hours and was to be repeated every 60 engine starts thereafter until the blade was removed from service. The wipe check procedure is to clean the blade upper surface between blade stations 100 and 145. Allow enough time for the blade upper surface to dry. Check affected area (Figure 1) for evidence of cracks by applying a blue food colouring in the area to be checked. After 10 to 20 seconds, wipe off the solution with cheesecloth and carefully check affected area for evidence of a crack. If a crack is present, the blue food colouring solution will remain in the crack as the excess of solution is wiped off or the cheesecloth will catch on the rough edges of the crack. If a crack is found, remove the blade from service before further flight and contact Bell Helicopter Product Support Engineering.

Transport Canada

In August 2009, following the August 2008 occurrence in Indiana, TC conducted a risk assessment and determined that there was a medium risk of another blade failure. TC accepted the wipe check developed by Bell Helicopter as a satisfactory interim strategy until the blades could be X-rayed. However, the wipe check solution with food colouring does not meet the Canadian Institute for NDE definition of a liquid penetrant; therefore, it is not considered nondestructive testing. It is however considered to be a new maintenance technique developed by the manufacturer as a visual aid to detect cracks on the surface of the rotor blade.

TSB Laboratory findings as to causes and contributing factors

According to a sequence of tests performed at the TSB Laboratory, the main rotor blades were manufactured with defects. As a result, several fatigue cracks initiated on the inner surface of the spar.

One of the cracks progressed until the occurrence main rotor blade separated in flight. After the August 2008 occurrence, Bell Helicopter implemented a damage tolerance approach for the main rotor blades. This approach did not provide the adequate inspection criteria required for a critical component; as a result, a fatigue crack progressed undetected until blade separation.

Transport Canada's assessment of the August 2008 occurrence resulted in an inadequate safety action for a critical component of a helicopter. Consequently, the defective blade remained in service, resulting in the occurrence blade failing in operations. ■

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BY SAM LONGO, AME A&P

One of Life's More Difficult Tasks

Saying goodbye to a special friend: George McMaster (1954 – 1976)

The history books are full of famous people who have made their marks in the world of aviation. Many lived long and prosperous lives after daring record-breaking flights or creating innovative technical achievements. Unfortunately, in some tragic cases, other lives were cut short, allowing all the latent possibilities of their fledgling aviation careers to fade into oblivion.

As this column goes to press I find myself reflecting on the past as my 61st birthday rapidly approaches on May 8th. This is always a bittersweet day for me as I shared this birth date with my good friend George McMaster. We met in high school and immediately got along, sharing many common interests, primarily motorcycles, aviation, and chasing girls — not necessarily in that specific order.

George was larger than life, tall — at about 6 feet 3 inches, — extremely personable, always with perfectly coiffed hair and a deep baritone voice. Add to all this a razor sharp wit, and you can quickly deduce who usually took first place in the girl-chasing department.

After high school, a number of us had our goals set on various careers in aviation. Another good friend, Maurice Sacco, joined the Canadian Forces as a Radar Tech. I took a job at Hudson's Bay to gather funds for Centennial College's Aircraft Program, and George applied for pilot training in the Canadian Forces. We often got together during that year, riding our Honda 500-Fours around and discussing our future career goals.

Finally, the word came through that George was accepted into the pilot program. He confided to me later that he almost didn't make it because of his height; he just barely squeaked into most of the trainers he would be flying! That summer we all decided to take a month off. Maurice pooled all his leave that year and also purchased a Honda 500-Four motorcycle. So we were the three amigos, with matching motorcycles. We had great times bombing around Ontario, all momentarily in the same place in life with money, motorcycles and freedom.

When our month-long adventure ended we all went in different directions. I enrolled at Centennial College, and George started his flight training. He often wrote home lengthy letters to our group of friends about his flying adventures. I remember him describing a formation flying exercise on the Tudor jets on a rather blustery day, where his commander kept prompting him to pull in tighter and tighter to his wingtip. His comment in the letter was something like, "That's as close as I'm coming without a court martial." A typical George commentary!

The letters continued and we kept in touch, even getting together occasionally when he was on leave. On one of those trips he flew home and rode his motorcycle back out to Moosejaw, Saskatchewan. My year at Centennial passed quickly and I was soon off to Montreal to start my apprenticeship with Nordair. Part of the employment agreement was that we would be sent to various northern outposts for 28-day tours of duty. My first such tour was to Frobisher Bay on Baffin Island. George and I were both 22 at the time, and I remember vividly that it was a cold, lonely and somewhat difficult time for me. However one fateful evening it got just a little colder and lonelier when I was called to the radio shack for an important phone call via satellite.

The connection was somewhat fuzzy, with that weird three-second delay, but the news sunk into me like a dagger. My friend Peter's voice sounded eerily distant, as the news unfolded, George McMaster had died. The conversation was brief, he told me of the funeral arrangements, I thanked him for letting me know and the call ended. Stunned, I walked out of the shack into the freezing pitch-black night, filled with stars and the shimmering northern lights. It was a moment in time that I will never forget.

I spoke to my supervisor about getting leave to attend the funeral. He felt bad for me but the rules were clear: only for immediate family if you were posted on an out-station. I thought about going anyway but just couldn't justify losing my job at that point in my career. So, regretfully, I missed his funeral.

The details of his death were heartbreakingly tragic. Having successfully completed his flight training, a week before his official wings ceremony, he died in a motorcycle accident. Mercifully, the investigation into the head-on collision concluded that he was most likely killed instantly.

Who knows what George could have achieved in his future life in aviation? He was certainly an inspiration in the 22 short years that he was with us. I have no doubt that he has earned his spiritual wings and wears them with great pride. For me, he will never be forgotten. Each passing birthday brings his memory flooding back, Second Lieutenant George McMaster, friend and soul mate, forever 22, and always reaching for the stars. *For more published writing by Sam Longo, please visit www.samlongo.com* ■