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ISSUE 3, 2015

# Flight Comment

## DOSSIER

Use It or Lose It

## CHECK SIX

Canada's Aviation Medicine Pioneers – Part 2

## VIEWS ON FLIGHT SAFETY

Commander of the Royal Canadian Air Force



Canada



Cover – A Royal Canadian Air Force technician guides a CP-140 *Aurora* to its parking area during Operation IMPACT in Kuwait on February 5, 2015.

Photo: DND



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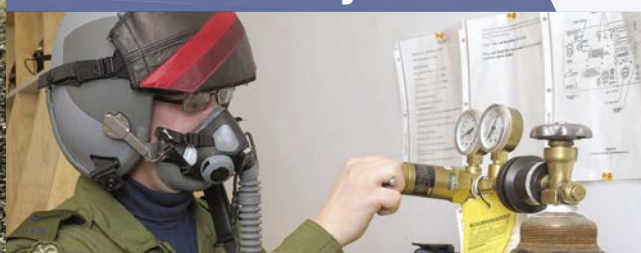
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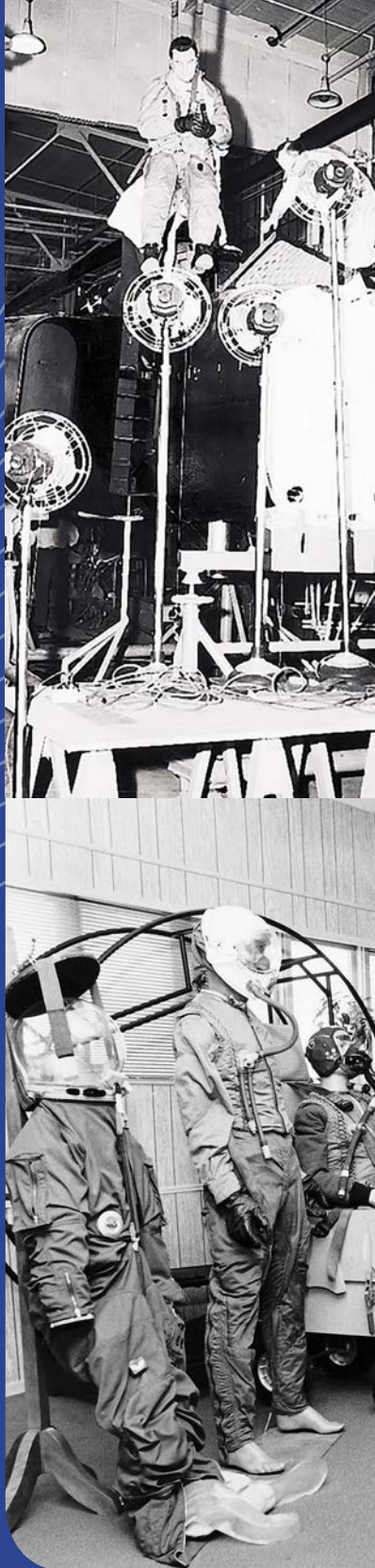
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# Flight Comment

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Photo: Cpl Heather Tiffney

# Views on Flight Safety

by LGen M.J. Hood, Commander of the Royal Canadian Air Force

Some safety thoughts from the Commander of the Royal Canadian Air Force...

You might not realize how long the Canadian Armed Forces' (CAF) Flight Safety program has been in existence. The foundations of the program were first introduced during the latter stage of the Second World War at a time when it was assessed that we were losing too many Royal Canadian Air Force (RCAF) assets (aircraft and people) in accidents that were preventable and not directly attributable to enemy action. Of course it has evolved over the last 73 years,<sup>1</sup> but the fact that the program is still functioning well today is testament to its importance and success.

Why is this relevant? We need to remember that many of our contemporary Standing Operating Procedures and training techniques have been borne out of costly lessons learned through the safety incidents of our air power forbears. This lengthy period of commitment to the safety review, learn, and improve cycle is fundamentally important as it provides the safe operational platform from which we execute training and operational missions today.

Out of great respect for the airmen and airwomen that went before us, and as a well-established Air Force, we always need

to execute our diverse air power functions (whatever your trade) within the rules and regulations established through our rich history. To this end, while we recognize that humans can occasionally make mistakes, we do not culturally accept purposeful violations of our rules, regulations, and procedures. This is the foundation of our effective 'just culture' system.

The statistical database of our Flight Safety program demonstrates clearly that the highest proportion of our safety incidents, notwithstanding the advances in aviation technology, are either attributable to human error directly or as a consequence of a human factors causal linkage. While humans in the loop represent our greatest strength, as a consequence of our susceptibility to errors, slips and lapses, we also naturally draw concomitant risk—a risk that is always prevalent and should drive us to maintain an ever-vigilant approach to human factors consideration across all our air power operations.

Another important flight safety principle is force preservation. Some might suggest that force preservation and mission execution represent almost naturally opposing functions, but I do not support this view. Force preservation and mission execution are linked by effective

risk management principles. This is where the *raison d'être* of Flight Safety comes into play, whereby we employ effective risk management strategies to accomplish the mission at the lowest level of risk practicable. Safety risks must be assessed then articulated to the chain of command to ensure that latent or residual risk is accepted at the appropriate level.

Further, we should avoid allowing ourselves to drift unwittingly into a higher risk regime. For any airpower operation risk awareness is key; we must always assess risks, mitigate them as much as possible, refer higher risk up the chain as necessary, to ensure we make risk-aware decisions to execute action when the mission demands. These risk concepts are relevant for all Canadian air power missions, training or operational.

Statistically, we have had the lowest number of catastrophic accidents for some time, and while we should be justifiably proud of our commitment to safety, we must guard against complacency. Our Flight Safety program is second to none, but the positive statistics and data are irrelevant if we do not maintain an ongoing commitment to accident prevention. Do not believe in our Flight Safety program as a consequence of positive statistics; the integrity of the program is only as good as

the commitment of all members of the team to the Flight Safety culture. The RCAF airworthiness and safety philosophy demands that all understand their role to be vigilant, speak up loudly and confidently, stand by the rules and regulations, and work to effectively manage risks.

I am fully committed to a healthy and robust Flight Safety program for the CAF, and I expect Commanders at all levels to assume a forceful cultural role in our program. It is essential that our aircrew, our maintainers, as well as our support trades, actively participate in the program so that we are able to deliver Canadian air power safely and effectively.

Remember that Flight Safety is everyone's responsibility but, first and foremost, it is a leadership responsibility. 📌

### Reference

1. The first known formal recognition of the need for a dedicated Flight Safety Organization occurred in mid-1942 when the RCAF Aircraft Accident Investigation Board (AIB) was formed under a Chief Inspector of Aircraft Accidents.



## The Editor's Corner

**W**elcome back! I hope you had a fun and enjoyable summer.

It is that time once again whereby we welcome to the position a new Commander of the Royal Canadian Air Force and invite him to share his thoughts on and vision for the Canadian Armed Forces' (CAF) Flight Safety (FS) program. As the General mentions in "Views on Flight Safety", we within the CAF find ourselves [fortunately] in a lull regarding catastrophic accidents but nevertheless must be on top of our game in the fight against complacency that can easily set in. Of greater note is his remark that FS is everybody's responsibility however; the onus is on the leadership to forcefully instill the culture throughout all levels of command.

In this issue, we borrow an interesting article from a study recently completed in the United States on the loss of proficiency in pilot cognitive skills due to the extensive use of automation in flying. I found this article quite relevant, case in point having witnessed as a Qualified Flight Instructor,

the ever-increasing use of systems guidance within the training syllabus and the difficulty for most students to appropriately navigate when said guidance (read: GPS) did not function correctly. Please have a read. I would enjoy hearing any of your comments or anecdotes on the matter. In addition, Part 2 of "Canada's Aviation Medicine Pioneers" continues in this issue with the development of pressure suits, helmets and oxygen masks.

On another note, it is also that time of year when the Director of Flight Safety soon begins his tour of military units and civilian contractors across the country. In October, the Director will start off this season's journey in Halifax/ Shearwater. Check with your FS representative for the tentative dates at your unit.

With the passing of another posting season comes the arrival of new members to the Directorate of Flight Safety (DFS). I would like to take the opportunity to welcome those who just checked-in on the investigative side within the

fighters/ trainers, fixed-wing, rotary wing and maintenance sections. Readers can check out the "Back Page" to see just who they are.

Finally, as a reminder to those who could find themselves dealing with a Flight Safety occurrence investigation, if you need guidance and/ or you want to get a second opinion on your initial investigation plan, you ALWAYS have 24/7 access to the duty DFS investigator at 1-888-WARN-DFS (927-6337) for advice. That's part of the duty DFS investigator's role.

*Volare tute*

**Major Peter Butzphal**



# For Professionalism

For commendable performance in flight safety

## Major Anthony Ambrosini

**O**n 20 November 2013, Maj Anthony Ambrosini, a CH146 *Griffon* First Officer with 400 Tactical Helicopter Squadron, was tasked to carry out a pilot proficiency training mission.

Prior the mission, other members of the crew had completed a walk around. The Aircraft Captain also performed another brief walk around and signed out the aircraft. While embarking on the aircraft, Maj Ambrosini took it upon himself to perform yet another walk around despite the fact that this was not a normal requirement in the performance of his duties. He noticed the oil level in the 90 degree gearbox at the lower portion of the sight glass seemed stained and it was difficult to determine if the stained portion of the sight glass was oil. The other crewmembers believed that there was sufficient oil in the 90 degree gearbox. Despite this, Maj Ambrosini instructed one member to obtain a ladder so that the oil level could in fact be confirmed. This subsequent inspection revealed that there was indeed no oil in the 90 degree gearbox. Later maintenance

analysis discovered that the breather valve within the oil cap had deteriorated over time and ceased to function. As a result, the breather valve over-pressurized the system and oil blew out of the valve leaving little oil in the gearbox. The stain on the sight glass led others to believe that there was oil in the 90 degree gearbox.

Maj Ambrosini is commended for his astute observation and highly professional conduct. The loss of lubrication oil in the 90 degree gearbox could easily have been missed due to staining of the oil level sight glass. His decision to have a crewmember inspect the gearbox averted a potentially disastrous situation and he is most deserving of the For Professionalism Award. 🦅



Photo: DND

## Master Corporal Martin Léveillé

**O**n 17 January 2014, MCpl Léveillé, an avionics instructor at Canadian Forces School of Aerospace Technology and Engineering (CFSATE) was carrying out his monthly inspections of the tool boards used during practical exercises by students. He astutely observed that a spring was missing on a set of diagonal cutters and immediately informed the unit tool control coordinator of his findings.

Recognizing the possibility that this problem might not be limited to this specific type of tool, MCpl Léveillé took the initiative and carried out a further investigation that determined that out of 28 tools of this brand at the unit, 18 had springs missing. Due to the potential seriousness of his findings, foreign object damage (FOD) checks were immediately carried out on all CFSATE aircraft. With his knowledge that this brand of

*Continued on next page*



Photo: Sgt Christopher Bentley

## Master Corporal Miguel Lourenco

**O**n 16 July 2012, while performing a pre-flight inspection of a CH146 *Griffon*, MCpl Lourenco, a 430 Tactical Helicopter Squadron Flight Engineer, discovered that the number one engine tachometer cannon plug was broken and there were exposed electrical wires. He also observed that the right-side cargo door was improperly installed.

The number one engine tachometer is located on the cockpit center instrument panel and the broken cannon plug to this gauge is only visible with significant effort. MCpl Lourenco's superior attention to detail clearly averted the potential for loss of vital number one engine performance information. He also found the right-side cargo door was improperly installed as a critical stopper in the sliding cargo door was placed 90 degrees opposite to the axis of a normal installation. When installed in accordance with

the Canadian Forces Technical Orders, this stopper serves to dampen sudden backward movement of a cargo door and prevents the door from completely departing the aircraft in flight.

MCpl Lourenco's outstanding attention to detail while performing a pre-flight inspection of the cockpit instruments and cargo door assembly clearly averted a serious occurrence. MCpl Lourenco's professional efforts make him deserving of this For Professionalism Award. 🦅



## Master Corporal Martin Léveillé ...Continued

tool is prevalent Forces wide, he quickly realized this was a wide-spread hazard and informed the Wing Flight Safety team. MCpl Léveillé's findings resulted in a Flight Safety Hazard Report and a Flight Safety *Flash* being raised to bring this incident to the attention of all aircraft maintenance operational units across the Royal Canadian Air Force, highlighting the potential FOD danger to all flying assets.

MCpl Léveillé's actions clearly demonstrated the importance of tool control and its implications with respect to flight safety, particularly to the impressionable aircraft maintenance technician students at CFSATE. His attention to detail and his initiative to investigate on his own showed a very high level of professionalism. In addition, MCpl Léveillé was involved in the follow up error

mitigation process which has resulted in changes to the tool control program at CFSATE and as such, he is truly deserving of this For Professionalism Award. 🦅

# For Professionalism

For commendable performance in flight safety

## Corporal Jeremy Pagé

**O**n 8 July 2014, while conducting a pre-flight inspection on a CH146 *Griffon* helicopter, Cpl Pagé, an Aviation Technician with 430 Tactical Helicopter Squadron, noticed an anomaly on the tail boom on the co-pilot's side of the aircraft. Knowing that the tail was constructed of composite materials, he conducted a tactile inspection of this part in addition to the visual inspection, as the latter would not have allowed him to identify any defects. Since this inspection went far beyond the periodic visual inspections, Cpl Pagé called on the services of an Aircraft Structures Technician, whose inspection revealed a partial delamination of an area measuring 30 by 45 centimetres on the tail boom. Cpl Pagé removed the helicopter from service to ensure that the delamination did not

reach the primary structure of the aircraft. If this delamination had continued without anyone noticing, a serious accident might have occurred.

The outstanding attention to detail displayed by Cpl Pagé during the inspection of an assembly that generally undergoes a pre-flight visual inspection was instrumental in preventing a potential catastrophic failure of the tail boom. Cpl Pagé is unquestionably deserving of the For Professionalism Award for his efforts. ✦



Photo: DND

## Corporal Pierre-Luc Tremblay

**O**n 23 January 2014, Cpl Tremblay, an aviation technician with 425 Tactical Fighter Squadron, was deployed on exercise CANNONBALL at Marine Corps Air Station Miramar in San Diego, California. While performing a post-flight inspection of the right-hand main landing gear of a CF188 *Hornet*, he observed a missing bolt on the door hinge.

Going beyond the requirements of the maintenance orders, he carried out an in-depth inspection of the door and discovered that one of the remaining bolts had broken in two. Cpl Tremblay immediately reported this unusual occurrence to the Flight Safety section of 1 Canadian Air Division. A non-destructive testing inspection was then initiated to determine the extent of the damage to the landing gear door. Stress-related

*Continued on next page*



Photo: LS Alex Roy



## Corporal Jocelyn Boudrias

**O**n 19 June 2014, Cpl Jocelyn Boudrias, an Air Traffic Controller trainee at 19 Wing Comox, observed a CH149 *Cormorant* helicopter on the far end of the same runway from which a commercial aircraft was about to takeoff. He instantly informed the primary Controller who immediately cancelled the commercial aircraft's takeoff clearance, just before they began their takeoff roll.

The *Cormorant* was conducting a training exercise and had requested the entire length of the runway to complete a simulated tail rotor malfunction, normally flown to not below ten feet above the runway. At the time, the traffic pattern in Comox was quite busy and tower was adjusting traffic flow to accommodate the *Cormorant*. The first attempt at the simulated tail rotor malfunction, for which the *Cormorant* had been cleared the option to land, was cut short due to commercial traffic. The *Cormorant* was then re-cleared into the circuit for another simulated tail rotor malfunction. There was a misunderstanding between the *Cormorant* and

the tower regarding whether or not the *Cormorant* had been cleared the option to land for this circuit. Following the second simulated tail rotor malfunction, the *Cormorant* landed at the departure end of the runway, un-noticed by the tower. The controller then proceeded to give a departure clearance to a commercial aircraft on the same runway.

Cpl Boudrias occupied the very busy and workload intensive Tower Data position. This position is administrative and generally personnel who are assigned to it are not trained to understand the complexities of Air Traffic Control (ATC). Despite Cpl Boudrias' lack of ATC training, his vigilance, situational awareness, quick thinking and rapid intervention were directly responsible in averting a serious incident. Had he not spoken up, a clear potential for a departure collision would have existed. Cpl Boudrias' exceptional diligence and decisive actions are commendable and fully deserving of this For Professionalism Award. 🦅



## Corporal Pierre-Luc Tremblay ...Continued

delamination and multiple cracks were identified. As a result of this inspection, the door had to be replaced and the damaged door was quarantined for further investigation.

Cpl Tremblay was instrumental in the undertaking of a local inspection on the nine remaining jets deployed on this exercise to determine if incorrect bolts had also been installed on these aircraft. A total of four aircraft were identified with the wrong hardware installed. Furthermore,

during the installation of the new door drawn from supply, he verified the attaching hardware supplied with the door assembly. The supplied bolts were also made up of the wrong material. These observations were relayed to the Life Cycle Material Manager who initiated a fleet-wide special inspection.

Cpl Tremblay's attention to detail averted the potential for a landing gear door departing in flight and causing damage to the aircraft.

He clearly displayed notable airmanship and is to be commended for his superior efforts by awarding him the For Professionalism Award. 🦅

# Maintenance IN FOCUS

## PARTS HANDLING – AIRWORTHINESS APPLICABLE?

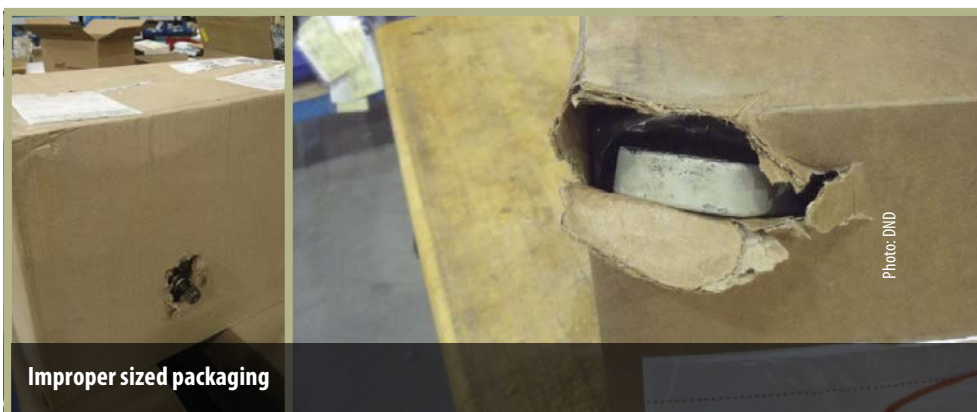
by WO James Gilmour, DGAEPM (TA&S) 6-4-3-4, DND Technical Inspector, Bell Helicopter Textron Canada

**A**s technicians, most of us have opened a container or package from the supply system only to discover a problem with the component or that some of the airworthiness paperwork missing. This of course raises red flags in our minds that this is not how it should be. The problem is normally brought to the attention of the supply tech or to our supervisor, depending on where you opened the box. Phone calls are made and emails are sent in order to try to rectify the problem before sending the part back. Hopefully, the solution is relatively simple and aircraft maintenance can continue. If not, then a replacement part is obtained.

When returning a part for repair, it would be expected that care is still given to the component. While the component may be unserviceable (U/S) due to a failure or it is time expired, we must ensure that it is still treated as an aircraft part. Proper handling of these components is crucial through all

aspects of aircraft maintenance. When receiving a part from supply, it will arrive in a proper container with adequate protection (bubble wrap, foam, etc.). The U/S component should be returned through supply in the same condition and preferably in the same container the replacement part arrived in. This will ensure that the component is well protected passing through the supply chain, until it arrives at contractor for repair.

Additional costs in repairing components damaged in shipping consume funds that would otherwise be utilized for overhauling other parts. Each fleet has a certain amount of funding for the fiscal year for Repair and Overhaul. Say for example, an engine oil filter costs \$1,000, the cost for overhaul would be a few hundred dollars, if you include the cost of shipping. If the filter was damaged







Incorrect packing of helicopter main rotor blade



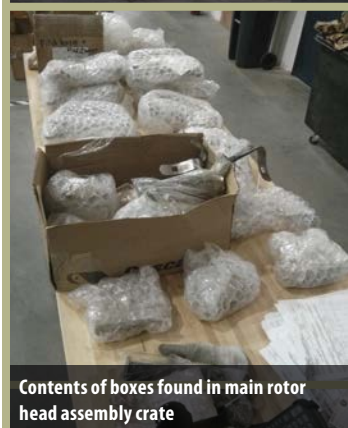
Correct packing of rotor blade



Condition tags missing



Section of firewall folded in half then placed in box



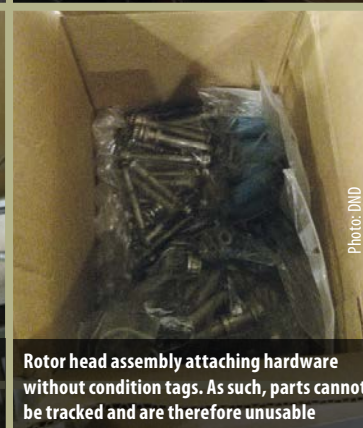
Contents of boxes found in main rotor head assembly crate



Helicopter rotor head assembly in crate with no condition tag, packed with other boxes



Electrical connection missing connector hardware in engine compressor section. Engine potentially contaminated with foreign object debris



Rotor head assembly attaching hardware without condition tags. As such, parts cannot be tracked and are therefore unusable

Photo: DND

beyond repair in shipping, it will now cost \$1,000 to purchase a replacement. Proper packaging would have prevented the damage and the component would be put back into service following overhaul. Cost saving would be roughly \$800, which would essentially pay for another four overhauls. While this may seem like a trivial amount, numerous components with additional damage will add up over the course of a year.

As fleets get older and technology changes, some components become more and more difficult to repair. The inner workings of a gauge for example, may not be repairable due to outdated technology.

*"While the component may be unserviceable (U/S) due to a failure or it is time expired, we must ensure that it is still treated as an aircraft part."*

The result is cannibalizing pieces from one component to repair another one. While not the best solution, this procedure allows us to keep spare parts in the system. If parts are damaged during shipping, we could lose the ability to salvage these parts.

Senior technicians have a responsibility to teach the new technicians on all aspects of aircraft maintenance, including parts return. The procedure for returning a part ensures that all appropriate airworthiness and supply documentation is kept with the component. Protecting it so that it survives the shipping process should be everyone's responsibility. While each fleet has AF9000 processes to be followed with regards to parts handling, experience and knowledge is still the ultimate teaching tool. Pass on your knowledge. 🛩️



## PART 2

# Canada's Aviation Medicine Pioneers

By Lydia Dotto

Reproduced and modified with permission from the Canadian Space Agency

### Pressure Suits

The G-suit dealt with only one of the physiological challenges faced by pilots flying high-performance aircraft. As planes flew higher and higher, crews also had to be protected against the drop in atmospheric pressure with altitude. Early military aircraft were not pressurized at all and were limited in how high they could fly without endangering the crew. Aircraft that were pressurized to maintain a safe level of internal pressure could fly much higher—but crews were still at risk if there was a sudden loss of pressure (known as explosive decompression) or when bailing out at high altitudes.

There are two kinds of pressure suits: partial pressure suits and full pressure suits. The former do not cover the entire body and contain inflatable tubes that apply pressure to the chest area, as well as the arms and legs. Above about 50,000 feet, pilots require a completely sealed full-body pressure suit equipped with an oxygen breathing system. These suits protect against several physiological risks associated with high-altitude flying, including:

- Hypoxia: a decrease of oxygen in the blood caused by reduced atmospheric pressure. Hypoxia can affect vision, cause dizziness and reduce muscle coordination. Without an oxygen supply, pilots can lose consciousness in less than a minute after exposure to low pressures at high altitudes.
- Decompression sickness, also known as “the bends”: joint pain caused by nitrogen bubbling out the blood and tissues as a result of a rapid decrease in atmospheric pressure. Severe cases can result in death.
- Armstrong’s line: the altitude (roughly 60,000 feet) at which water goes from a liquid to a gas (i.e. boils) at body temperature. Exposure above this altitude can cause unconsciousness and death in seconds.

In the 1950s, after graduating from the University of Western Ontario with a degree in math and physics, Roy Stubbs worked on developing pressure suits for pilots who would be flying new Canadian fighter aircraft such as the Avro CF-100 *Canuck* and the soon-to-be-



A photo of some of the early models of the pressure suit





infamous Avro *Arrow*, which were then in development. These aircraft did not require the use of full pressure suits because they were used for fairly short-duration missions, unlike bombers that flew missions lasting many hours. What was required, said Stubbs, were “get-you-down suits” that could protect the pilot in the event of an explosive decompression while he brought the plane to a lower altitude. “Fighter or interceptor aircraft usually operated near base, unlike the bombers, so the suits got you down from altitude safely to return home if cabin pressure was lost,” Stubbs said. (Bombers, which ranged much further afield, couldn’t simply descend a safer altitude because this would increase fuel consumption, making it more difficult to get home.)

In the fighters, it was sufficient to wear a pressure vest and anti-G suit that could be inflated differentially if the aircraft lost pressure or created G forces. To accomplish this, Stubbs developed a pressure-gravity valve that was fitted to the pressure vest and went down to the G-suit. If the pilot experienced G forces, only the G-suit inflated. If cabin pressure was lost, both the G-suit and the pressure vest were inflated and a pressure oxygen mask was activated.

Stubbs said the development of the partial pressure suit was one important reason why the design of the Franks G-suit was switched from water to air. Both would be needed for the *Arrow*, which was being developed at the time. The scientists at the Institute of Aviation Medicine (IAM) and its successor organizations “were very much involved in developing equipment for it. We fitted out the test pilots with these suit systems so when they flew the *Arrow*, they had protection.”

Since both the G-suit and the pressure vest were made of rubber, aircrew wearing the suits ran the risk of suffering heat stress in flight. “The body loses a lot of heat by evaporative cooling. If you put on an impermeable suit, you can’t lose heat by the evaporation of moisture,” said Douglas Soper, who worked on the design and testing of a ventilation system for the suit.

The overheating resulted not only from the pilot’s metabolism and exertions but also from aerodynamic heating of the skin of the aircraft, which was radiated into the cabin. (Astronauts inside the space shuttle face a similar phenomenon during re-entry into the earth’s atmosphere, which is why the shuttle is coated underneath with heat-resistant tiles.)

One of the options for ventilating the suits was to create a garment threaded with small tubes filled with cooling water, a design that is employed today in the suits used by astronauts for spacewalks. However, in Soper’s day, they decided this was too complicated and instead developed a system that drew air from the aircraft’s air conditioning system. This resulted in a tug-of-war with the engineers responsible for the *Arrow*’s cooling system.

The *Arrow* “was a very demanding aircraft in many ways,” said Soper. “We hadn’t got to the sophisticated electronics we have today; we had the old-fashioned radio tubes. They not only used a lot of electricity, they produced a lot of heat. Every time I thought I had enough AC [for ventilating the suit], the electronic engineers would have to have some more cooling for the electronics bay and they would take it away from the cockpit and its occupants. It became quite a back-and-forth struggle.”

After testing the ventilated suit in a wooden mock-up of the aircraft using heat lamps to simulate high-heat conditions, Soper was ready to try it in the *Arrow* itself. The test never happened. “I was supposed to fly in the *Arrow* the day it was cancelled,” he said.

Like everyone else associated with the project, he was shocked and disappointed by the news. However, he didn’t have much time to brood about it because he was scheduled to go to the Royal Air Force Institute of Aviation Medicine in Farnborough, England, to continue work on air-cooled garments. “The British were very interested in what we had been doing with the *Arrow* and they picked my brain. They were building the TRS-2, a big fighter aircraft that had a lot of similar features. They were particularly interested in the design of our cockpit AC outlets because if large quantities of air are blown out of an orifice, a very noisy whistling condition results which they were having trouble solving.”

In 1959, Soper went to Farnborough, where he spent more than two years engaged in several research projects. His interest in how the body loses heat led him into some interesting adventures. For example, he studied professional fishmongers who worked on the docks cutting up cod fish off the fishing ships. The fish were kept in ice to preserve them and the fishmongers were continually plunging their hands into icy seawater. “They were very skilled men. They were filleting the fish with razor sharp knives—it was like skilled surgery with ice-cold hands. They were so cold that if they missed with the knife and cut their hands, they wouldn’t even know it until they saw them bleeding. I wondered, how could they do this?”

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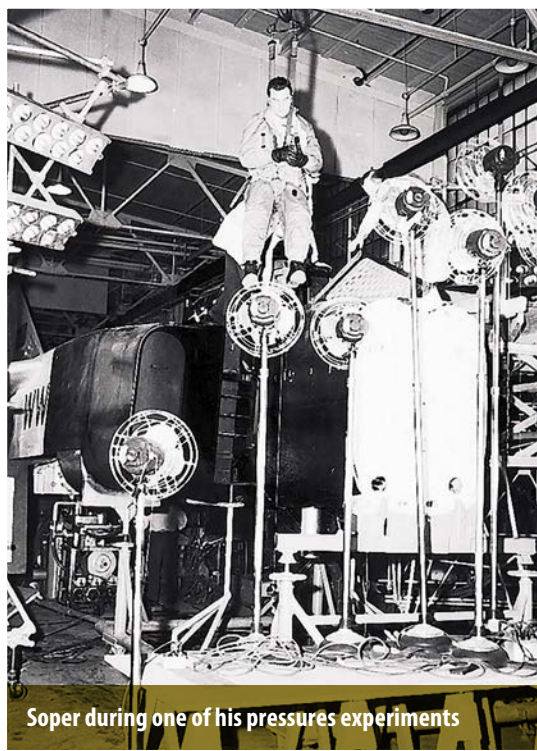
Many people tried the job because it paid well, but most gave it up in short order because they couldn't stand the cold. "Some could only stand it once, some for a week. But some of them could do it all the time," said Soper. "They were a unique set of people that had unique blood flow through the hands."

At the other end of the temperature scale, Soper subjected himself to sweltering conditions to gain insight into the mechanisms of body heat loss and the conditions that induce heat stress. "We were trying to understand what goes on in a cockpit when people get overheated," he said. "Heat stress can be fatal very quickly." He recalled an incident in which two U.S. pilots were flying long distances over tropical waters wearing rubber suits to protect them if they went down at sea. "One guy got into real trouble from heat stress. He was flying so erratically at the end that it was obvious he was going to crash. You could hear the two pilots on the intercom, hollering, pull up, pull up. Too late, too late."

In extreme heat conditions, Soper said, "you reach a point where you can't lose heat, you can only gain heat. You can't lose heat from conduction or convection if the air around you is hotter; you can't lose heat by evaporative cooling if the air is saturated."

That's exactly the state he found himself in during tests at Farnborough. He lay on a bed on top of a large balance arm inside a compartment that he described as "a big tin can." The temperature and humidity were maintained at a level that made it impossible for his body to lose heat. The subject had to remain motionless during the heat exposure so that the beam balance could measure the amount of sweat that dripped off his body. The exposures were about one hour long.

This system allowed his body temperature to continue climbing into an artificial fever situation. "You would get very hot," he said. In fact, he sometimes went into convulsions due to hyperventilation. The people who were monitoring the experiment couldn't see him inside the tin can, but they were alerted to the convulsions when the balance arm on which the bed was resting started to shake. "They'd put my head in a paper bag so that I could re-breathe my own respiratory carbon dioxide and in a couple of minutes the convulsions from the hyperventilation would stop."



Soper during one of his pressures experiments

For relief, he would sometimes slip outside the building into the cool morning air. "I was stark naked and I would go out and lean against the wall—it was the quickest way to cool off. One day, I was leaning against the wall with my eyes closed when I heard a female voice saying, 'Good morning, Flight Lieutenant.' I don't think I was even interested in replying, I was so hot."

Between 1954 and 1956, Roy Stubbs also worked at Farnborough on the development of full-body pressure suits. These suits were not being developed in Canada at the time because Canada was not flying long-range bombers on which they would be needed. Some of the bombers could fly above 50,000 feet and the flights could last for many hours, so the crews needed protection from getting the bends in the event of cabin depressurization. "The bomber crews were normally far from base, so they had to stay at altitude to have enough range to continue on the mission, or to get home if cabin pressure failed," Stubbs said.

The British were flying bombers, so Stubbs was seconded to Farnborough to help develop a full pressure suit there. As its name suggests, and unlike the partial pressure suit, the full pressure suit covers the entire body, including the hands and feet, and also requires the use of a pressure helmet. The entire unit must be completely sealed.

One of the things Stubbs examined was the suit's comfort factor. "We had done testing in altitude chambers, so we knew the suit would protect us. What we had to find out was whether it was a practical thing to wear. Could you fly in it? Was it too cumbersome?"

Like Soper, he was also interested in heat stress. Wearing the suit was like wearing a rubber glove all over the body and it could be "pretty miserable," he said. It had to be ventilated even while the aircrew was walking to board the plane.

Particularly concerned about the use of the suit in tropical climates, Stubbs and his colleagues tested it in a bomber flying out of Khartoum, Sudan. It was so hot that the plane couldn't take off during the day because its jet engines needed cooler air; in fact, it could barely taxi.





Stubbs noted that these tests demonstrated that ventilation suits were needed even on the ground, as temperatures could reach nearly 60°C. He added that the plane was always welcomed by ground crews at the bases it visited because, after flying at 52,000 feet, it was nicely chilled. "They wanted to climb inside a cold airplane, so we got great treatment."

Another result of the tests, he said, was the realization that "more development work was necessary to improve our full pressure helmets."

## Helmet and Oxygen Masks

Pressure suits were of little use without proper helmets and oxygen masks and the Institute of Aviation Medicine (IAM) scientists invested a lot of effort in improving both. As head of the Flying Personnel Medical Establishment, Roy Stubbs felt there was an urgent need for a new helmet design that would protect aircrew during ejections from high-speed aircraft. One of the major goals was to design a helmet and mask that would stay on the pilot's head during an ejection or a crash. "The crash hats we were using would not stay on your head when you crashed—they were always coming off," said Soper, who headed the team that tested the new design from 1961 to 1967 after returning from Farnborough.

The helmets were also vulnerable to being whipped off by the plane's slipstream when a crewmember ejected. When that happened, he also lost his oxygen mask and communications system. Stubbs developed on a new helmet design that would ensure the pilot would keep the oxygen mask during the ejection process. "We had to design it as a two-piece unit and that had never been done before. You put it on as a one-piece unit, but if the wind force was too high, the outer shell would just break off. It disconnected, but left the mask on." He took the idea to Gentex, a company that was the top

helmet maker in the United States at the time, and they built a model that was put through extensive trials at IAM.

Stubbs devised a way to test the helmet designs for slipstream tolerance in the decompression chamber—although not with human subjects this time. ("There were limits," said Douglas Soper.) The window of the chamber was removed and replaced with a stovepipe that acted as an air funnel. Then a dummy's head wearing the helmet being tested was placed in front of the stovepipe. With just a thin piece of craft paper covering the stovepipe hole, the pressure in the chamber was reduced to the desired altitude. "When you cut the paper, the air would rush in with an instantaneous pulse," said Soper.

This work resulted in the development of "the first helmet that would stay on your head in an accident," he said. It was used by the Royal Canadian Air Force for many years.

Of course, the oxygen systems associated with the helmets were also critically important. In his CAHS paper, Peter Allen notes that "in 1939, the oxygen masks used by the British, American and Canadian air services were sadly inadequate. They were extremely wasteful of oxygen and many a mission had to be completed after the



An early model of an oxygen mask to be used with a pressure suit

*Continued on next page*



supply had been used up.” He said that Canadian-developed pressure vests and oxygen masks allowed Allied pilots to fly 2,000 to 5,000 feet higher than enemy pilots. “This was a closely guarded secret which the enemy did not know about until after the war.” An “ingenious” valve in the oxygen mask that assisted pilots in breathing out against the mask’s pressure allowed “our reconnaissance aircraft to operate above the ceiling of enemy fighters, enabling them to perform essential tactical photography while escaping unscathed.” Researchers at the Clinical Investigation Unit (CIU) were also the first to develop an oxygen mask that did not freeze up at high altitudes. The freezing problem, which often blocked the oxygen supply, resulted from the freezing of moisture in the pilot’s exhaled air. These masks were used by Royal Canadian Air Force pilots during the war and its innovations were later used in masks developed for British and American pilots.

While at Farnborough, Soper helped to evaluate a new, more sophisticated pressure-breathing helmet being designed by a British company. Positive pressure breathing masks deliver oxygen to the pilot’s respiratory system at higher than ambient pressure—they literally force air into the lungs. They’re needed to maintain consciousness in the event of a cabin depressurization at altitudes above about 35,000 feet.

Positive pressure systems are not comfortable; they blow out the chest and lungs and make breathing quite difficult because the user has to breathe out forcefully. “Above 45,000 feet, the face is puffed up like a frog because of the pressure of the oxygen mask,” said Charles Bryan. The pressure can also cause blood to pool in the lower body, requiring counter pressure from a pressure suit.

The standard oxygen mask used at the time, known as the Pate suspension mask, was not adequate to deliver oxygen under pressure, said Soper. It had straps strung through rollers that were used to pull the mask tight to the face but they did not provide a strong enough seal for positive pressure breathing. “Even when you turned up the tension to counter the oxygen pressure, you got a lot of leaking.” The new British helmet, on the other hand, “had a visor built into it and you could get a lot of pressure built up with this thing.”

The reason Canada was interested in this helmet was—again—the *Arrow*, which could fly up to about 60,000 feet. “When the *Arrow* was cancelled and we didn’t have an aircraft that would go that high, we went back to the Pate,” said Soper. “We didn’t need the other one.”

Around this time, however, the issue of oxygen supply at high altitudes was beginning to extend beyond the military. “Big passenger jets were being built and they would fly at 40,000 feet so they had to be pressurized,” said Bryan, who was assigned to investigate how long it took for passengers and the flight crew to get oxygen masks on. “That meant trying to figure out how long they would stay conscious.”

Bryan and another officer, Wilson (Bill) Leach, devised a series of tests in a decompression chamber that involved taking test subjects from the pressure at 8,000 feet to the much lower pressure at 40,000 feet in a matter of seconds. This is known as explosive decompression—the kind of thing that can happen if a plane’s hatches or windows blow open or if the sealed cabin is breached in some other way. The tests were risky. “When decompression occurred, there was a terrific rush of gas from the lungs,” said Bryan. “If you happened to have your throat closed, if

you were swallowing at that point, your lungs could burst. We always made a point of making sure the mouth was open at the time we pulled the plug.”

Typically, Bryan and Leach were their own guinea pigs. “If you’re going to do experimental work, you should do it first on yourself,” Bryan said. “My work was to sit in the chamber at 8,000 feet and get blasted to 40,000 feet.” He added wryly: “I had to persuade several of my friends to do the same thing—that’s why I have so few friends.”

Soper served as a test subject for some of these experiments and he had an unexpected and rather frightening experience as a result. Subjects undergoing explosive decompression experienced hypoxia “which we thought cleared up as soon as you received oxygen and returned to a lower altitude,” Soper said. “On one occasion, I found that after the initial effects, there could be a lingering, more lasting effect of which we were not aware.”

The experiment was conducted in a decompression chamber at a lab in Downsview and afterwards, Soper got into his car to drive back to his office at the original IAM site on Avenue Road near downtown Toronto. “I have absolutely no recollection of leaving Downsview or of the drive itself until I found myself in central Toronto near College and Bay Streets, having overshot my destination by several miles. When I realized where I was, I pulled into a parking space to try and sort things out. It was very frightening. Not only could I not figure out why I was there but I realized that I had no memories of what had happened. So, puzzled about the events, I drove back to the Avenue Road site. It was noon when I got there and my colleagues were in the bar. I told them what had happened and there was





a lot of laughter and teasing about my forgetfulness. Nobody took my amnesia seriously until [Bryan] had a related experience a short time later.

"When Dr. Franks heard about these events, he was horrified and said that these hypoxic experiences were costing us grey cells. As a result, guidelines and restrictions were imposed on what sort of experimental work we could carry out in the future. It still frightens me when I think about that drive through Toronto traffic, of which I have no memories at all. How lucky not to have been involved in an accident!"

The tests in the decompression chamber revealed that passengers who experienced a sudden loss of cabin pressure had about 15 seconds to get their masks in place. The situation is made more urgent by the fact that passenger jets, unlike military aircraft, can't dive rapidly to a lower altitude where it would be possible to breathe without a mask. They must descend more slowly and at a much shallower angle or risk serious structural damage. "We've had airliners go into a sharp descent because of malfunctions," said Bryan. "In one case, the pullout was so drastic, the engine fell off."

When they did tests to see if passengers could survive without oxygen during a typical slow descent in a commercial airliner, "we had to abort every time," Bryan said. "With the shallow descent, it took a long time to get to a breathable atmosphere. At the rate of descent that the plane could stand, we'd get serious brain damage—even young, fit people couldn't get enough oxygen."

He noted, however, that modern airliners are designed with a scoop in front that forces air into the aircraft as it descends, providing some pressurization. Therefore, an explosive decompression may not drop the cabin pressure as low as that at 40,000 feet. A pressure level

closer to about 25,000 feet would be more typical and "that gives you a minute or so" to get on an oxygen mask, he said. "Although there have been rapid decompressions [in commercial airliners], there have been very few of a catastrophic nature."

A film of the decompression chamber tests was distributed to the Canadian airlines and their pilots, providing graphic evidence of what could happen in an explosive decompression. The IAM scientists also trained airline pilots and their research led directly to the development of the drop-down oxygen masks that are now used in commercial planes. Unlike the more sophisticated pilot's masks, the passenger masks are round so that people who have never seen one before and are trying to put it on under stressful conditions "don't have to figure out what was up and what was down," said Bryan.

In 1960, Leach (who later became Surgeon General of the Canadian Forces) received the coveted McKee Trophy, which was awarded each year for "meritorious services in advancement of Canadian aviation." The report of this award particularly emphasized Leach's specialized work on the effects of anoxia and explosive decompression and its applicability to the new generation of military and civilian jet aircraft. "The results of this research have received national and international acclaim and have provided a base for further research in many countries. His work has also resulted in improved airline and military crew training techniques and the design of new oxygen equipment.

"During his research work, Leach continually exposed himself to explosive decompression and periods of anoxia at high atmospheric altitudes despite the fact that no observations had ever been made which recorded the effects of such exposure. The personal courage he displayed in

the pursuit of his research was beyond the call of duty and has resulted in greater safety for people the world over who fly in high altitude aircraft." ✈

*In the next issue: The article will conclude with the development of early ejection seat designs and combating physiological illnesses in flight.*

# ON TRACK

## Alert or Bust?

This article is the next instalment of a continuous *Flight Comment* contribution from the Royal Canadian Air Force (RCAF) Instrument Check Pilot (ICP) School. With each “On Track” article, an ICP School instructor will reply to a question that the school received from students or from other aviation professionals in the RCAF. If you would like your question featured in a future “On Track” article, please contact the ICP School at: +AF\_StdS\_APF@AFStdS@Winnipeg.

This article was written by Captain Greg Boyd, ICP Instructor. It will address some recent RCAF incidents while flying in the far north.



CFS Alert is according to Wikipedia the northernmost permanently inhabited place in the world. The airport is not surprisingly the most northern permanent runway in the world. The Russians build an ice runway and camp very near the North Pole each year but they have yet to figure out how to keep it from melting in the summer. I suspect that their communication procedures are less confusing than ours though.

Alert airport (ICAO: CYLT) is a highly controlled, uncontrolled airfield. Despite the prevalence of radio communications used by the various ground agencies, the uncontrolled air traffic frequency airfield is surrounded by Class G uncontrolled airspace in the Edmonton Flight Information Region (FIR). This uncontrolled airspace (ICAO: CZEG), extends in the vertical to the Arctic Control Area floor of Flight Level (FL) 270 controlled by Edmonton Area Control Centre (ACC). In the horizontal, this airspace extends far to the North, West and South but is relatively close to the neighbouring FIR boundary of Sondrestrom (ICAO: BGGL). Sondrestrom is uncontrolled airspace from the surface to FL195 with the exception of areas surrounding the largest Greenlandic airports. Above FL195, Reykjavik Oceanic Area Control Centre (OACC) controls the airspace.

The Reykjavik OACC (ICAO: BIRD) deconflict their airspace through the call sign “Iceland Radio.” This airspace is always controlled.

So where am I going with all this? IFR 101: IFR flight in controlled airspace requires an IFR clearance!

RCAF flight crews are well aware of this fact. However, in busy operations and competing priority-one tasks, sometimes common practice is forgotten or missed. There have been several Civil Aviation Daily Occurrence Reporting System (CADORS) events recently that were the impetus for this article. Just recently, a four-engine turbo-prop cargo aircraft that descended out of controlled airspace (or climbed into controlled airspace) near Alert violated the Air Traffic Control/aircrew contract that guarantees IFR traffic separation.

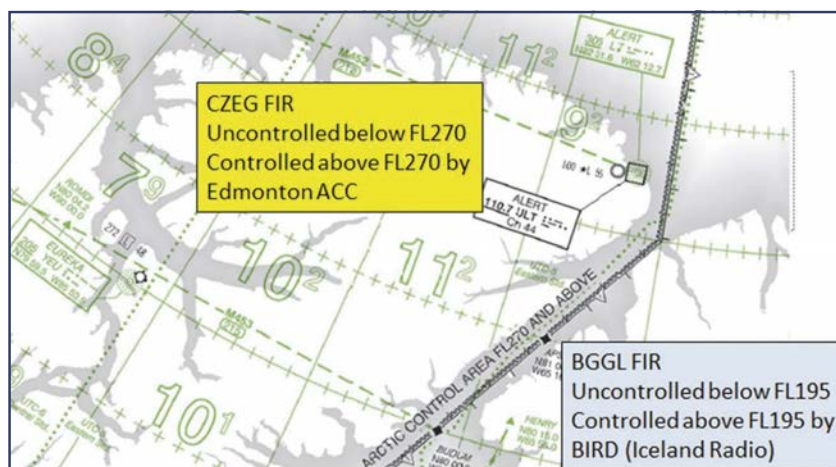
There are exactly two scenarios for getting to CYLT IFR, even if coming from Russia. Scenario one is primarily domestic with significant flight time in CZEG prior to descent. Scenario two transits the international airspace of BGGL (could be from southern Canada or departure out of Thule AB, Greenland for example) and will spend minimal time in CZEG. Each of these can be divided into a





further two scenarios: cruise in controlled airspace with a late descent into uncontrolled airspace and cruise in uncontrolled airspace (table 1).

Ok, having safely and legally arrived in CYLT, how do we get out? Specifically, how do we get a clearance to enter controlled airspace? For flight into BGGL FIR above FL195, Article 431 of the General Planning Handbook provides phone numbers to Reykjavik OACC. A valid clearance with a “void time if not airborne by” can be issued for both CZEG and BGGL with this one call. For flight solely in CZEG it is easiest to remain below FL270 and get a clearance airborne via Arctic Radio (HF 5680). If fuel does not permit a restricted climb profile, the North Bay FIC through 1-866-WXBRIEF will liaise with Edmonton for the clearance. Do not simply takeoff from CYLT and climb to FL350 because it was on your flight plan!



The advisory traffic calls on 126.7 MHz are required by RCAF pilots and will definitely affect grading on training trips and assessments on check rides. However, without a resulting safety incident, the Division Instrument Check Pilot is unlikely to hear about these errors. The omission of a required call to an ACC will

definitely be noticed and most likely result in a CADORS entry that affects all of us with wings on our chest. More importantly, it is unsafe. While the Russians continue to rebuild their ice runway, let's trap this error and always get clearance in controlled airspace. 📡

<b>CZEG only Cruise</b>	<b>Below FL270</b>	<b>FL270+</b>
Call Edmonton centre for descent	Not applicable	<b>Shall</b>
Advise “Alert traffic” on 126.7 MHz of descent and approach	<b>Shall</b>	<b>Shall</b>
<b>BGGL Cruise with only descent in CZEG</b>	<b>Below FL195</b>	<b>FL195+</b>
Call Iceland radio for descent (Sondrestrom below FL195)	Not applicable	<b>Shall</b>
Advise “Alert traffic” on 126.7 MHz of descent and approach	<b>Shall</b>	<b>Shall</b>

Table 1

# Risk UNDERSTANDING & MANAGEMENT in the establishment of a new capability

by Lieutenant-Colonel C.A. McKenna, Commanding Officer, 450 Tactical Helicopter Squadron

In May of 2012, 450 Tactical Helicopter Squadron (THS) was reactivated in Petawawa, Ontario receiving its first state-of-the-art CH147F *Chinook* Helicopter on 24 June 2013. The re-establishment of the *Chinook* Medium-to-Heavy lift helicopter in the Royal Canadian Air Force (RCAF) represents a transformational capability for Canada and the RCAF. In the same manner that the introduction of the CC177 *Globemaster* represented a significant step-change in the RCAF's ability to strategically project and sustain forces, the CH147F *Chinook* represents a transformational change in the RCAF's ability to tactically project and sustain land and special operations forces in the modern full spectrum battlespace.

While the aircraft is seemingly infinitely capable, it is important to realize that the establishment of this capability for the RCAF is vested solely in our people - the maintainers, supporters, and aircrew that maintain, support, and fly this aircraft every day. In this light, the aircraft is a tool and the people truly represent the established capability. With this in mind, the stand-up of such a capability is a fundamentally human activity that depends heavily on leadership, trusting interpersonal relationships within the squadron, integrity at all levels, and initiative. Further, it is essential to maintain clear understanding at all levels of the risks

inherent with developing and executing a new maintenance program, new aircrew procedures, the introduction of a high level of automation in a fully glass cockpit, and the establishment of a far higher level of industry/ contractor dependence than tactical aviation has ever previously experienced. While the challenges are many, a collective understanding and constant communication of these risks and an open dialogue on these challenges down to the lowest level remains the greatest hedge against flight safety incidents and accidents within the fleet.

The risks associated with such a complex project fall into several key categories: organizational (achieving Initial Operational Capability/ Full Operational Capability timelines and manning), technical (errors or inconsistencies in publications such as the Interactive Electronic Technical Publication, Standard Manoeuvre Manual, or Original Equipment Manufacturer documentation), general safety (building design/ end use, fall restraint, new Aircraft Maintenance Support Equipment [AMSE]/ tooling, etc.), procedural (risks associated with the development and implementation of new flying procedures and automation), and what could be characterized as emotional/ morale risk (complacency associated with aircrew and maintainers



waiting long periods at the unit prior to their qualification). Alone these risks are not insurmountable, however, when aggregated they present a significant leadership and flight safety challenge for squadron and wing Command teams.

## Culture and the RCAF melting pot

There are myriad challenges associated with the stand-up of a new unit and a new capability; however, the most challenging aspect in this effort has been the

establishment of a healthy safety and reporting culture within the unit. This is made more difficult with the fact while the aircrew came primarily from within the tactical aviation community, the maintainers and supporters came to 450 THS from virtually every single squadron and wing in the RCAF. We have discovered that each RCAF wing has a unique maintenance culture and personality with a subtly different understanding and interpretation of flight safety and maintenance policies. This represents a significant leadership challenge for the senior Non-Commissioned and junior officers in the maintenance and logistic support sub-units at 450 THS who need to create understanding and communicate daily across the barriers and biases that are inherent with this culture of amalgamation.

While this could be viewed as a significant challenge and a primarily negative issue, I would argue the opposite. The introduction into the strong and vibrant 1 Wing 'Air Warrior' culture of fresh perspectives from elsewhere in the RCAF has had the effect of forcing leaders and aviators within the unit to adapt their leadership styles, question why we have done things a certain way, and in many cases adopt best practices from other fleets, squadrons and wings. The key to achieving RCAF cross-cultural integration at 450 THS has been an open mind and a willingness to listen and adapt to new ideas. In doing so, I believe we have built a strong and flexible maintenance and support organization. The 1 Wing leadership mantra of making sure our aviators are "well-trained, well-led, and well-equipped" is complemented by ensuring a flexibility of mind and a willingness to listen when approaching all of these emerging issues and challenges.

### **Risk acceptance/understanding**

In most long-established RCAF units, change is focused in a measured way within small pockets of the unit as we collectively deal with shifts in personnel or maintenance policy, flying orders, or mission sets. These changes are usually handled by unit leadership in a deliberate manner and the risks are small, quantifiable, and well understood with the majority of the unit remaining stable. When establishing a new unit and new fleet, change is constant, accelerating and aggregating on a daily basis. While this is exciting and challenging, the aggregation or accumulation of risk associated with this pace of change is often very difficult to quantify and the management and mitigation becomes a leadership function vested in leaders at all levels of the unit and extending well into the Weapons Systems Manager (WSM), wing and divisional support staff.

While there are mature and robust methods to deal with risk acceptance in the RCAF such as Record of Airworthiness Risk Management in the Operational Airworthiness (OA) context and Mission Acceptance—Launch Authorization in the tactical employment context, they cannot cover every eventuality faced by a unit processing this much change on a daily basis. My leadership team spends a great deal of time and energy discussing and managing the aggregated risk at 450 THS. A key example of this is that our maintenance procedures are often found to be incomplete, needing clarification and immediate re-drafting by the OEM with Director Technical Airworthiness and OA approval. This is compounded with the *Chinook* being one of the first operational Defence Resource Management Information System fleets making maintenance

record keeping and Aircraft Maintenance Control and Repair Office errors or omissions the leading cause of unit flight safety incidents to date. While this is incredibly frustrating for our maintenance and support teams, they continue to impress me with their ability to pragmatically identify issues, propose viable solutions, get buy in from the Squadron Air Maintenance Engineering Officer/WSM and OEM staff and get on with safely putting aircraft on the line. In my view, this is 'Warrior Spirit' at its best, pushing through adversity to achieve a collective goal, all the while balancing safety and ensuring that smart risk is accepted and communicated to the appropriate level.

***"There are myriad challenges associated with the stand-up of a new unit and a new capability; however, the most challenging aspect in this effort has been the establishment of a healthy safety and reporting culture within the unit."***

### **Industry partnership and culture**

450 THS is unique in 1 Wing in that we have in place a 20 year in-service support contract with Boeing to support the *Chinook* both at the main operating base and while deployed domestically or internationally. While all maintenance activity is conducted by RCAF technicians supported by Boeing Field Service Representatives, the entire supply chain for the aircraft in addition to tool control and

*Continued on next page*



# DOSSIER

AMSE is supplied, calibrated, and maintained by Boeing and their sub-contractors. Similarly, aircrew training and courseware delivery is supported within the unit by Canadian Aviation Electronics (CAE) in a unique military/civilian partnership that sees aircrew being instructed by a mix of civilian and military instructors. While there are great benefits to these enduring industry partnerships, it is important to note that the corporate cultures of these companies are now fully intertwined with those of the RCAF and need to be considered and integrated from a flight

safety perspective. Thankfully, we have open and constant dialogue with both of these organizations that have allowed us to ensure that the extant Flight Safety culture of the unit is espoused and integrated.

Ultimately, this capability will not stand up or succeed due to the advanced technology nested in this incredible new helicopter. It will succeed and deliver transformational tactical aviation effects for our land and special operations forces due to the determination, professionalism, and risk awareness of our

technicians, supporters, and aviators that are at the centre of this capability. Their abilities trust, and freedom to apply their experience and judgement to challenges with the support and encouragement of their leadership is at the very core of what makes the RCAF a learning organization, capable of managing and mitigating risk in programs such as this. I am amazed and made incredibly proud by the resilience and professionalism of the 1 Wing "Air Warriors" at 450 THS every single day.

By Air to Battle! ✦



Photo: Corporal Nicolas Tremblay



Photo: Mgt Roy MacLellan

## USE IT *or* LOSE IT

Without practice, pilots find that some flying skills — especially cognitive skills — grow weak.

by Linda Werfelman

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*AeroSafety World Magazine*.

**E**xtensive use of automated cockpit systems causes pilots to lose proficiency in some cognitive skills required for manually flying an airplane—such as keeping track of aircraft position without using a map display—although other skills remain relatively intact over a long period of time, a new study says.

The study, led by Stephen M. Casner of the U.S. National Aeronautics and Space Administration (NASA) Ames Research Center, found that pilots' instrument scanning skills

and manual control skills remained strong, even among pilots who said they practiced them infrequently.

Casner and his research team based their conclusions on results obtained when 16 airline pilots flew routine and non-routine flight scenarios in a Boeing 747-400 simulator. The researchers varied the level of automation in use, graded the pilots' performance and asked questions about their thoughts during the simulator sessions.

A companion study, conducted during the same simulator sessions (*AeroSafety World* 7-8/14, p. 26), found that, although cockpit

automation systems were designed to give pilots more time to think about and plan for upcoming portions of the flight, instead, during uneventful periods, their minds sometimes wandered.<sup>1</sup>

The report on the new study, published in the December 2014 issue of *Human Factors*, noted that a research report published in 1971 said that pilots had varying degrees of success in remembering different types of skills.<sup>2</sup>

*Continued on next page*



"The researchers found that when [hand-eye skills such as those used to scan instruments and manipulate flight controls] were initially well learned, they were surprisingly resistant to forgetting, even after four months of inactivity," the 2014 report said. "Another type of skill considered in the study is the set of cognitive skills needed to recall procedural steps, keep track of which steps have been completed and which steps remain, visualize the position of the aircraft, perform mental calculations and recognize abnormal situations. Like researchers before them, [this team] found that after four months of inactivity, pilots' cognitive skills had significantly deteriorated.

The 1971 research was used at the time as guidance for regulators responsible for setting minimum recent experience requirements for pilots, the new report said.

"The wisdom provided by this early research is evident in the regulations we have today," the report said. "Pilots can wait almost two years without flying and still operate under visual flight rules (with no passengers aboard). If they want to exercise the privileges of operating under the more cognitively demanding instrument flight rules, six months of inactivity is the limit."

Today, the report added, concern about deteriorating pilot skills centers on inactivity associated with the increasing use of cockpit automation to do everything from performing fuel calculations and tracking the aircraft's position to reconfiguring navigation equipment and monitoring and identifying instrument system failures.

Nevertheless, cockpit procedures have retained methods intended to prevent a lack of use from leading to a deterioration of pilots' manual flying skills, by closely monitoring the work

performed by automated systems and occasionally shutting off those systems to practice manual flying skills.

To determine how effectively these methods help pilots retain their manual skills, the researchers asked seven captains and nine first officers, all of whom worked for U.S. air carriers, to participate in the 747-400 simulator study. The pilots had an average of 17,844 flight hours, including an average of 623 hours in the 12 months before the simulator evaluation and 13 hours during the previous week. Participating pilots said that they had accumulated 73 percent of their total flight hours in airplanes equipped with a flight management computer (FMC) and 89 percent of their time in airplanes with flight directors.

## Hand-Eye Skills

To enable the researchers to evaluate the pilots' hand-eye skills—their instrument scanning abilities and their manual control of the airplane—the pilots flew routes that had been programmed into the simulator's FMC with three different combinations of automation.

The autoflight phase involved use of the autopilot, flight director and autothrottle to follow the route programmed into the FMC. The manual control phase involved use of the flight director and autothrottle system along with manual manipulation of the control yoke "in response to flight director commands that directed them along the FMC-programmed route," the report said. In the raw data and manual control phase, pilots followed the same route while manipulating the control yoke, controlling thrust levels and relying on primary flight instruments for information.

"We asked each pilot to fly during three phases of flight (i.e., arrival, approach and missed approach) in the three automation conditions," the report said. "To save time, we did not ask pilots to fly all three flight phases using the autopilot, as we did not expect to see much variation in pilots' performance across the three flight phases when the autopilot was used."

Researchers scored the pilots on their ability to comply with course, altitude and speed assignments on the route.

In their responses to a research survey, the participating pilots said that they had "strong background in basic instrument flying, moderate recent experience in flying without an autopilot and very little recent experience flying with both the autopilot and flight director turned off," the report said.

Table 1 shows how pilots performed—and how many times they committed significant<sup>3</sup> deviations from speed, altitude or course—in the three different automation conditions and three phases of flight.

The researchers' analysis of the results showed that during the arrival and approach phases, there was "no significant association between automation condition or recent practice on pilot performance," the report said. In the missed approach phase, researchers found "a significantly higher likelihood of a speed deviation in the manual control condition when compared to the raw data and manual control condition... Pilots' scanning and manual control skills seemed to be more likely overwhelmed in the midst of this high-tempo phase of flight."



Table 1 : Pilots' Flying Performance (Instrument Scanning and Manual Control Skills) in Three Automation Conditions			
Flight Phase	Automation Condition		
	Autoflight	Manual Control	Raw Data and Manual Control
<b>Arrival</b>			
Off course (3 course assignments per pilot)	0% (0 of 48)	0% (0 of 48)	2% (1 of 48)
Speed deviation > 10 kt (3 speed assignments per pilot)	8% (4 of 48) (M = 17 kt)	23% (11 of 48) (M = 15 kt)	(7 of 48) (M = 42 kt)
Altitude deviation > 300 ft (3 altitude assignments per pilot)	2% (1 of 48) (M = 740 ft)	10% (5 of 48)(M = 968 ft)	10% (5 of 48) (M = 732 ft)
<b>Approach</b>			
Off localizer (1 localizer assignment per pilot)		0% (0 of 16)	6% (1 of 16)
Off glide slope (1 glide slope assignment per pilot)		0% (0 of 16)	13% (2 of 16)
Speed deviation > 10 kt (3 speed assignments per pilot)		0% (0 of 48)	6% (3 of 48)(M = 21 kt)
Altitude deviation > 300 ft (3 altitude assignments per pilot)		0% (0 of 48)	0% (0 of 48)
<b>Missed Approach</b>			
Off course (1 course assignment per pilot)		6% (1 of 16)	13% (2 of 16)
Speed deviation > 10 kt (2 speed assignments per pilot)		6% (2 of 32)	38% (12 of 32)
Altitude deviation > 300 ft (1 altitude assignment per pilot)		0% (0 of 16)	6% (1 of 16) (M = 310 ft)
M = mean <b>Note:</b> Based on actions of 16 pilots in a Boeing 747-400 simulator. Data in cells refer to percentage of tasks during which pilots committed at least one operationally significant error  Source: Casner, Stephen M.; Geven, Richard W.; Recker, Matthias P.; Schooler, Jonathan W. "The Retention of Manual Flying Skills in the Automated Cockpit." <i>Human Factors</i> Volume 56 (December 2014): 1506–1516			

*Continued on next page*

The results supported the findings of earlier research that, as long as pilots had been formally trained in instrument scanning and manual control, those skills were “reasonably well-retained, even in the absence of regular practice.” Nevertheless, the study said, the results also showed “some atrophy [in those skills] that perhaps merits additional practice.”

Cognitive Skills

The participating pilots were unanimous in telling researchers that, although they had strong backgrounds in conventional navigation methods, they had no recent experience in that area.

Table 2 shows how pilots performed on eight navigation tasks—and how many times they committed at least one operationally significant error<sup>4</sup>—while flying an arrival, approach and missed approach without using an FMC. For this portion of the study, researchers compared each pilot’s performance while using the simulator’s FMC against his or her performance using a conventional VHF omnidirectional radio (VOR) receiver.

“Aside from requiring different procedures to operate them, the two types of navigation equipment differ more strikingly in how much pilot involvement they require,” the report said. “Whereas VORs require the pilot to closely follow the progress of the flight and reconfigure the equipment as [the airplane] arrives at each waypoint, the FMC permits the pilot to program the entire route prior to departure and to think of the navigation process as a ‘once-and-done’ programming exercise.”

The process included three specific unannounced instrument system failures as part of the test of pilots’ abilities to recognize and confirm an abnormal instrument indication by cross-checking their instruments. The failures involved the participating pilot’s heading indicator and altimeter—although heading indicators and altimeters elsewhere in the cockpit continued operating; and blocking the pitot-static system, which caused malfunctions in all airspeed indicators in the cockpit. The engine indicating and crew alerting system also was disabled.

Table 2: Pilots’ Performance When Navigating Without the Use of the Flight Management Computer	
Navigational Task	Deviations
Tune VOR station (1 opportunity per pilot)	6% (1 of 16)
Navigate to VOR station (1 opportunity per pilot)	6% (1 of 16)
Altitude deviation > 300 ft (2 opportunities per pilot)	16% (5 of 32) (M = 4,686 ft)
Speed deviation > 10 kt (2 opportunities per pilot)	0% (0 of 32)
Final approach course (1 opportunity per pilot)	25% (4 of 16)
Missed approach point (1 opportunity per pilot)	44% (7 of 16)
Approach minimums (1 opportunity per pilot)	19% (3 of 16)
Missed approach heading (1 opportunity per pilot)	38% (6 of 16)
M = mean; VOR = VHF omnidirectional radio	
<b>Note:</b> Based on actions of 16 pilots in a Boeing 747-400 simulator	
Source: Casner, Stephen M.; Geven, Richard W.; Recker, Matthias P.; Schooler, Jonathan W. “The Retention of Manual Flying Skills in the Automated Cockpit”, <i>Human Factors</i> Volume 56 (December 2014); 1506–1516	



Table 2 shows that all pilots were able to hold their airspeed within allowable limits and all but one were able to tune a VOR station and select an inbound course; in addition, only one pilot had difficulty navigating to the VOR station. But six pilots failed to fly the published heading on the missed approach, and seven incorrectly announced their arrival at the missed approach point. Only one pilot completed the entire process without errors.

“Overall, like instrument scanning skills, pilots reported that navigation skills, once initially mastered, are seldom, if ever, practiced,” the report said. “But rather unlike instrument scanning skills, which are resistant to forgetting, navigation skills that have been supplanted by the use of cockpit automation are highly susceptible to forgetting and likely require frequent practice to keep them sharp.”

In its analysis of the pilots’ responses to the three events involving instrument system failure, the study noted that 81 percent of participants told researchers that they had received “considerable training and practice with recognizing and dealing with puzzling instrument indications.” However, fewer than half said their airline recurrent training had included similar practice.

Table 3 shows that in each of the instrument system failures—altimeter lag, heading indicator skew and unreliable airspeed—all but one of the pilots verbalized the problem.

*Continued on next page*

**Table 3: During Three Instrument System Failure Events**

System Failure Event and Pilot Action	Proportion of Pilots
<b>Altimeter lag</b>	
Verbalized problem	100%
Cross-checked instruments	69%
Deviated from altitude	75%
Diagnosed problem	81%
<b>Heading indicator skew</b>	
Verbalized problem	94%
Cross-checked instruments	63%
Deviated from heading	38%
Diagnosed problem	56%
<b>Unreliable airspeed</b>	
Verbalized problem	100%
Cross-checked instruments	94%
Approached stall (number of stick shaker activations)	94% (M = 4.6, SD = 4.0)
Diagnosed problem	94%

M = mean; SD = standard deviation

**Note:** Based on actions of 16 pilots in a Boeing 747-400 simulator.  
Percentages indicate number of pilots who took the indicated action

Source: Casner, Stephen M.; Geven, Richard W.; Recker, Matthias P.; Schooler, Jonathan W.  
“The Retention of Manual Flying Skills in the Automated Cockpit.” *Human Factors*  
Volume 56 (December 2014): 1506–1516

In dealing with altimeter lag and heading indicator skew, fewer pilots correctly took the next step—cross-checking instruments. In the case involving unreliable airspeed, only one pilot failed to make “an obvious attempt” to check the other instruments.

In two of the three scenarios—altimeter lag and unreliable airspeed—most of the pilots deviated from the assigned altitude and failed to prevent the approach of a stall, respectively. They were better at coping with heading indicator skew, with 38 percent deviating from the assigned heading.

Heading indicator skew was the easiest of the three problems to diagnose, the report said, noting that only one pilot failed in his diagnosis. Eighty-one percent successfully diagnosed the case of altimeter lag, and 56 percent correctly identified the heading indicator skew, the report said.

Data showed that pilots who reported that they had at least occasionally had practice during recurrent training in dealing with puzzling instrument indications performed no better than the others in the three instrument failure scenarios. The report said that one explanation might be that the recurrent training focused on “a few familiar failures” and did not include general methods of handling other types of abnormal events.

“Overall,” the report said, “the data suggest that pilots performed well at detecting failures but often neglected to cross-check other instruments, diagnose the problem and avoid the consequences of an unresolved failure. In regard to the reported frequency at which pilots receive initial and recent practice in

dealing with puzzling instrument indications, our findings suggest that this sort of skill is vulnerable to forgetting and could also benefit from more emphasis during initial and recurrent training. ↴

*This article is based on “The Retention of Manual Flying Skills in the Automated Cockpit,” by Stephen M. Casner, Richard W. Geven, Matthias P. Recker and Jonathan W. Schooler, published in Human Factors, Volume 56 (December 2014):1506–1516.*

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1. Casner, Stephen M. and Schooler, Jonathan W. “Thoughts in Flight: Automation Use and Pilots’ Task-Related and Task-Unrelated Thought.” *Human Factors Volume 56* (May 2014): 433–442.
2. The current study cited Mengelkoch, R.F., Adams, J.A. and Gainer, C.A. “The Forgetting of Instrument Flying Skills.” *Human Factors Volume 13* (1971): 397–405.
3. Deviations were classified as “significant” if airspeed was more than 10 kt from the assigned speed, if altitude was more than 300 ft above or below the assigned altitude and if a full-scale deflection was recorded on a course deviation indicator.
4. Airspeed and altitude deviations were scored as outlined in Note 3. While navigating to a VOR or a missed approach point, deviations were recorded “when pilots missed the assigned point by more than 3 nm [6 km]” or flew more than 10 degrees off an assigned heading.



Photo: DND

## Expanding Flight Safety South of the Equator

by Captain Dave Henriquez, Liaison Officer, Canadian System of Cooperation Among the American Air Forces

We often take Flight Safety (FS) for granted until an accident or incident occurs. The heightened awareness becomes more prevalent when conducting combined air operations with foreign nations. With the built up excitement of conducting operations with other air forces, one tends to put aside the importance of FS and the impact it could have if not taken seriously. This was the case during a recent System of Cooperation Among the American Air Forces (SCAAAF) air operation exercise COOPERACION III conducted in Lima and Pisco, Peru back in April 2014.

The main purpose of the exercise was to support the Peruvian government in the event of an earthquake and tsunami. Secondly, it was to validate the SCAAAF combined air operations manual and put to practice the lessons learned from the virtual exercise, which was conducted in April 2013 in Mendoza Argentina. During the

exercise, one thing that was neglected was the topic of FS. With multiple aircrafts ranging from Beechcraft King Airs to CC177 Globemaster IIIs conducting strategic airlifts to search and rescue missions conducted by light to medium-lift helicopters, it became evident that steps were needed to implement a FS culture to address the various reports that the aircrews were submitting.

The evaluation cell assigned to the exercise took these considerations into account and included the FS concerns into the after action report. As part of the SCAAAF Campaign Plan, the promotion of a FS culture was one of the main institutionalize objectives that needed attention. For the last couple of years, the SCAAAF organization was mainly focused on applying the procedures for the conduct of air combined operations in support of Humanitarian Aid and Disaster Relief HADR. These institutionalized

objectives were completely ignored. During the 2014-2015 SCAAAF cycle, the main objectives were to update the various manuals including the FS manual.

This particular task was assigned to the Royal Canadian Air Force, because of their commitment and profound leadership in this particular topic. The Canadian SCAAAF LO in concert with the Directorate of Flight Safety has made significant improvements to the SCAAAF FS manual and will present it at the next SCAAAF conference. The new and improved FS manual will serve as a guiding document for future SCAAAF exercises to address FS concerns both in air and ground operations. Because SCAAAF is conducted in the Spanish language, the Canadian SCAAAF LO will have the responsibility to act as the Canadian ambassador to all FS matters within the organization. ✈





## Sleeping AT THE WHEEL

by Captain Dan Gillis, Pilot, 413 Search and Rescue Squadron, Greenwood

It was a cold Sunday evening in January of 2012 when our CH146 *Griffon* lifted off heading 60 nautical miles north east of Goose Bay. Earlier that evening, a little after nine, I received a call from Rescue Coordination Centre (RCC) to pick up a sick hunter suffering from abdominal pains. He was in a hunting party of 8-10 people that set up camp beside a lake a few days before. The patient was unable to travel on a snowmobile due to his pain.

444 Squadron is a secondary Search and Rescue (SAR) asset and at the time, no crews were dedicated to be on standby. I called around and mustered up a crew and checked the weather: cold, mostly clear, great visibility with westerly winds around 20 knots. I was thinking what a great night to have my first mission as a SAR Aircraft Captain: a quick flight out to pick the guy up, back in bed before midnight.

When we got on scene we could not see any sign of the camp. We started a high expanding square and I started to work the high frequency (HF) radio trying to confirm the coordinates with RCC.

With HF communications working just enough to not give up on them and not well enough to pass traffic we continued the search. With no luck on HF and fuel remaining for on scene quickly disappearing, we landed nearby in order to try our satellite phone. We didn't have the best track record with it, so it was not our go-to option for communications. The landing was made difficult by the recent snow fall and the lack of proficiency in landing under snowball effect conditions. It took a few minutes to find a place that was large enough to land safely yet provide adequate references. The SAR Technician slugged through the snow with snowshoes and called the hunting party on the satellite phone to get the correct coordinates. We found out later that the hunting party gave RCC the wrong ones! By this time, we did not have enough fuel to pick up the patient and make it home, so we headed back to base to refuel.

Shortly before 1 a.m. we launched on our second attempt. This time everything worked out. We found the hunting party and after a quick assessment we had our patient onboard heading

back to Goose Bay and landing just before 3 a.m. The patient was transferred to the awaiting ambulance and we finished up what we had to before heading out the door.

I have always found that after a few hours of wearing NVGs I can't go straight to bed. I find I need to stay up for about an hour to let my eyes relax. So I headed down to the local coffee shop for a late night snack. On my way back I thought I missed my turn not once, but twice! Here I was barely able to drive back to my house, and yet I was flying less than 45 minutes earlier.

I learned a lot of things that night, but the biggest thing is that we are very poor at recognizing how fatigued we are. Even though our crew day was less than 6 hours, most of us were up for 20 hours. Even more, none of us expected to work that day, so we never put any of the safe guards like an afternoon nap into place. It's important to note that when thinking about crew day, one needs factor in time awake and take the whole day into account, not just time at work. ⚡

## Crossing Over

by Captain Dean Vey, 413 Transport and Rescue Squadron, Greenwood

**R**e-treading' to a new aircraft is something all Royal Canadian Air Force pilots experience. During initial training in Portage La Prairie and Moose Jaw, the transition is always challenging and students must keep adapting after relatively short periods on various aircraft. After training, students are selected for their first tour aircraft type, and begin to develop years of 'muscle memory' and flying techniques that eventually become a part of their instinctive flying behaviour. These instincts can be difficult to change for many pilots and it takes a varied period of time for them to erode after transition, especially during hi stress or unexpected situations, where things can revert in a heartbeat.

I had completed close to 1,200 hours on the CH146 *Griffon* in a Search and Rescue (SAR)/Combat Support Squadron role in Goose Bay when I transitioned to the CH149 *Cormorant* in Gander. This was a significant aircraft upgrade in capability and complexity, requiring more than a few modifications to my flying technique. Most of these involved managing autopilot systems that were designed to relieve workload, and certainly do so when used effectively. Unfortunately, initially for many of us

*Griffon-Cormorant* converts, there is almost always a desire to take manual control and do something more quickly than to fly through (and sometimes against) the automation. Rarely is this actually required.

A few months after being at 103 SAR Squadron, we were on a training flight one afternoon, flying home from St. John's to Gander, which is about a 45 minute flight direct. We wanted to do some overland training along the way but knew that we may have to work around some onshore fog, drizzle and low cloud along the way. Having the entire afternoon at our disposal, we were in no rush with lots of options. If the weather was unworkable enroute for visual flight rules (VFR) training, we would contact air traffic control (ATC) for an instrument flight rules (IFR) clearance to get through it, a procedure used very often for SAR missions and frequently for training given the unpredictability of this type of weather. In fact, we trained regularly for unplanned IFR scenarios with new First Officers (FOs) so they were familiar with the procedure of acquiring an IFR clearance over satellite communications direct with ATC in Gander. The forecast for the Gander area was going to be VFR all afternoon.

We departed St. John's and set out to cross Conception Bay, over 14 NM of water. Weather was as expected, visibility was about six miles and we were transiting 600-800 feet with the aircraft trimmed but no autopilot systems engaged. During the eight minute or so crossing, the rain and mist started to intensify and I slowed and descended the aircraft from 130 knots down to around 100 knots and brought the altitude down to about 500 feet. The approaching shoreline was about three miles away and immediately rose 100-200 feet on land with a peak of about 900 feet just three miles inland. In what seemed like a matter of seconds, there was a drop in visibility down to about 1/8th of a mile due to a rapid onset of precipitation and/or encountering low level mist behind it. Instincts kicked in to not lose visual meteorological conditions (VMC), so with my eyes on the ocean below us, I immediately depressed the trim release button and eased the altitude down to roughly 400 feet, all the while aggressively bringing the speed back as slow as 40 knots, while simultaneously cross checking our altitude on instruments. Success!

*Continued on next page*



Photo: DND



# LESSONS LEARNED

I had prevented us from going further into instrument meteorological conditions (IMC). Let's press! This was much to the surprise, however, of the aircraft captain (AC), who had only flown in *Cormorant* aircraft. The same could be said for the rest of the crew who were also puzzled as to what was going on that required such a rapid maneuver. As we leveled at better visual conditions, I felt his hand pressure on the cyclic pushing forward encouraging me to increase airspeed to a more comfortable 60 knots, and we both looked at each other for a moment wondering what the other was thinking. To me this was a perfectly executed rapid deceleration that kept us out of IMC which I had witnessed and conducted myself on a *Griffon* in the past. To this *Cormorant*-only AC however, it was a completely unnecessary and dangerous tactic that he had most likely never seen anyone perform in these benign conditions! It took some reflection in the hours following but I came around to completely agreeing with him.

We turned the aircraft around 180 degrees back toward the better VMC, proceeded to get our IFR clearance and continued IFR. Once enroute, we discussed the reasoning and the options for what had just happened. Inadvertent IMC (IIMC) in a *Griffon* was basically avoided at all reasonable costs for a number of reasons, including no anti-icing capability, no approved GPS direct capability, no weather radar, with autopilots that sometimes had to be disengaged and the aircraft manually flown if they proved insufficient to handle the conditions (turbulence, etc). Most *Griffon* pilots were often very low on IFR actual flight time and generally avoided it for the simplicity and 'comfort' of VFR, even in

bad weather. Each one of those aircraft deficiencies no longer existed for me on this aircraft and, while going IIMC was to be avoided, it was no longer something that required the fastest hands and feet in the West.

In my scenario, a simple 180 degree level turn back to better VMC would have sufficed. Engaging an autopilot in radar (RAD ALT) or barometric altimeter (BAR ALT) hold to the already perfectly-trimmed aircraft would have been even better, allowing us to raise the nose using the trim switch and slow the airspeed (without climbing) and prevent further entry into the IMC throughout the turn. Alternatively, having the radar up and displaying the upcoming coast would have

***"We are all the product of our experiences and while our instincts may be necessary and appropriate on one aircraft, they may not be on others."***

allowed a controlled reduction of speed and trimmed decent on RAD ALT mode with an accurate depiction of land in front of us that would be easily monitored and avoided. As a less desirable option, we could have initiated an immediate climb with the knowledge of the highest elevation of the terrain in front or around us would have given us a minimal safe altitude. All these very calm, controlled options were available at any time, well within the margin of safety; they only needed one thing: a solid IMC plan.

Encountering bad weather on SAR missions is unavoidable when you are at the pointy end of things and trying to save a life. Pilots are forced to fly in unfavorable conditions below normal minima and have a mandated responsibility to do it so that "Others May Live". That said, risk can always be managed and the proof is in the planning. Having a fluid and adaptive plan as weather conditions change is vital, as is having the various aircraft autopilot holds prepped, strong Cockpit Resource Management and a fully briefed crew. Had I had used the radar to paint the shoreline with the low height warnings set for a specific altitude as required, I could have briefed the crew on the actions I would take if we were to lose visibility and successfully followed my IIMC plan. As it turned out, I didn't voice one, and reacted more than anything. A lesson that I try to pass on to every one of my FOs to this day.

In summary, we are all the product of our experiences and while our instincts may be necessary and appropriate on one aircraft, they may not be on others. Our training institutions do a great job teaching to a standard that is the same for all pilots on that applicable course. It is our responsibility, coming from different aircraft and backgrounds, to fill in the gaps in the new procedures with "what don't I have to do now, what instincts may no longer be applicable?" The key to avoiding a muscle memory reaction is planning to avoid it before it happens. 🍀





Photo: Sgt Lindsay Grimster

## The Holes *Align*

by Captain Andrew Rees, Air Traffic Controller, 19 Wing Comox

If you have spent any time in an operational position, you have undoubtedly suffered through your fair share of Flight Safety briefings that try to explain to you the Swiss Cheese Model. Then, one day, a situation arises that so perfectly fits this paradigm that the importance of Flight Safety really hits home. In aviation, we all know proper phraseology and clarity is paramount—there simply isn't room for ambiguity or misinformation. So, when an IFR aircraft departs the wrong runway and no one, not even the pilots, realizes the error, it shows you just how important standard procedures really can be.

It was a typical weekday morning in the Comox Military Terminal Control Area with the usual rush of civilian departures to Vancouver from several different airports. Flow control was in effect, which is how larger airports such as Vancouver manage the acceptance rate of aircraft from a particular airspace, by issuing departure times which must be met +/- 2 minutes. Among those departures was a Beech 1900 flight-planned from Comox at 6:30 a.m.

The aircraft requested airways with a runway 36 departure and a flow time of 6:45 a.m. Runway 36 is Comox's secondary runway, and is frequently used by civilian itinerant traffic due to its proximity to the civilian ramp. Following coordination with the overnight tower controller, I issued the following clearance: "Cleared to Vancouver via Comox LIBOG SOUND3 arrival... depart 36 turn right climb on course" and it was read back correctly.

Ten minutes later the aircraft began its taxi for departure, just as the morning controller took over in the tower. It was here the system began to break down. The night tower controller had incorrectly briefed the oncoming controller that the aircraft had airways for a runway 12 departure. Now, to provide a bit of context—if the same aircraft were to depart 12, Comox's primary IFR runway, the clearance would read: "...depart 12, turn left climb on course" barring any other restrictions due to traffic. A right turn, which was the clearance issued with the 36 departure, would turn an aircraft departing 12 south toward mountainous terrain, and

require the aircraft to conduct a 330 degree turn on course. As the ground controller had not yet arrived and signed on duty, the taxi clearance for runway 12 was issued by the tower controller, who subsequently missed the crucial taxi notification call to the terminal that includes the runway the aircraft is taxiing for. To make matters worse, the aircraft failed to query the tower controller about the runway change or request the required amendment to the departure clearance. Instead, the aircraft requested to taxi for a full length departure vice the intersection departure issued by the tower.

I had just finished briefing my trainee into the position as the tower called and requested release of the aircraft off 12 with a flow of 45. Instead of responding with the proper phraseology, which would be "(callsign) clearance valid runway 36 with a flow of 45" the trainee responded with "(callsign) clearance valid with a flow of 45". At this point, having myself

*Continued on next page*

# LESSONS LEARNED

missed that the tower stated 12 and not 36, I began to explain to my trainee the importance of always using proper phraseology in co-ordination and validation calls with the tower. A few moments later the tower called the aircraft "airborne 12" and it became clear the error that had unfolded. Fortunately, the flight was able to continue without further incident.

So what went wrong? How many holes had to line up for an event such as this to occur? Here is the sequence of what was missed: Information was incorrectly passed on handover between tower controllers that resulted in taxi clearance being issued to the wrong runway; the aircraft failed to query the tower on the runway change or request an amendment to its departure clearance; the tower controller failed

to make the taxi notification call to the terminal; the terminal trainee and I both failed to hear the tower controller specify runway 12 in their request for validation; the terminal trainee failed to specify runway 36 in the clearance validation and I failed to immediately correct my trainee's omission of the runway number during validation. While we will ever know for certain, had a single one of the above steps not been missed it is more than likely that the issue would have been corrected before the aircraft rotated off the wrong runway.

Many steps were missed that caused this breakdown from every person working that morning, from the tower controllers, to myself as the terminal controller, to the pilots operating the flight. While it is fortunate that


there was no negative impact to the aircraft or other traffic as a result, the outcome could easily have been much worse. Standard phraseology exists for a reason and while it can be tempting to deviate from the norm, this scenario underscores how even a small deviation has the potential for serious repercussion. Proper phraseology, clarity, and attention to detail all play a crucial role in maintaining Flight Safety. 



Photo: Sgt. Norm McLean, Canadian Forces Combat Camera



## DUDE Where's MY JET?

by Sergeant T.W. Blackwell, 410 Tactical Fighter (Operational Training) Squadron, Cold Lake

**I**t was a busy deployment with a typical day consisting of 30-plus launches a day. We had just completed our handover and were in the process of launching the last wave of the day. The jets were to leave at the same time but were being slightly staggered as armament reconfigurations needed to be completed and signed for before the jet could be weapon-systems released.

Two sets of pilots had already taken off and the very last two were on the way out the door. After stepping a pilot came back in to recheck

the line up as he could not find his jet, to which we guaranteed it was out there. Shortly he came back in and stated that it wasn't. It dawned on us that a pilot had inadvertently taken the wrong jet, an easy mistake to do with the tail numbers being 776 and 778. A quick review of the servicing set showed the pilot had indeed signed for 776 and taken 778.

In this case with both jets scheduled for the launch and with the same configuration, both before-checked and weapon system released, it was not a huge issue but nonetheless a Flight Safety incident.

A seemingly small error could have had much greater issues and consequences. What if the aircraft had the wrong configuration for an actual mission? What if the jet was actually unserviceable and went airborne, even with the many back-up systems built in to the Hornet nothings stops a fuel leak fire.


Better situational awareness, and an extra second of time could have prevented this occurrence. In this case it was lucky that the jet was exactly the same configuration as required and serviceable. 



Photo: DND



## Short on Time

by Master Corporal Tim Brown, Canadian Forces Environmental Medicine Establishment, Toronto

Working in an Aircraft Life Support Equipment (ALSE) shop can be a very rewarding position. It can also be very busy when it is part of one of the Royal Canadian Air Force's tactical fighter squadrons.

Pilots that fly the CF188 *Hornet* wear a large amount of equipment which is maintained by the first line ALSE shop. Helmets, masks, g-pants, survival vests, and many more require maintenance and inspections at regular intervals. One of the pieces of gear that is worn is the PCU-56P torso harness. This harness is wearable and provides restraint in the seat of the aircraft and serves as a parachute harness in case of ejection. This harness gets inspected more than once during a year and one of these inspections includes a suspension check with the pilot.

We in the 409 Squadron ALSE shop had determined that one of those harnesses was due for an inspection. We notified Pilot A via email (which was the norm) that this suspension check was required in about a weeks' time. Within a day or so a response from Pilot A was received acknowledging the requirement for the suspension check and that he wouldn't be in for at least a couple days. Along with the suspension check there is also an inspection of the harness that needs to be done so we brought the harness into the shop to carry out this inspection. We decided to keep it in our shop to facilitate the suspension check when Pilot A came in to see us later in the week.

Later that week when reviewing the flying schedule, we noticed that Pilot A was flying that day. We assumed that he would be in the shop to see us before the flight to try on his harness. We got to work on other things in the shop and didn't realize that the time when Pilot A was to have launched had come and gone. Initially we thought that the flight may have been cancelled until we saw that all the remaining pieces of Pilot A's gear was missing from his locker. How could he be flying we thought, without his harness. A quick glance to the right in the next locker revealed that Pilot B's gear was complete with the exception of a torso harness.

It was revealed after the flight that Pilot A did use the torso harness belonging to Pilot B instead of his own. Pilot A may have forgotten about the harness until too soon before his flight to have the suspension carried out.

Regardless of the reason it was a risky move as these harnesses are fitted and sewn to each individual user. Ejection while wearing an improperly sized harness not only could injure, but kill. Use of ALSE is for the users' exclusive use and shall not be used by other personnel.

There may have been other steps that we in the ALSE shop could have done to remind the pilot that this inspection was due and that his harness was in our shop. This may have averted the condition in which Pilot A chose to use Pilot B's harness. This doesn't absolve the ALSE shop of all responsibility however; in the end it's the users responsibility that his or her gear is used and cared for properly and that it's inspected by trained and qualified Aircraft Structures Technician. It is worth a little extra time to ensure that your ALSE is ready to go before you need it so it can be depended upon to save your life. ⚡



Photo: DND

# From the Investigator

TYPE: CC15004 *Polaris*


LOCATION: Op IMPACT

DATE: 8 May 2015

On 8 May 2015 at 15:10 local, the CC150 departed its base of operation for an air to air refueling mission in support of Op IMPACT. Upon successful completion of the mission the crew commenced their return home. Approximately 4h into the flight and 1 h 15 min from landing, the crew felt a significant, sudden vibration which lasted approximately 3-4 seconds, and was felt in the control column and rudder pedals on the flight deck, as well as generally throughout the aircraft. The crew checked all

aircraft system pages on the Electronic Centralized Aircraft Monitoring system, and nothing unusual was found. The flight continued without further incident and landed safely at 20:24 local.

Upon landing, an exterior inspection revealed delamination of the right hand Elevator trailing edge. Damage was assessed as minor.

The investigation is working with the aircraft original equipment manufacturer to inspect the damaged elevator and gather data in an attempt to explain the failure mode. 

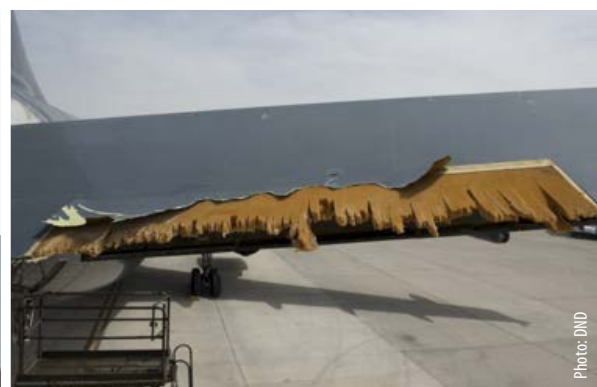


Photo: DND

Photo: DND

# From the Investigator

TYPE: Schweizer 2-33 C-GCSK

LOCATION: Lachute, QC

DATE: 16 May 2015

This was a training flight in support of the Air Cadet Gliding Program. The flight was part of the Annual Proficiency Check for a passenger carrying qualified cadet. The accident occurred during the initial climb out on aero-tow using the L19 *Superdog*.

The initial take off was without incident. As the tow plane and glider started the climb through 100 feet the tow plane started to experience a loss of power. The tow continued however at a significant loss of rate of climb. The gliding instructor radioed the tow plane pilot to ask if everything was "OK". The tow plane pilot responded that things were not "OK". The Launch Control Officer then radioed the glider pilot advising them to release when they felt it was safe to do so.

Shortly thereafter, at about 200 feet above ground level, the glider released, turned to the right and was last seen dropping into a wooded area. The tow plane regained power, and was able to return to the airfield without further incident. The glider was not able to reach a field nearby, and landed in some trees. It fell vertically and came to rest suspended in the trees with the nose of the glider touching the ground. Both pilots were transported to hospital, and later released. One of the occupant sustained minor injuries.

The investigation is focusing on the cause of the tow plane loss of power; specifically, the carburetor heat box rigging. The circumstances, decisions and actions related to the release of the glider are also being examined. ✈



Photo: DND



Photo: DND



# From the Investigator

TYPE: Bell 206B3 *Jet Ranger*

LOCATION: Portage la Prairie, MB

DATE: 6 May 2015

The accident aircraft, a Bell 206B3 *Jet Ranger* with civilian registration C-FTHA and military designation CH139301, was a training helicopter operated by 3 Canadian Forces Flying Training School in Portage la Prairie, MB. The crew of two, a qualified flying instructor (QFI) with a student pilot (SP), was flying NAV 1 as part of the Phase III basic helicopter course.


During the return to base following completion of the navigation portion of the mission, the QFI gave the SP an unexpected simulated engine failure scenario. The QFI reduced the throttle to idle to simulate the engine failure and advised the SP of the simulated emergency. The SP reduced the collective to enter autorotation while initiating a right 170° turn to manoeuvre into wind and towards an identified landing zone. He completed all required actions while establishing the aircraft on final approach to the landing zone.

Once the exercise was completed and the QFI satisfied with the SP's performance, the QFI took control to initiate an overshoot at approximately 250' above ground level (AGL). Being closer to the ground, the QFI had now identified obstacles; namely a power line and uneven ground. At the same time as slowly applying power, the QFI

raised the collective in an attempt to reduce the rate of descent and extend the glide. However the rate at which engine power seemed to come on was much slower than expected.

With the helicopter's main rotor speed being low and feeling vibrations with associated unusual sounds, it became apparent that an overshoot was not going to be possible. The QFI flared and used what energy remained in the rotor to settle the helicopter onto the ground just past a shallow depression. The helicopter landed with considerable forward speed and skidded forward for approximately 200 feet past the initial point of contact.

The helicopter suffered serious damage to the tail boom and numerous components surrounding the main rotor transmission as a result of low rotor speed and a hard landing. The crew was not injured.

The investigation is focusing on the engine response during the overshoot, and on human and organizational factors. 



# Epilogue

**TYPE:** CH149 *Cormorant*  
**LOCATION:** Bass River, Five Islands  
Provincial Park, NS  
**DATE:** 14 November 2013

The training scenario, near Bass River in Five Islands Provincial Park, NS, involved hoisting two Search and Rescue Technicians (SAR Techs) and a rescue basket into and out of a wooded confined area while the helicopter remained in a 120 foot high hover. After the SAR Techs were lowered and some practice manoeuvres were conducted using the rescue basket, the first SAR Tech and the rescue basket were hoisted back on board the helicopter.

In preparation for being hoisted up, the second SAR Tech stowed the rescue basket guide rope and verified that the helicopter was directly overhead before he attached the hoist hook to his harness and signalled to the Flight Engineer (FE) in the helicopter that he was ready. The FE then took up the slack in the hoist cable and began to raise the second SAR Tech. Seconds later, the SAR Tech fell to the ground and landed flat on his back.

Shortly after, the SAR Tech stood up and indicated to the FE that he was not injured. The FE reeled in the hoist hook and then brought the SAR Tech up using the back-up hoist. After returning to a staging area, the crew decided to terminate the training mission.

The investigation focussed on the phenomenon known as rollout, in which the rescue harness connecting D-ring can misalign with the hoist hook and allow the D-ring to disconnect. A Flight Safety *Flash* bulletin was immediately sent to all Royal Canadian Air Force hoist users to identify this hazard.

Preventive measures included changes to SAR Tech training, amended hoisting procedures and evaluation of a self-locking gate for the hoisting hook. ⚡



# Epilogue

**TYPE:** CC130608 *Super Hercules*  
**LOCATION:** Resolute Bay, NU  
**DATE:** 18 March 2015

The accident aircraft was a Lockheed Martin CC130J *Super Hercules* transport aircraft operated by 436 Transport Squadron out of 8 Wing, Trenton, Ontario (ON). The crew were flying a mission to Canada's far north in support of Operation NOREX – an exercise aimed at confirming the military's ability to operate in the northern environment. The mission was transporting personnel, equipment and supplies.

The accident aircraft with a crew of four carried five pallets and twenty one passengers from 8 Wing, Trenton, ON to Resolute Bay, Nunavut (NU). The flight to Resolute Bay airfield (CYRB) on 18 March 2015 was uneventful and *Hercules* CC130608 made a successful landing on runway 35T in good weather conditions at 11:01 local time. With only one mid-field taxiway to exit the runway, the crew backtracked in a southerly direction and exited westbound on Alpha taxiway.

The CYRB radio operator directed the crew to park on the northern Polar Shelf apron due to a CC177 *Globemaster III* which occupied the better portion of the main apron and was scheduled to depart within two hours. Approaching Bravo taxiway which leads to the Polar Shelf apron, the crew asked the CYRB radio operator to confirm the feasibility of taxiing a *Hercules* aircraft to that location on the airfield. After receiving confirmation from

the CYRB radio operator that *Hercules* and Boeing 737 aircraft had previously taxied to that location on the airfield, the First Officer (FO), who was the Pilot Flying (PF) and occupying the left seat for this leg of the mission, proceeded to steer the *Hercules* northbound on Bravo taxiway.

Having identified obstacles on the left hand side consisting of light poles and a storage shed, the Aircraft Commander (AC) directed that the FO taxi on the right side of the taxiway. While taxiing, the radio operator called to report that he believed the aircraft had struck a light post. The FO then looked out at the left wingtip to see it make contact with the storage shed (a second object) and the aircraft was brought to a stop.

After considering the predicament and confirming that the wingtip was clear of the storage shed, the AC elected to continue taxiing to the Polar Shelf apron where the aircraft was parked and the engines shut down. A preliminary assessment was conducted revealing considerable damage to the outer two feet of the left wingtip. Following this, the crew unloaded their passengers and cargo, terminating the mission.

A full assessment of the damage revealed serious damage (C-Category) to the outer two feet of the left wing. The Preventive Measures focussed on task prioritization, communication, training and correction of routine deviations from standard procedures. ✈

