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Flight Comment

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Canada

Commander of 1 Canadian Air Division

Views on Flight Safety

By Major General J.M. Duval, Commander of 1 Canadian Air Division and the Canadian NORAD Region

Since assuming command of the Air Division this past July, I have been humbled by the dedication, loyalty and professionalism that I have seen across the Air Force. I am a firm believer in the concept of flight safety being a force multiplier and that its principles are essential for us to follow. We are in the midst of an era of unprecedented growth in the Air Force with the acquisition of the CC177 *Globemaster* and CH148 *Cyclone*, as well as the prospect of the CC130J (which I am told is "not just another *Hercules*," but a whole new capability) and heavy-lift helicopters. The next few years will be exciting in terms of this new equipment being introduced, but it will also be daunting in terms of how we can continue effective, relevant, safe operations as we retire older fleets, integrate these new capabilities and learn to safely and effectively take advantage of the giant leap in automation they will bring.

We must ensure that our limited resources remain operational for when they are needed anywhere in the world. Preventable incidents or accidents that result in injury, the loss of life or equipment is unacceptable. Our job will always entail a certain level of risk, but we can safely accomplish our mission through mitigation of those risks. Additionally, we must continue to strive for realistic training opportunities, but realistic training does not mean dangerous training. Flight safety is about making smart choices, and I challenge all of you to speak up when you feel we are approaching unacceptable levels of risk. If you are uncomfortable with the way things are going, chances are someone else is too.

My flight safety principles have not changed from the time I was a line pilot. These include the requirement to say, "Stop," when required, discuss what is being contemplated, and ensure that everyone's situation awareness is at the same level. All personnel must fully understand what the mission aim is, the parameters in which it will be accomplished, what the boundaries of risk are, what point we will not go beyond, and, ultimately, when we will call off the mission. This requirement applies to the cockpit, shop floor and control tower, or wherever flight operations are supported. There is always enough time to do the job safely. If we don't take that time, we may not be able to try again tomorrow, and that would be simply not acceptable.

The Air Force of today is more exciting and holds promises for the future that have not been seen in a very long time. I urge you all to remember that safe and effective operations must be our focus, but that focus must never be obscured by the perceived belief that the mission must be completed at any cost. The cost of a preventable injury or loss of life is a price I am not willing to pay. My commitment to you is to provide direction to a destination; I ask in return that you commit to me that we will get there and back safely, or not go at all. ◆

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Photo: *Corporal J.F. Lauzé*

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Good Show

For Excellence in Flight Safety

Captain Sean Hanson and Captain Andy Mackay

On 15 May 2007, the *Snowbirds* planned to conduct a nine-plane high show practice in Mossbank, Saskatchewan. *Snowbird* 6 was being flown by Captain Sean Hanson, with Captain Andy Mackay of the Central Flying School on board as an observer. Shortly after takeoff, the *Snowbirds* completed the "shakeout" manoeuvre. During the subsequent rejoin, *Snowbird* 6 experienced an inability to reduce engine RPM. Capt Hanson commenced an overshoot while advising the formation lead. Capt Hanson and Capt Mackay then assessed the situation and determined that the engine RPM was both unresponsive to throttle movement and stable at 103%. The two pilots worked together to determine that a forced landing at Moose Jaw airfield was the best course of action. In consultation with the formation lead, they then broke away from the main formation to return to base. Enroute to Moose Jaw, the two pilots carried out the pre-ejection checklist. Capt Hanson shut the engine down at approximately nine miles back from the airport. The pilots then completed a forced landing check while Capt Hanson flew an ideal deadstick forced landing into Moose Jaw.

Throughout this emergency, both Capts Hanson and Mackay rose to the challenge and demonstrated a very high level of cockpit resource management and professionalism. The CT114 *Tutor* rarely experiences engine failures or the requirement to conduct a deadstick landing. Capts Hanson and Mackay's response to this unusual situation confirmed a high level of preparedness and proficiency as pilots. They efficiently completed checklists and maintained excellent cockpit communications. Their communications with the formation lead were timely and resulted in enhanced situation awareness for the formation. They demonstrated superior judgement in their choice of when to shut down the engine, having given themselves adequate altitude to glide back to the airfield. They then maintained appropriate altitude to complete an orbit at Moose Jaw in order to assess winds and rate of descent prior to commencing the forced landing pattern. The circumstances were improved by their clear and concise radio transmissions with ATC, allowing for uncomplicated management of the situation and for emergency responders to be in position on the airfield.

Capts Hanson and Mackay's confidence, airmanship and performance of duties while under the pressure of such unforgiving circumstances were admirable. Their skill, professionalism and teamwork in the cockpit are highly commendable as it ensured both their own safety as well as the preservation of the aircraft. Due to swift thinking and timely actions, the best imaginable outcome was achieved. For these reasons, Capts Hanson and Mackay are most worthy of recognition and are hereby awarded the Directorate of Flight Safety's Good Show award. ◆

Captain Andy Mackay is currently serving with the Canadian Forces Flying Training School (2 CFFTS) at 15 Wing Moose Jaw. Captain Sean Hanson is currently serving with 431 Air Demonstration Squadron at 15 Wing Moose Jaw.

Good Show

For Excellence in Flight Safety

Captain Brandon Robinson

While on a routine Air Sovereignty Alert mission in an armed CF188 *Hornet* on 16 May 2007, Captain Robinson experienced a left compressor stall. He quickly responded with the appropriate emergency checklist procedures and was shortly thereafter informed by his lead that the engine was, in fact, on fire. Capt Robinson immediately took action, and the fire was extinguished.

However, in addition to the already stressful situation, the flight control system had reverted to mechanical mode, bypassing the electronic dampening and giving direct input to the flight controls. This condition is generally characterized by pilot induced oscillations (PIOs), which require a great deal of skill to smooth out during the recovery phase of flight. Capt Robinson was able to minimize the PIOs on the aircraft and commenced a recovery to the Bagotville aerodrome. While doing so, he conducted a controllability check to verify the ability to configure the aircraft for landing before the final approach. During this check, Capt Robinson was unable to arrest the nose-down attitude caused when half flaps were selected and was forced to conduct an auto flap approach. His approach speed was above 200 knots, which, according to the aircraft operating instructions (AOIs), is over 20 knots more than the rating for the approach end arrestment he intended to fly. Despite this, Capt Robinson conducted a smooth final approach and was able to reduce his airspeed to within the cable rating, which resulted in a successful approach end arrestment and egress from the aircraft.

The post-landing inspection revealed that the aircraft had sustained significant damage to the left engine area due to the fire and parts of the engine turbine departing the aircraft. Damage included burn marks and a charred arresting hook assembly from the fire, and multiple large exit holes around the engine and strikes on flight control surfaces from engine debris. Furthermore, damaged hydraulics, wiring and mechanical parts meant that Capt Robinson had in fact lost control of the left rudder and stabilitor.

Capt Robinson's exceptional flying ability, calm demeanour, and step-by-step approach to successfully handling this extremely difficult sequence of events enabled him to overcome six various red and yellow page emergencies and recover an armed and heavily damaged CF188. His outstanding performance clearly exemplifies his superior operational competence, and he is highly commended for his actions. ◆

Captain Brandon Robinson is currently serving with 425 Tactical Fighter Squadron, 3 Wing Bagotville.

MAINTAINER'S CORNER

Tampering with Torque

By Dan Watchorn and Joanne Laflamme, Canadian Forces Tool Control Centre, Aerospace and Telecommunications Engineering Support Squadron (ATESS), 8 Wing Trenton

Proper torque values play an important role in day-to-day aircraft maintenance. Torque wrenches are precision instruments, calibrated to indicate the exact amount of force being applied to a nut or bolt. This is paramount in ensuring that aircraft components are precisely installed so that nuts and bolts don't become loose, which could permit excessive play, disconnections, and, ultimately, unexpected performance. Torque instruments must therefore be well maintained and regularly verified to guarantee accuracy. The role of the technician is to keep it clean and release the pressure and locks (*Figure 1*) and reset the torque value to its lowest setting after every use and before storing.

The internal maintenance of torque wrenches is the job of the technicians at the Canadian Forces Tool Control Centre (CFTCC). They have access to the manuals, special tools and conforming parts, besides also possessing the qualifications and experience. While units have electronic torque testers at their disposal, they are prohibited from making repairs by regulations: the torque testers are meant to simply determine whether a wrench is a go or no-go.

***Figure 1:** Locking mechanism*

A very disturbing trend is emerging, where a high percentage of torque wrenches that come to CFTCC for repair have been opened or altered in some way. It is not unusual to receive one with the handle covered in duct tape in an attempt to hold it all together. Are technicians really using tools in this condition? We hope not! A taped up wrench may be good enough for the garage, but it doesn't cut it for aircraft maintenance. And the things that are found inside torque wrenches are also very unsettling (*Figure 2*): spacers have been replaced with circlips or aircraft washers; parts are installed in the wrong order, or just plain missing; sometimes there are split pins, locking wire, and metal shavings in handles and spring tubes; and incorrect lubricants are found to have been used, clogging the internal mechanism or causing excessive wear. These can all have a drastic effect on the operation and accuracy of the instrument. Modifying the internal mechanism of a torque wrench will simply lead to no good.

With the number of torque wrenches available in units, there is no need to take it upon yourself to make a wrench work and save the day. There is no reason to grind down pivot blocks, drill holes through ratchet tangs, or shave, grind or shorten load screws. But this all happens on a regular basis and it is compromising the integrity of torque wrenches. Based on the number of altered torque wrenches seen at CFTCC, it appears that there are many altered wrenches out there. This is worrisome because CFTCC only sees the wrenches that are actually sent for repair: it is possible that many altered wrenches out there are still considered serviceable.

Most torque wrench companies are quick to point out their tamper-proof products. But CFTCC takes an extra step beyond what even they offer and puts seals over main adjustment points in an effort to further deter tampering. You may have seen the seals that adorn our handy work, stating "calibration void if seal broken."

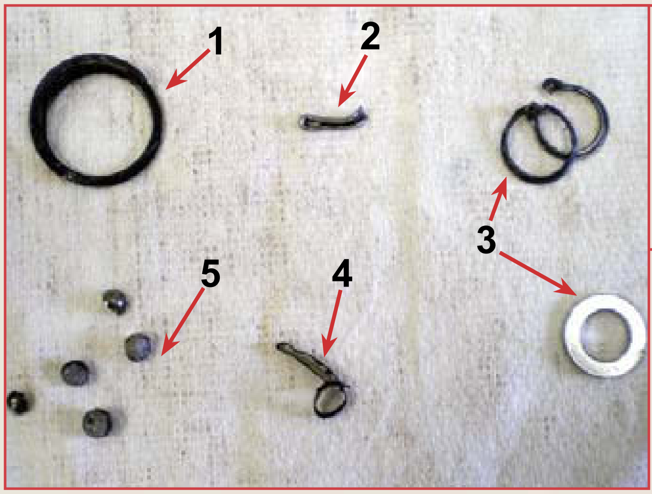


Figure 2: *A sampling of the unsafe items found that revealed obvious tampering:*

1. *Ratchet seal, soldered, in place of the Cerro safe seal*
2. *Cotter pin found in load spring*
3. *Circlips and aircraft washers used as spacers*
4. *Metal shaving found inside torque wrench*
5. *Broken ball bearings in lock mechanism*

If the seal is missing or broken, you can no longer be assured that the torque you dial in is the one you are really going to get. All this tamper proofing makes our job a little easier in determining which tools have been altered. However, tampering makes for time-consuming repairs, frequently results in scrapping wrenches, and, in the end, can contribute to injuries and accidents.

The most obvious sign of tampering is the condition of the labels: check for a correct calibration inspection due date on the user verification label (*Figure 3*). Also check that the tamper seal is in place and that it is not broken or cut (*Figure 4*).

Figure 3: *User verification label*

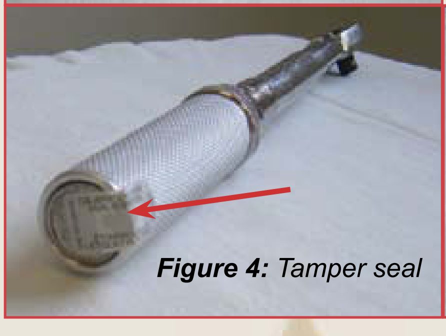


Figure 4: *Tamper seal*

Figure 5: *Cerro safe seal*

Next, check the Cerro safe seal – a dull solder plug in the end of the handle or calibration screw (*Figure 5*) – has not been removed and replaced with solder, silicone or something that looks like wax. Solder is shiny and very hard; it requires very high temperatures in order to put it in place, which can then cause the internal spot-weld on the handle to fail. Silicone will not stay in place and can become FOD. And the wax-like substance tends to gum up the handle and is very time consuming to remove.

Finally, check the pivot pin of the fixed or ratchet head. Does it show signs of tampering? CFTCC has had torque wrenches come in for repair with nuts and bolts in place of rivets, or sometimes circlips are missing. Have a look at the handle: does it show signs of abuse, such as marks from jack handles or extension bars being used? The use of extensions destroys ratchets, bends torque wrench spring tubes, and leads to over-torquing. Some torque wrench models have plastic handles that can break when dropped or subjected to excessive force. If anything is missing or looks suspicious, have the wrench verified. It's worth your time.

Torque wrench tampering is a serious problem that must be addressed. As a technician, it is your responsibility to ensure the tools you use are treated with appropriate respect. As a supervisor, it is your responsibility to ensure your technicians are using the tools correctly. This can start with picking up the torque wrench off the tool board during your walk-around and checking for signs of tampering. Torque wrenches are precision instruments and require a little extra care to ensure that you are getting the torque you need. Tampering costs time, money and, in certain circumstances, lives. Don't find yourself paying the price for using a torque wrench that has been tampered with.

DO

- ✓ Treat a torque wrench like the precision instrument it is.
- ✓ Return torque wrenches to the lowest value on the scale for storage.
- ✓ Pull torque wrench to apply torque: do not push.
- ✓ Apply torque smoothly: don't use a fast jerky motion.

DO NOT

- × Use cheater bars or extensions.
- × Exceed rated torque capacity of the wrench.
- × Use torque wrenches to break fasteners loose.
- × Tamper with torque wrenches. ◆

From the DIRECTOR

Flight Safety & Op Tempo: Strange bedfellows?

One of the toughest flight safety issues involves operational tempo. Everywhere I visit, people express concern about the rate of effort demanded on a continuous basis. And while all agree that high operational tempo presents a challenge, attitudes about its safety implications generally fall into one of two camps. The first I would express as, "Yes, it's high, but we can handle it." The second is more along the lines of, "If we keep going like this, we are going to break something or hurt someone." Whether those in the first group are optimistic or delusional, and whether those in the second group are pessimistic or realistic, I'll leave up to you.

The Royal Australian Navy recently released a collateral Board of Inquiry into a multiple-fatality *Sea King* accident. The Board gave serious consideration to the relationship of high operational tempo to safety, which they found to be complex. "The Inquiry identified that…non-compliant practices (had) developed in response to high maintenance workload…during periods of high tempo of operations… that resulted from strategic and Government tasking… When combined with low supervisor experience levels, these practices became embedded as part of the way maintenance was conducted." Although problems in the unit maintenance culture were exacerbated by high operational tempo, the Board noted that reducing operational tempo would not have cured the sick maintenance culture. Only good leadership and supervision could have done that - and the Board assigned blame accordingly. Procedures to mitigate human error, and to ensure accountability, were sacrificed in a maintenance culture that valued expediency over safety and that minimized supervisor responsibility for airworthiness. The flight safety system had given warning of problems in the unit, but effective action was not taken and a serious accident resulted.

The Board also found that while the CO had informed his superiors of the unit's problems, he had softened the message sufficiently that they were not unduly alarmed. No one questioned when he bid to increase his YFR allocation or when he increased the number of squadron detachments. Maintenance authorities at higher levels did not react to audit observations expressing serious concern about unit maintenance culture. Thus, resources to help the unit were not deployed and the situation went from bad to worse. In the end the CO was held accountable – but so were others whose timely intervention might have helped to avoid this accident.

This takes us back to the two views of operational tempo. If your view is, "It's high, but we can handle it," you may be deluded unless you have adequate warning systems (flight safety or others) to let you know when things are going wrong so that you can correct early. If your view is, "If we keep going like this, we are going to break something or hurt someone," (and you think you're a realist) you should be looking for ways to solve the problem (bypassing safeguards isn't one of them). High operational tempo is not going to go away anytime soon, but if it is affecting safety, your superiors need to know about it in clear and unambiguous language. High operational tempo can be managed safely, but as I said at the beginning, it is one of the toughest issues we face today. ◆

Director of Flight Safety

From the Flight Surgeon

Solving the Misery

Motion sickness in aviation

By Dr. Bob Cheung, Neurophysiologist, Defence Research and Development Canada (DRDC), Toronto

Many forms of transport, from surface vehicles to air and space vehicles, cause motion discomfort in susceptible individuals. The symptoms are collectively known as "motion sickness", a term popularized by Sir Frederick Banting during the Second World War when seasickness and airsickness were first studied together. Motion sickness is a maladaptive response to real or apparent motion. The most dreaded kind of motion discomfort occurs on long duration voyages where susceptible individuals often feel that they are effectively imprisoned in the nauseogenic environment; for example, when one must sit at the back of a *Hercules* or *Aurora* on a long haul flight.

Motion sickness can be evoked as much by the absence of expected motion as by the presence of unfamiliar or apparent conflicting motion. For example: simulator sickness and cyber sickness (sickness induced by computer generated virtual displays, or in an IMAX cinema) are examples of conditions where the stimulus is the absence of physical motion and the presence of a visually-induced apparent sensation of motion. Simulator sickness comprises a number of motion sickness-like signs and symptoms. It is generally less severe but the after-effects (flashbacks) can appear much later after the initial exposure.

Signs and Symptoms

The most obvious signs are pallor (turning pale), cold sweating, vomiting, or retching. The most obvious symptom is nausea, which is often a precedent to vomiting. However, vomiting can sometimes occur without nausea. The physiological mechanism of vomiting and retching is identical except that vomiting involves the forced expulsion of stomach contents, and it is psychologically more gratifying afterwards as it usually provides rapid relief from nausea. Retching is unproductive and the feelings of malaise usually linger.

Signs and symptoms commonly occur in an orderly sequence, including stomach awareness, stomach discomfort, cold sweating, skin pallor, drowsiness, yawning, feeling of bodily warmth, increased salivation, nausea, and vomiting/retching. The common after-effects are persistent headache, apathy, lethargy, lack of appetite, general malaise, persistent dizziness, light-headedness or disorientation, belching/flatulence, and feeling miserable or depressed. There is a symptom complex known as Sopite Syndrome that includes frequent yawning, drowsiness, both physical and mental disinclination for work, and avoidance of participation in group activities. There is also some evidence that individuals who are extremely susceptible to motion sickness may succumb to hypothermia more quickly.

The time scale for the development of motion sickness is determined primarily by the intensity of the stimulus and the susceptibility of the individual. Certain individuals may experience many of the above effects – feeling ill for a considerable amount of time – but they may not vomit; others may have a short warning period, vomit, and feel better almost immediately. The cyclical pattern may last for several hours or, in extreme cases, for days. Dehydration and disturbance of electrolyte balances in the body brought about by repeated vomiting worsens the disability.

Performance

There are documented changes in behaviour and performance such as losing a sense of wellbeing, distraction from tasks, decreased spontaneity, inactivity, being subdued, decreased readiness to perform, and decreased muscular and eye-hand coordination. Other related problems such as spatial disorientation, sleep disturbance, postural disequilibrium, and visual blurring have been documented, sometimes without obvious sickness. Operationally, loss of wellbeing interferes with a person's ability to perform tasks, and the person can become a liability to others: for example, motion sickness can affect the ability of troops to carry out duties immediately after landing or following a parachute jump; and the sight and smell of vomitus in a confined space can affect morale (remember the back of the *Hercules* or *Aurora*). It has also been reported that severe motion sickness can erode the will to survive.

Susceptibility

How susceptible individuals are to motion sickness varies widely and depends on three factors: **receptivity**, **adaptability** and **retentivity**. **Receptivity** relates to how sensitive one's inner ear vestibular system is to the particular motion experienced. A highly receptive person will become sick with only minor stimulation. **Adaptability:** generally, aircrew who fly frequently adapt to the motion of the aircraft and rarely become motion sick. However, some people do not adapt to new motion and may become sick each time they fly, even if they fly frequently. **Retentivity**: it is important for adaptation to be retained once it has been achieved. If one can retain the sensation of a new motion easily then the adaptation will be sustained even without being frequently exposed to that environment. Someone who cannot retain it will lose the adaptation very quickly. Overall, if someone is very receptive to new motion stimuli, adapts slowly, and fails to retain this adaptation easily, there is a high probability that motion sickness will be an ongoing problem. And if the reverse is true, the person is unlikely to suffer the effects of motion sickness.


Photo: Master Corporal Brian Walsh

Genetics may play a role, but there is little evidence that there is a gender difference. However, some scientific data suggests that aerobically fit individuals are more susceptible. That said, anyone can experience motion sickness given enough stimulation, although some are simply more prone than others. Introduce a complicating factor such as speed, turbulence or a particular flight manoeuvre and that individual can quickly begin to feel overwhelmed with motion sickness and the associated stress.

Prevention and Countermeasures

Certain drugs can reduce the incidence and severity of motion sickness. Unfortunately, none can completely prevent motion sickness in the population susceptible to all conditions of provocative stimulation. There is also no "magic bullet" for everyone: while drug A is effective on some, drug B may be better for others. None of the drugs that have been proven effective are all-encompassing, and all have side effects that severely limit their utility in the working environment.

For example, the three relatively effective and commonly used drugs promethazine, dimenhydrinate, and scopolamine are central depressants that can affect brain activities and cause drowsiness, blurred vision, and dizziness. They should not be taken by those in a situation in which performance impairment could jeopardize safety. Those given drugs must be warned that the drugs may impair their ability to fly or operate machinery and that they should refrain from the consumption of alcohol as it will increase the sedating effect. The possible performance decrement due to sickness *must* be weighed against side effects that may be produced by the drugs.

Unconventional Treatments

Various commercial devices, such as wristbands and sea bands, were found to be ineffective in reducing nausea and vomiting. A variety of herbal (ginger root) and homeopathic (Cocculus, Nux Vomica, Petroleum, Tabacum, Kreosotum, Borax and Rhus Tox, ginger roots) remedies have not been found consistently effective, and the various purported evidence is confusing at best. It is possible for the alternative remedies to appear beneficial by a combination of the placebo effect and habituation to the environment. The effectiveness

The Canadian Forces Airsickness Desensitization Program

By Captain R. Morrell, Wing Surgeon, 15 Wing Moose Jaw

Many student pilots experience airsickness as they begin their flight training. For most, this will be a mild annoyance for a few flights and then improve. But for others it can be debilitating; these students will be offered the airsickness desensitization program after three consecutive flights involving significant nausea.

After assessment by a flight surgeon, the first step is a trial of medication and education on techniques to combat motion sickness. For three non-solo flights, the student may fly with anti-motion sickness medication (in combination with a stimulant to counteract the sedative effects) to see if acclimatization will occur. The medications used for this are 25 mg of promethazine with 10 mg of dextroamphetamine one to two hours before flight. If the student still experiences airsickness following a trial of medication, they are entered into the "spin" program.

The spin chamber is an enclosed rotation platform (see photo) fitted with monitoring equipment and a central jet seat. The student is monitored continuously during the spin and communicates with the operator via headset. Every 20 seconds, the student completes a series of head movements and then describes the degree of symptoms they are experiencing on a scale from 1 to 7. The spin begins at a speed of 4 RPM with a goal to tolerate a speed of 20 RPM without symptoms at the end of desensitization. This takes about 40 sessions over three to four weeks of being "spun" twice daily during the week and once daily on weekends.

Once the spin portion is complete, the student goes for a series of five remedial flights with an instructor involving an ever-more aggressive flight profile to evaluate the success of the desensitization. If no motion sickness occurs, the program is complete and the student can resume flight training. The overall success as measured by return to normal flight training is 77%[1]. ◆

1 Banks, R.D., Salisbury, D.A., Ceresia, P.J. (1992). "The Canadian Forces airsickness rehabilitation program", 1989-1991. *Aviation, Space and Environmental Medicine*, *63*, 1098-1101

of biofeedback and other behavioural techniques remains unclear, although they can modify the physiological responses and ameliorate the anxiety that accompanies certain noxious situations.

Desensitization

The most suitable non-pharmacological intervention, at least for airsickness, appears to be habituation to the nauseogenic stimuli. Exposure to the nauseogenic motion provides the susceptible individual the opportunity to improve their ability to predict spatial sensory patterns generated by their actions. This ability is crucial to resolve the sensory conflicts in an altered gravitoinertial environment so that the stimulus is less able to provoke motion sickness.

Practical Recommendations

1. Be well informed about the causes of motion sickness, and be familiar with the signs and symptoms of motion sickness.
2. Do not dwell on past experience or worry about the occurrence of motion sickness because anxiety will only inhibit habituation to the provocative environment.
3. An individual should not fly or sail unless he or she feels fit and well. Recent illness and fatigue cause debility and adversely affect an individual's response to motion.
4. Affected individuals should discuss their symptoms fully and frankly with the flight surgeons as early as possible. It will facilitate recovery and prevent misunderstanding when the effects of motion sickness decrease an individual's performance.
5. Minimizing anxiety by gradually introducing personnel to the type of motion that might be

Photo: Private Vaughan Lighthowler

Low-level flying and fast manoeuvres can aggravate the susceptible individual. Remember the recommendations given here in prepart

experienced in the working environment using ground-based devices might be useful. A self-desensitization procedure such as the torso-rotation technique (Cheung & Hofer 2005) may be introduced under the supervision of a physician or medical staff who are familiar with or have been taught about the procedure.
6. Being involved and concentrating on the task at hand can minimize thinking about and being aware of bodily functions.
7. Do not self-medicate with anti-motion sickness drugs. The affected individual should consult a flight surgeon to try a number of standard anti-motion sickness drugs under supervision.
8. Excessive consumption of food is best avoided since it may increase the volume of vomitus and therefore also amplify the fear of sickness and the extent of any subsequent inconvenience.
9. Alcohol heightens the sensitivity of the organs of balance, and it continues to have measurable effects on the brain and the organs of balance 36 hours after consumption. Hangovers also adversely affect an individual's general ability.
10. Provide optimal environmental conditions including suitable temperature and ventilation and external visual frame of reference when possible. ◆

Dr. Bob Cheung is head of the Performance Group – Individual Readiness section at DRDC and is a motion sickness expert for the Canadian Forces. This article is written with contribution from the DFS flight surgeon, Major Martin Clavet.

We Both Lost the Bet!

By Mr. Jacques Michaud, Directorate of Flight Safety, Ottawa

I was scheduled for a night vision goggle (NVG) navigation training mission in the low flying area north of Valcartier. I was the commanding officer (CO) of the squadron at the time and a fairly experienced pilot, as was my observer, the squadron sergeant major (SSM). But we had less than one hundred hours of NVG experience between the two of us. Given our responsibilities in the squadron, we wanted to maximize the training value of this particular mission in order to keep our standards high. The weather for the duration of the flight was forecast to be visual meteorological conditions (VMC) with increasing cloud cover. A severe low pressure system was approaching from the west with heavy snowfall and strong wind; it was expected to move into our area upon completion of the training mission. We planned the low level mission toward the northwest thinking that upon entering deteriorating conditions, we could simply do a 180-degree turn and return to the base.

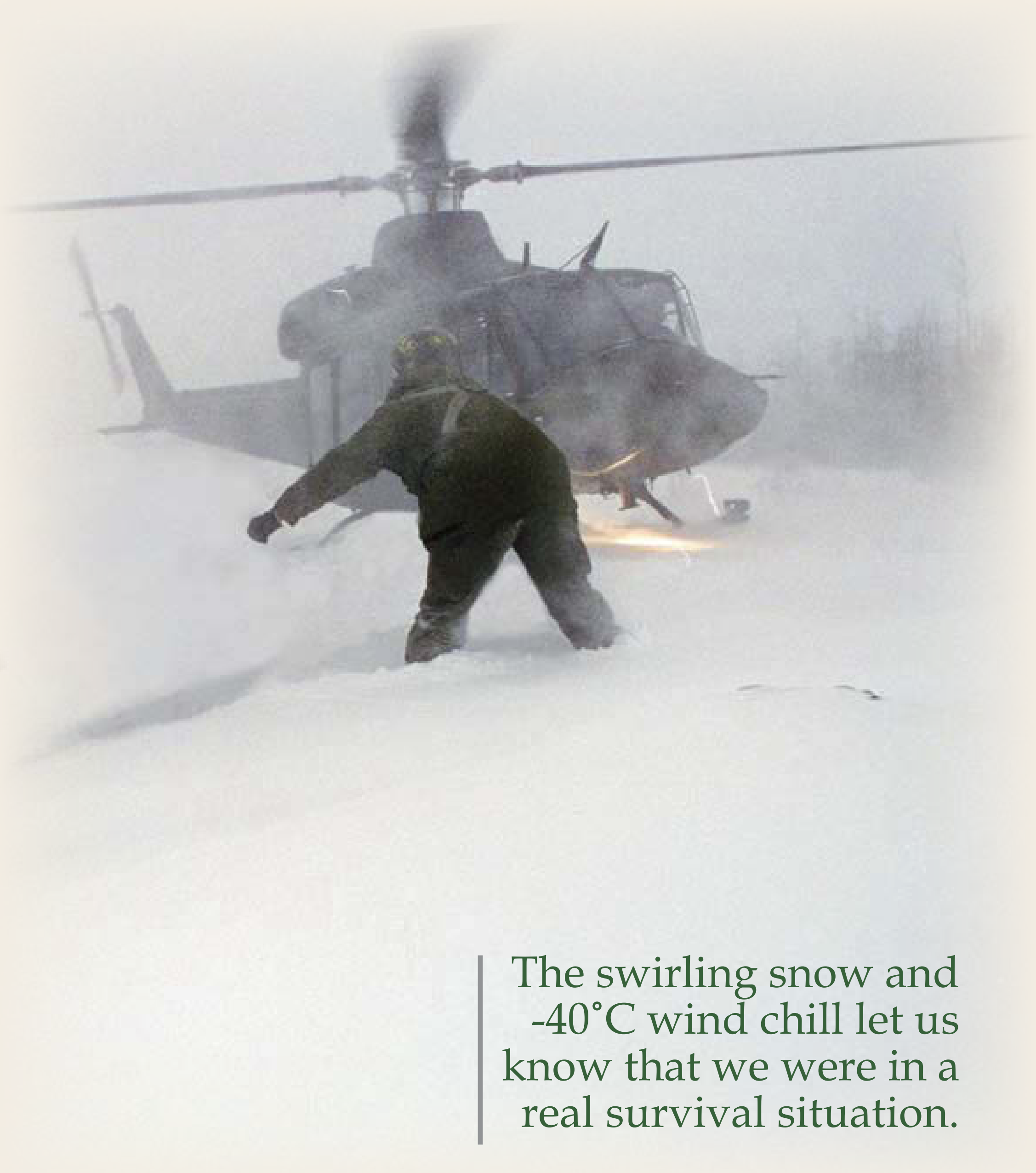
We were able to fly at two hundred feet above the ground without any problems for the first few legs. Whenever we flew together, my observer and I always made friendly bets with each other, like how much fuel we had remaining, our estimated time of arrival at a turning point, pinpointing an exact location, etc. This flight was no different: the betting was tied at two wins each.

Because the mountains prevented direct communications, we had to climb to make a position report back to the Valcartier flight advisory at each turning point. Flight advisory didn't report anything unusual, nor did I think to ask for updates on the rapidly progressing low pressure system.

The third leg was a very long one. It would be taking us along several interconnecting valleys in a northwesterly direction. While approaching our turning point for this next leg, we realized that the ambient lighting conditions had

Photo: Sergeant Ron Hartlen

deteriorated slightly. We decided to climb so we could assess the situation and get the latest weather from Valcartier. In the climb, we noticed that none of the bright red obstacle lights or distant city lights that we expected to see were visible. When we contacted flight advisory, they informed us that the aircraft operating in the low flying area to the south were returning to operate locally as the visibility in their locale was reduced by snow and low clouds. We advised them that we were going to revise our route and come directly back to base. The low weather system that we had been anticipating to be straight ahead to the northwest had blindsided us. It was now a mad race to reach Valcartier before the weather closed in on us.



The swirling snow and -40˚C wind chill let us know that we were in a real survival situation.

Soon, light snow started to fall. The turbulence increased significantly as we progressed towards Valcartier, and so did the snow. Navigation became more and more difficult. We pushed as far ahead as we could, but finally decided that we would be endangering our lives by continuing. It was becoming obvious that we might have to test our survival gear as well as swallow our pride. After all, it isn't every day that the CO and the SSM have to spend the night camping together because they failed to properly assess the weather. When it came to assessing the weather conditions and planning this mission, we definitely both lost this bet!

Due to our reduced altitude, we couldn't contact our squadron or flight advisory to let them know about our intentions to camp overnight. Already having enough problems on our plate, we found a suitable location on a lake that was close to the shoreline and away from the wind and any running water that might have thinned the ice and landed safely. While I tried to radio any overhead civilian aircraft on guard frequency so that they could pass our position and intentions to squadron operations, the SSM bundled up the helicopter and tied the rotor with the high winds tie-downs.

The storm was fully upon us at this point. While the trees along the shoreline gave us some protection, the swirling snow and -40°C wind chill let us know that we were in a real survival situation. During our landing approach, we had seen a small log cabin about seven hundred metres from our position. We didn't want to break into the cabin unless absolutely necessary, but we kept it in mind as a last resort. Happily, both of us had followed unit procedures in wearing the appropriate seasonal clothing. We also had supplemental winter clothing and both survival and winter kits onboard the *Kiowa*.

We decided to set up a tent a few metres into the woods in order to have protection from the storm and ready access to firewood. Things didn't go smoothly, though. Our snowshoe straps broke after only a few steps. The slope, thickness of snow, and density of the forest ultimately prevented us from leaving the lake area at all. Despite the punishing wind gusts, the SSM got the survival tent up while I managed to build a fairly large fire. Those annual winter briefings were really paying off! But maintaining the fire proved very exhaustive. The nearby evergreens provided very poor fuel for the fire, and then the handle of the axe broke. The cottage was quickly becoming more and more attractive.

We eventually agreed that it was better to secure ourselves in the tent – out of the wind – and to try to sleep until the storm passed. We thought about sharing a sleeping bag to preserve body heat: while being good friends, we were not that desperate. We split the available clothing and the sleeping bags between us and settled in for a more or less comfortable night with the noise and cold waking us in turns.

The storm had tapered off to very light snow showers by the next morning after having left a foot of snow. The SSM walked (without snowshoes) to the cottage to confirm its status, just in case we would have to spend a second night in the scenic but isolated Parc des Laurentides. Meanwhile, I checked the helicopter and removed the snow that had infiltrated the intakes despite the winter covers. While the snow had almost stopped, it was obvious that we would not be leaving soon.

> This mission could have been planned differently...

Upon his return, the SSM melted some ice and brewed a hot drink using half of an orange juice packet. And with one square jujube from our survival pack each, we were ready for our day. We concentrated primarily on survival, all the time thinking about how we would brief the troops on our humbling experience.

The ground search party eventually reached us on snowmobiles in the late afternoon. Apart from a few frozen fingers and hurt pride, we arrived safely at home. The helicopter was recovered, undamaged, by a fresh crew the next morning.

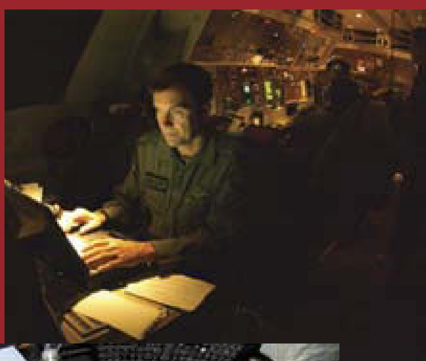
I can't recall exactly what we said to our fellow crew members during our morning briefing the next day, but I certainly remember some good lessons from that experience:

- **Plan for the worst.**
- **Keep air traffic control informed** with accurate position reports – it sure helps during the search and rescue response.
- **Weather, even with the improved forecasting methods, can be unpredictable.** Given the forecast that day, the training mission could have easily been planned closer to the base so that recovery would have been easy in the case of deteriorating weather. It would have also made possible constant two-way communication. Given the chain of events, we could have saved the day by **seeking the latest hourly weather reports or forecast changes** every time we climbed for a position report.
- **NVGs are great but they have important limitations in precipitation and low ambient lighting conditions.** The low level profile normally followed during NVG flights will often have the aircrew recognizing later, rather than sooner, that they are flying under descending cloud.

While it may be good to maximize the training value of a mission, the risk analysis has to assess all factors impacting the mission. This includes assessing the risk and factoring in some mitigating measures to alleviate or eliminate the risk. I strongly believe that, unless you love winter survival, this mission could have been planned differently while achieving the same training value, and eliminating the risk of being surprised by the weather. Even if you're a betting person, you don't want to bet on your life or the lives of other crew members. ◆

Where's Your Mind in Thin Air?

By Captain Serge Parisien, A3 Long Range Patrol Readiness 2, 1 Canadian Air Division, 17 Wing Winnipeg



Are you backing up your crewmembers? Is someone experiencing symptoms of hypoxia? You know what to do!

Photos: Sergeant Frank Hudec and Corporal J.F. Lauzé

Our CP140 *Aurora* crew of 14 pilots, navigators, flight engineers, and airborne electronic sensor operators (AESOPs) had been flying together for nearly seven months. We had worked up together as one of the high-readiness Vanguard crews. We had a healthy mix of experience levels, as would be expected, but we were all professionals. Everyone knew the rules and regulations and was comfortable that other crewmembers were good to go.

We were scheduled to fly a routine surveillance patrol: a ten-hour mission locating and identifying all vessels in our assigned area. We had gotten airborne, gone through our post takeoff checks, and configured the plane for our mission. We were settling in for the 45-minute transit to our patrol box flying at FL150 when the flight engineer indicated that there was a problem: somehow our plane was losing pressurization.

At the time it was noticed our cabin pressure was almost up to 11,500 feet. We quickly ducked down to below 10,000 feet where we were breathing safe air. This whole incident took place in the span of a few minutes and appeared to be over before it had begun. Or so it would appear.

During the discussion immediately following the incident (still airborne, mind you), the cabin crew noticed no symptoms of hypoxia. However, both pilots acknowledged some minor dizziness that had passed, but indicated they were fine now and insisted we continue the mission.

Everyone in the back of the *Aurora* began chattering about how unwise this was. Even the most junior member of the crew was able to quote verbatim the regulations: by orders[1], we were required to return home *immediately* after any crewmember experienced hypoxia symptoms and get checked out by a flight surgeon. Once the pilots were confronted with the written order in hand, the crew commander took a look and said, "Of course, what was I thinking?" We returned home without further incident.

My point is that we all need to remember our training. Remember your chamber ride during aeromedical training? You disconnect from the oxygen and try to draw silly little pictures or something of the sort until you notice your hypoxia symptoms. I now understand why they did that to me – so the orders make sense!

Our pilots were experienced: they knew the rules and had the training. But for a short little while in that CP140, their brains were fuelled with a little bit of thin air and they couldn't draw the silly little pictures. Their backup, the rest of the crew, did exactly what they were supposed to do: they approached the crew commander with their concern and the plane and crew landed safely at the end of the day. ◆

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1 B-GA-100-001/AA001 *National Defence Flying Orders* Chapter 9.22 and 24

Pride Has No Place

By Captain Peter Kallenbach, 51 Aerospace Control and Warning Squadron, 22 Wing North Bay

Photo: Sergeant Frank Hudec

Operation DENY FLIGHT, the air policing of Bosnia-Herzegovina, was one of the busiest periods of operational flying for the NATO E-3A Component: 24-hour coverage in one orbit, and daylight hours or more in a second. It was a time where waivers on flying quotas were being regularly granted to meet mission requirements, and augmentation from one squadron to another was equally as common, when crews were needed for yet another deployment.

Using two-week rotations, it was Flying Squadron 2's turn to provide crews for the Adriatic orbit; they would stage from Forward Operating Base (FOB) Aktion, Greece. Since Squadron 3 was manning the Hungarian orbit, we at Squadron 1 were asked to provide augmentation. We would supply Sqn 2 with a weapons controller (WC) for the first week of the deployment, and a surveillance controller (SC) for the second week.

As an available SC, I quickly volunteered. I loved the flying, and Greece in September is a very nice place to be. Things weren't quite so rosy when I arrived with the rest of the swap-out crew, though. It was discovered too late that the Sqn 1 WC that came down for the first week was DNIF-A (duties not to include flying, A = expired medical category). Sqn 2 was very upset, and there was much cursing about the quality of augmentation Sqn 1 had provided. I did what I could to avoid their wrath.

Then, a couple of days later, it happened. I awoke at the hotel in as much pain as I had ever experienced. My entire body ached, and I had no explanation for why; the night before had certainly been uneventful. There were no sharp pains, but every move I made heightened the overall effect. As I laboured to ready myself for show time, thoughts of seeing the doctor were furthest from my mind. The quality of Greek flight surgeons aside, I was not going to let anyone know that Sqn 1 messed up the second week, too.

The walk out the hotel to meet the crew bus was agonizing, the pain being amplified further by the brilliant sunshine. Finally on the jet, I managed to seat myself at the bulkhead console to help prop myself up. Somehow I survived and even landed, thinking that I had done my job. Still avoiding the medics, I hoped to be able to sleep it off in time for the next sortie, but the night's rest changed nothing, and I had to go through this ordeal a second time. Another 24 hours passed before I felt I had recovered.

I had never felt anything like that before or since, and it would be years before I objectively reflected on the consequences of my decisions. While I succeeded in not leaving the crew a man short, my condition could have made me a serious liability to them if there been any sort of in-flight emergency. Though I could do my job on scope, I was otherwise little more than dead weight. Had there been an incident on either flight, could the adrenalin rush have been enough to overcome my ailment, or would someone still have to help me while also keeping themselves safe? Had I grounded myself, yes, the jabs at my squadron would have certainly started up again, but they would have ended eventually. Instead I let unit pride dictate my actions and, in the process, I potentially and needlessly jeopardized the lives of some or all of my fellow crewmates for the sake of being spared a few insults.

The rivalries we enjoy within the military are really good morale builders, but they should not be the principles on which mission success hinges. If you are sick, stay home. Just because you are not contagious does not mean that you are fit to perform. When it comes to flight safety, pride has no place in the decision matrix. ◆

178 Seconds to Live

VFR into IMC

A guide for pilots flying VFR on how to avoid getting into trouble in deteriorating weather

By Paul Cummins and staff writers at Flight Safety Australia

It's an all-too-common scenario: a VFR pilot flies into instrument meteorological conditions (IMC) and needs help.

On average, Australian air traffic controllers are called upon once every 10 days to assist a pilot in deteriorating weather.

Of the reported occurrences, 60 percent are above cloud and can't get down. The remainder are either in deteriorating weather, in cloud, or have reduced visibility due to smoke or haze.

It is a dangerous situation. American research shows that 76 percent of VFR into IMC accidents involve a fatality.

Thee dangers of flying VFR into IMC have been recognized for a long time. Yet VFR pilots still fly into deteriorating weather and IMC.

Some of these pilots may simply underestimate the danger and overestimate their ability to cope with flight in reduced visibility.

The pilots of the 24 fatal aircraft accidents involving continued flight into IMC in Australia over the 10 years from 1992 to 2002 probably thought the same thing. Fifty-four lives were lost in these accidents.

At some stage in your flying you will encounter bad weather – unless you only fly on perfect weather days. Spatial disorientation is the big danger, and it can happen a lot faster than you might think – just 178 seconds on average, about the length of a commercial break on TV.

That estimate is based on studies in the 1990s by aviation researchers at the University of Illinois. They took 20 VFR pilots and got them to fly into IMC in specially programmed flight simulators.

All of the pilots in the study went into graveyard spirals that would have ended in uncontrolled flight into terrain or rollercoaster-like oscillations that become so intense that they result in structural failure of the aircraft.

In repeated tests on the simulator the result was the same – all pilots lost control of the aircraft. The outcome differed only in the time required before control was lost, which ranged from just 20 seconds to 480 seconds.

They took 20 VFR pilots and got them to fly into IMC in specially programmed flight simulators. All of the pilots went into graveyard spirals.

A close look at one VFR-into-IMC incident illustrates the dangers.

In 1999, a pilot was conducting a VFR flight from Walgett to an airstrip near Merriwa. The Piper Archer had departed from Walgett earlier in the day, but returned a short time later when it was reported that weather at the destination was not suitable for VFR flight.

However, the pilot felt under pressure to complete the flight that day. He continued to monitor the weather by telephoning for weather reports from an automatic Bureau of Meteorology outlet and by contacting a friend near the destination airfield.

The aircraft departed again at 1415. But the pilot never reached Merriwa.

The aircraft's wreckage was located two days later on top of a ridge, 3,880 feet above mean sea level (ASL) slightly to the left of the direct track between Walgett and Merriwa.

The Australian Transport Safety Board (ATSB) investigation found that the Piper Archer collided with trees during a right turn, at a rate of descent of about 2,500 ft/min. A post impact fire consumed the cabin and fuselage immediately behind the cabin.

The pilot and passenger escaped the wreckage; however, the pilot died from his injuries before rescuers could get to the accident site.

The pilot held a private pilot licence for airplanes and a commercial helicopter licence, together with a valid medical certificate. He did not hold an instrument rating and the aircraft was not approved for IMC.

Reports at the time of the accident indicated that the cloud base was 3,600 ft ASL, and that cloud was covering the ridge where the wreckage was found. The weather over lower terrain to the southwest of the accident site was suitable for VFR flight.

Once the aircraft entered cloud, the pilot was no longer able to rely on external visual references, and most likely became spatially disoriented.

Investigators noted that the pressure the pilot felt to complete the flight might have influenced him into choosing the shortest direct route over high terrain, with associated poor visibility, rather than the longer route further to the southwest where clearer conditions prevailed.

Decisions, decisions

Just how different decision making patterns affect safety was the subject of a recent ATSB report.

Three weather-related decision making behaviours were compared: VFR pilots flying into IMC; a weather-related precautionary landing; and significant weather avoidance action.

The results suggest that the mid-point of the flight can be a "psychological turning point" for pilots, regardless of the flight distance involved.

The VFR into IMC group had the greatest risk of a fatality or serious injury, while the precautionary landing group had the greatest risk of some form of aircraft damage.

The chance of a VFR into IMC encounter increased as the flight progressed until it reached a peak during the final 20 percent of the flight distance. The results highlight the danger of pilots "pressing on" to reach their destination.

A VFR pilot may exhibit a range of behaviours when faced with adverse weather. For example, at the first hint that conditions are deteriorating, a pilot may decide to immediately return to the point of departure.

At the other extreme, a pilot may press on into deteriorating weather, either unable or unwilling to see the increasing danger of their actions, until the aircraft suddenly enters IMC.

A more typical scenario might involve a pilot who, in response to deteriorating conditions, initially continues the flight as planned, but later decides to return, divert, or perhaps even carry out a precautionary landing.

Chance can play a big part in the outcome as the following two accident case histories illustrate:

In case 1, the aircraft was on a private flight from Shepparton to Moorabbin with the pilot and three passengers on board. Before departing from Shepparton, the pilot had obtained an enroute weather forecast that indicated that VFR flight via the Kilmore gap was possible but that conditions were likely to be marginal.

On departure from Shepparton, there was scattered cloud at 2,500 ft with a ceiling of approximately 4,000 ft. Visibility was about 8 km (5 statue miles), with occasional rain showers.

As the flight approached Mangalore, the hills to the east and southwest were shrouded in low stratus. Abeam Seymour, the weather ahead appeared to be closing in, so the pilot began a left turn onto a reciprocal heading for Mangalore. However, the weather had closed in from behind, and soon after completing the turn the aircraft was enveloped in cloud.

The pilot contacted Melbourne ATC and reported that he was in cloud with nil visibility. ATC advised him to concentrate on keeping the wings level, and provided radar vectors to ensure that the aircraft remained clear of high terrain in the vicinity.

Abeam Mangalore the aircraft broke free of cloud and the pilot was able to resume navigation. The flight continued to Shepparton and a safe landing.

This pilot emerged unscathed from a VFR into IMC incident because – luckily – advice and guidance were at hand.

In contrast, the pilot involved in the next accident, while initially slow to recognize deteriorating weather, made a wise decision to carry out a precautionary landing. In spite of this, the aircraft was destroyed and the pilot and one of his passengers were injured.

The planned flight was from Bendigo to Albury. The area forecast indicated that the weather enroute would be okay for VFR flight. A cold front was moving slowly through the region from the southwest, but was not forecast to reach the area of the planned route until after the flight. The pilot did not hold an instrument rating but had completed three hours of instrument flight training.

The aircraft departed Bendigo at 11 am with the pilot, his wife, and their two children on board. It soon became clear that the front was moving much more quickly than forecast and that the weather along the planned route could deteriorate below that required for VFR flight. The pilot decided to return to Bendigo and told ATC of his intentions.

A short time later the pilot again contacted ATC and advised that the weather had deteriorated further and that he was going to carry out a precautionary landing in the Rushworth area.

The pilot identified a suitable landing area and carried out a low speed pass to confirm the area was free of obstacles. He configured the aircraft for a precautionary landing and made a slow-speed approach to the field.

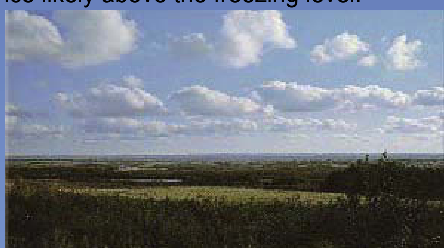
Just after touchdown the nose gear hit the bank of a ditch that was hidden by reeds and long grass. The nose gear was sheared off, and the aircraft continued for some distance before it overturned and came to rest.

The pilot and the front seat passenger were restrained by their lap-sash seat belts, but the pilot suffered

CLOUD CLASSIFICATIONS

CUMULONIMBUS (CB)

Heavy, dense cloud. Lightning, thunder and hail occur and there may be moderate to heavy showers of rain, snow or hail. Turbulence may be severe both in and below cloud, very violent on entering or leaving. Risk of icing; clear ice likely above the freezing level.



CUMULUS (CU)

Generally dense with sharp outlines and uniform bases. Light to moderate turbulence in fine weather. Large cumulus may generate moderate to severe turbulence both in and below cloud; strong turbulence on entering or leaving. Rain or snow may occur. Risk of icing; clear ice just above freezing height.

STRATOCUMULUS (SC)

Grey or whitish patch or sheet of cloud. Very light rain, drizzle or snow may occur. There may be light to moderate turbulence beneath and in cloud, and when passing through inversion at cloud top. Smooth above. Occasional rime icing if the freezing height is low enough. A change in air density through the inversion causes changes in aircraft performance.

STRATUS (ST)

Generally a grey cloud layer with fairly uniform base, which may precipitate as drizzle. Light turbulence. There may be an inversion as with stratocumulus. Usually no icing. At takeoff you need to attain a good speed early in the climb and exercise care in descent.

NIMBOSTRATUS (NS)

Dark grey cloud layer generally covering the whole sky. Generally light turbulence in cloud; may be moderate to severe at fronts and over high landforms. Definite risk of icing; moderate rime. Clear ice probable in lower levels of cloud, particularly when turbulence is present. Accumulation of ice may be great due to extensive cloud coverage. Cumulus or cumulonimbus may be embedded in a large expanse of nimbostratus.

ALTOSTRATUS (AS)

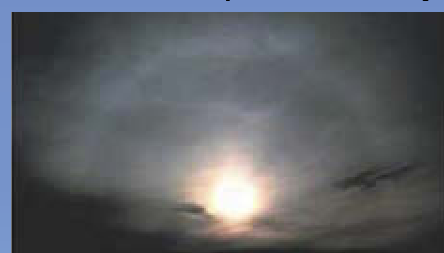
Greyish or bluish cloud sheet. Rain or snow can occur. For thin altostratus there may be a little turbulence in the cloud. Some risk of icing and light rime. Clear ice is possible in lower levels of cloud. For thick altostratus, turbulence is generally light in cloud. Turbulence may be moderate to severe at fronts and over high landforms.

CIRROCUMULUS (CC)

Thin white patch, sheet or layer of cloud without shading. The globular form of cirrocumulus indicates turbulence. Too high for significant icing. Cloud usually dissipates rapidly.

CIRRUS (CI)

Detached clouds in the form of white filaments. Little turbulence unless cirrus is associated with a jet stream. No icing.



CIRROSTRATUS (CS)

Transparent whitish veil and generally producing a halo phenomenon. Turbulence may be felt on entering cloud – but is usually light. Mostly too high for significant icing.

ALTOCUMULUS (AC)

A patched layer of cloud made up of flattened globular masses. An unstable atmosphere may produce virga or slight showers. Turbulence is usually light. There is a risk of light rime icing.

a fracture to his left arm. One of the passengers in the rear of the aircraft received minor injuries.

What happens when you enter cloud?

Our normal environment is with two feet planted firmly on the earth, clear vision of our surroundings, gravity allowing us to feel weight/pressure on our feet (with a force of 1 g), and our inner ears providing our sense of balance.

Orientation is achieved with 80 percent of the input to your brain coming from your eyes (external visual references) and 20 percent split between your inner ear and proprioceptive system (seat of the pants or what you feel).

When you are flying, you are operating in an unnatural environment that can result in different forces.

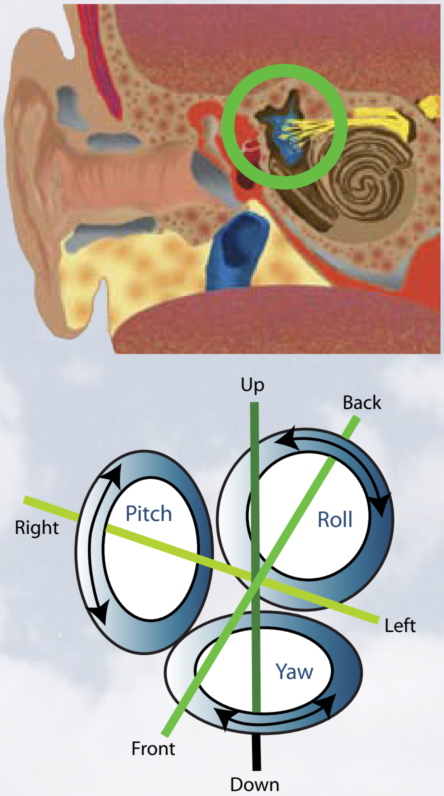
Usually it is easy to orient yourself in VFR flight. You have visual reference to a horizon outside the aircraft, and in steady flight you only have a force of 1 g acting on you. Even pulling 2 g in a steep turn is usually not a problem as long as you can see a horizon to maintain orientation.

But when a VFR pilot enters cloud, the horizon disappears. Suddenly, 80 percent of the input you need for orientation is lost. Worse, if your flight attitude changes, or you make any manoeuvre that results in forces of more than 1 g, your sense of balance will also change.

Forces on the ear

Each of the three canals in the inner ear is aligned along a different axis of rotation and contains a small tuft of sensory hairs (above circled). Orientation illusions can occur when these hairs are affected by acceleration.

Spatial illusions and disorientation are created when the fluid of the inner ear responds to acceleration, deceleration, pitch, roll and yaw.



***Forces on the ear:** Each of the three canals in the inner ear is aligned along a different axis of rotation and contains a small tuft of sensory hairs (circled above). Orientation illusions can occur when these hairs are affected by acceleration.*

It is very easy to find yourself in a gradual turn once you have lost the horizon.

Your inner ears will simply not detect the change.

Even after a minor distraction in the cockpit, you can find that when you look back at the artificial horizon that there has been a slow, 10 or 15 degree bank angle introduced.

You make control inputs to correct the turn. But without a view of the horizon you will be relying on your sense of balance provided by your inner ears. The problem is that the acceleration forces affect the fluids in your inner ears, resulting in a sensation of turning in the opposite direction.

To overcome this illusion you might make a correction back to the original position. While this may feel better to you, the original turn has been reintroduced with the airspeed increasing and the altimeter unwinding rapidly.

The illusions can be so strong that many pilots will disregard their instruments, certain that they're wrong.

There is a simple way to demonstrate what it feels like to experience a slight disorientation or dizziness similar to the illusions that may happen in a cockpit in cloud. Sit on a swivel office chair and tuck you feet under the seat of the chair.

Close your eyes and place your head forward so your chin touches your chest. Hold onto the seat so you don't fall off and get someone to spin you around on the chair for three or four rotations (it doesn't have to be very fast).

Then lift your head up straight and open your eyes. You will feel a slight dizziness as the movement of the fluid in the inner ear was moved into another rotational plane when you moved your head. This is different to what your eyes were telling you.

If you are VFR and you find yourself in IMC you need to ignore your senses and follow your instruments. Seek help from ATC if you can. And try to remain calm. Some general principles of instrument flying need to be understood and followed:

- Trust the instruments and believe what they are telling you.
- Maintain a scan of the instruments.
- Do not dwell on one instrument for too long, and check the attitude indicator after you check any other instrument.
- Use smooth and gentle control inputs to get the aircraft to do what you want.

One of the keys to avoiding a VFR into IMC incident is to be able to recognize deterioration in the weather while there is still time to make a safe diversion. This is often easier said than done, but there is evidence that in-flight, weather-related decision making can be practised and learned.

Research by the US Federal Aviation Administration has found that experienced pilots generally use the following indicators to assess in-flight weather changes:

- Lowering cloud base
- Rising terrain
- Darkening clouds
- Increasing cloud cover
- Reducing visibility
- Rain showers
- Changes in wind direction and speed

A change in three or more indicators is sufficient for the experienced pilot to initiate a diversion to an alternate or a return to the departure aerodrome.

You should monitor the weather behind your aircraft. There is no point deciding to turn back to find that the weather behind the aircraft is as bad as it is in front – or worse.

Always give yourself time to make informed decisions. If the weather appears to be getting worse, slow the aircraft down (use flaps and lower the undercarriage). The slower speed will usually improve your forward visibility and give you more decision making time. It will also reduce your turning radius if you have to manoeuvre in a tight space.

The safest thing to do is to cancel a flight if the conditions look like they might become marginal. But it can be a difficult decision because you might have a lot of time and effort invested in the flight, and there may be friends and family counting on you.

Remember, your primary responsibility is your safety and the safety of your passengers.

Preparation (Canada)

The key, of course, is to avoid deteriorating weather or IMC in the planning phase.

Thorough weather planning and an extensive understanding of weather forecasts and meteorological conditions help pilots determine whether the weather is acceptable for VFR flight.

Weather briefings for Canada are available on the intranet at http://met.forces.gc.ca, or on the Internet www.flightplanning.navcanada.ca.

The weather on the TV usually gives a satellite image and a surface chart. Get to know what they mean and use them to check the weather around you even when not flying to give you an indication of how frontal passages and cloud bands evolve. Animations of satellite imagery are particularly useful.

However, when you do commit to going flying make sure you get the relevant aviation forecasts you need and update through local flight service stations (FSSs). You can also call ahead to your destination to find out actual weather or check with ATC to hear from pilots flying along the route. Free access to the pilots automatic telephone weather answering service (PATWAS) is available at 1-866-WXBRIEF (1-866-992-7433). Calls to this service are routed to the flight information centre (FIC) serving the area from which you are calling. METARs and TAFs for the local area and all across Canada can be obtained through this service.

When you are planning to take passengers, make sure they understand the importance of the weather conditions, and tell them that you will cancel plans if the weather is not suitable.

If someone has to be home by a certain time, make sure they understand this might not be possible.

Have the latest applicable routine weather reports (METARs), terminal area forecasts (TAFs), and graphical area forecasts (GFAs).

Use ATC flight following services enroute. Call FSSs for updates of weather reports. And remember to always update the altimeter with local ATIS or FSS reports to ensure you are flying an accurate height.

It all comes down to thorough preparation, alternate plans, and timely decision making.

And decisions have to be constantly reassessed based on the current situation – looking and planning ahead is essential. Problems occur when pilots fail to make a decision.

It is vital that you constantly consider your options and that you are prepared to act swiftly.

Think *could I get through there – have I got an escape route? It's okay to turn around. It's okay to consider that I won't make my destination.*

It comes down to thorough preparation, a range of alternate plans and timely decision making. ◆

Sources

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This article is printed with permission from the author and from the editor of Flight Safety Australia*, in which it was originally printed in the January-February 2006 issue. It has been slightly modified to be relevant to the Canadian audience. Thanks to Mr. Barry Konzelman at the Canadian Forces Meteorology School for his input.*

WEATHER INFORMATION INTERPRETATION

TERMINOLOGY

Date/Time	eg, 192053Z = Issued at 2053 UTC on 19th of month.
Validity period	eg, 0214 = Valid from 0200 UTC to 1400 UTC.
Wind direction	Degrees true in TAF, METAR and SPECI Degrees magnetic in takeoff and landing reports from ATC and ATIS. eg, in TAF, 24015G30KT = 240 degrees true, 15 kts, gusting 30 kts
Visibility	Statute miles in TAF, METAR and SPECI

SIGNIFICANT PRESENT AND FORECAST WEATHER - ABBREVIATIONS

-	Light
	Moderate (no qualifier)
+	Heavy
BC	Patches
BR	Mist
DS	Duststorm
DU	Dust
DZ	Drizzle
FC	Funnel clouds (tornado or waterspout)
FG	Fog
FU	Smoke
FZ	Freezing
GR	Hail
HZ	Haze
IC	Ice crystals (diamond dust)
MI	Shallow
NC	No change
PO	Dust devils
SA	Sand
SH	Showers
SN	Snow
SQ	Squalls
SS	Sandstorm
TS	Thunderstorms
RA	Rain
VC	Vicinity of the aerodrome

CLOUD AMOUNTS

SKC	Sky clear
FEW	1-2 OKTAS
SCT	3-4 OKTAS
BKN	5-7 OKTAS
OVC	8 OKTAS

CLOUD TYPES

AC	Altocumulus
AS	Altostratus
CB	Cumulonimbus
CC	Cirrocumulus
CI	Cirrus
CS	Cirrostratus
CU	Cumbulus
NS	Nimbostratus
SC	Stratocumulus
ST	Stratus

CLOUD — HEIGHT OF BASE

TAF, METAR, SPECI
Hundreds of feet above aerodrome level, e.g. 014 = 1400 FT

Takeoff and landing reports, ATIS
Feet above aerodrome elevation

CUMULONIMBUS

ISOL	ISOLATED - for individual CBs
OCNL	OCCASIONAL - for well-separated CBs
FRQ	FREQUENT - for CBs with little of no separation

FORECASTS

TAF **Aerodrome Forecast:**
5NM radius
Cloud Heights - AGL

GFA **Area Forecast:**
Below FL200
Cloud Heights - AMSL

OTHER REFERENCES

SIGMET
AIRMET

FORECAST TERMS

AMD	Amended – at the time stated for the period started
PROB	Probability – eg, 30% probability of fog occurring
FM	From – followed by the time a weather change is forecast to begin (eg FM1439 Indicates changes significantly different to preceding information in one or more elements. The changes relate to improvements as well as deteriorations. The fore cast conditions commencing with "FM" will continue until the end of the forecast validity period, or until replaced by another significant change.
TEMPO	Used to indicate change in prevailing condtions expected to last for a period of less than one hour in each instance.
INTER	Used to indicate changes expected to occur frequently for periods of less than 30 minutes duration, the conditions fluctuating almost constantly, between the times specified in the forecast.
FZL	Freezing level in feet ASL
INTST	Intensity

On the Dials

CNS/ATM (Part I)

Solutions for crowded skies

Information for IFR Flight

This article is the first of a series intended to inform you of upcoming technology and procedural changes that will revolutionize how we conduct instrument flying operations. Time to do some studying again!

By Major Mike "Ruggy" Wolter, Instrument Check Pilot (ICP) School flight commander, 17 Wing Winnipeg

It's quiz time! My 11 year old's favourite line to hear at school… not! You need a 70% to pass this one. Have a look at the list of acronyms on the left and then draw a line to the acronym or word on the right that *best* matches:

GLS	RADAR
CPDLC	APPROACH
EVS	ALTITUDE
ADS-B	ILS
MODE-S	COMMUNICATION
LPV	TCAS
MLAT	NVG
TAWS	TRANSPONDER
RVSM	NON-PRECISION
LNAV	GPWS

Check page 26 for the answers. So how did you do? I imagine not too well for most of you out there. The list on the right should be familiar, but what the heck are CPDLC or MLAT?! Read on to find out.

The skies around the world are getting more crowded each year. The Federal Aviation Association (FAA) and Eurocontrol estimate that there will be three times the current traffic levels by the year 2025. The current air traffic systems and methodologies cannot support that volume of activity.

The various air traffic service providers, civilian aircraft operators, and militaries are working together to find solutions to the ever-increasing traffic levels under the CNS/ATM banner. CNS/ATM stands for communications, navigation, surveillance/air traffic management. The ICP School attends a number of military and civilian CNS/ATM conferences to keep abreast of the latest activity. This article and others that will follow are intended to familiarize you with the latest technologies being implemented in the realm of CNS/ATM.

Any air traffic system needs the ability to **communicate**, to have the traffic in that system **navigate** accurately, and the capability to monitor the traffic to help prevent collisions (**surveillance**). To fill these needs, we currently use voice comms, an airway system established on ground-based navaids, and ATC radar and procedural control to keep traffic apart. As the traffic levels continue to rise, comms frequencies will become saturated with too many folks trying to talk; the airway system won't have the capacity to allow enough aircraft into the airway structure; and controllers will become overwhelmed by the volume of traffic.

The acronyms on the quiz are some of the technologies that are being introduced to create the air traffic system of the future. Some, in fact, are in place now. The complete change will take time and will be done in an incremental fashion. Many of these technologies will be mandatory installs in order for an aircraft to remain a player. The big question for the Air Force is, "Will we be ready?" As you read this article you should ask yourself, "Is my community preparing for the changes?" If your fleet fails to keep up, mission accomplishment may be jeopardized if we are ever denied access to airspace.

So let's look at the technologies in the quiz. Later articles will discuss some of these in detail.

GLS stands for GNSS landing system. This is the satellite-based equivalent to today's Instrument

***Figure 1:** Gables G7501-01 GLS-capable navigation control panel (image courtesy of Boeing)*

Landing System, providing both lateral and vertical guidance down to CAT III minimums. Recently, three ICP School staff had the opportunity to fly GLS approaches in a Boeing 737-800 Next Generation aircraft simulator (see in *Figure 1* for the navigation control panel used). It was very similar to ILS to both set up and fly.

CPDLC stands for controller-pilot data link communications. This system is intended to allow the communication of routine ATC instructions through data link vice voice radio. Many airlines and corporate operators are already receiving their initial IFR clearances through data link. The picture in *Figure 2* shows a Boeing 747 flight management system (FMS) CPDLC page with a clearance from ATC to "climb and maintain flight level 330." Note some of the options available for the crew depending on which button they select: standby, reject or accept.

Figure 2: *Boeing 747 FMS CPDLC page (image courtesy of Boeing)*

The following link is a very comprehensive site on ATC data link: http://members.optusnet.com.au/~cjr/index.html.

EVS stands for enhanced vision system. This technology uses different methods, but is similar to

Figure 3: *EVS night view*

night vision goggles (NVGs) in that it is intended to provide a means to see through darkness and, unlike NVGs, through cloud as well. *Figure 3* is a night approach as seen with EVS through a head-up display (HUD).

The following link takes you to an excellent website from CMC Electronics showing the capabilities of EVS technology. It is very interesting to see the difference between the naked eye and the EVS: www.cmcelectronics.ca/En/Prodserv/Commav/commav_evs_overview_en.html#evs_video_clips (videos not viewable through the DWAN firewall).

ADS-B is the acronym for Automatic Dependent Surveillance-Broadcast. This system is designed to provide surveillance capability both between aircraft and ATC. The way it works is relatively simple. Aircraft use GNSS to derive their position. That position information plus other data is then transmitted via datalink to other appropriately equipped aircraft or ATC facilities. *Figure 4* outlines the basic ADS-B architecture.

Nav Canada is implementing ADS-B in the Hudson's Bay area, in the 2008 timeframe, to provide surveillance where previously there was none. ADS-B will provide surveillance coverage over 250,000 square miles of the Hudson Bay area. The following link is to an excellent site on ADS-B: www.ads-b.com/home.htm.

Mode S is a type of transponder. The Mode S transponder is the key

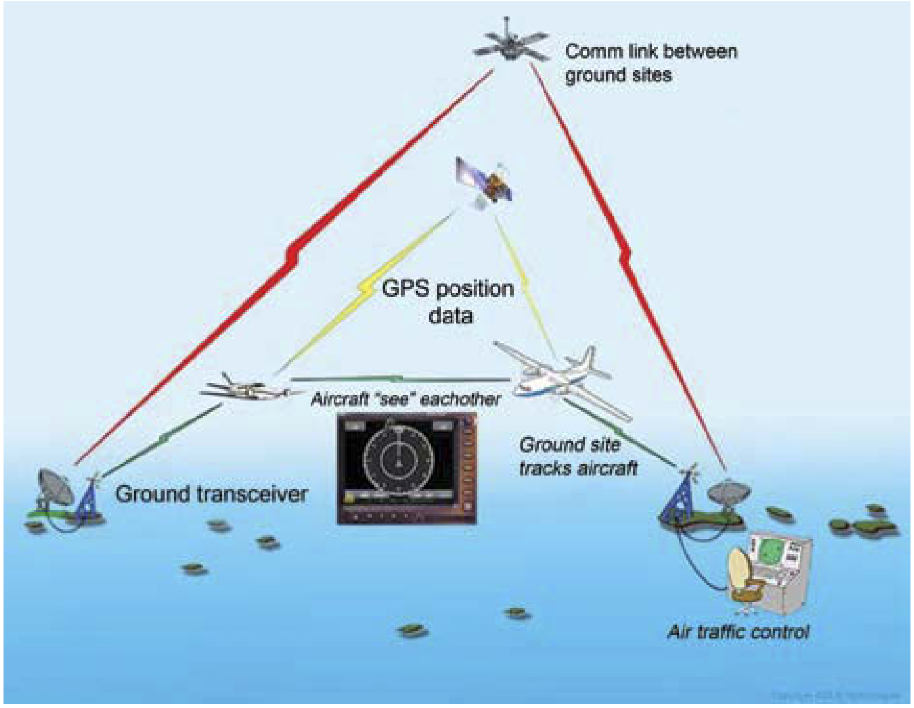


Figure 4: *Basic ADS-B architecture (image courtesy of ADS-B)*

piece of technology on which various other technologies rely. TCAS and ADS-B, for example, both require Mode S transponders to function. The following link provides a comprehensive history on Mode S: http://web.mit.edu/6.933/www/Fall2000/mode-s/index.html.

LPV stands for localizer performance with vertical guidance, a new type of approach that requires avionics with wide area augmentation system (WAAS) capability. These satellite-based approaches can provide precision approaches down to 250 ft. This is achieved without ground-based equipment and allows the creation of approaches to just about any airfield with minimums nearing ILS standards. A sample approach plate is shown in *Figure 5*.

MLAT is the acronym for multilateration. This is a new system being introduced as a low cost substitute for ATC radar. Nav Canada is installing such a system at Vancouver Harbor and Fort St. John. The system uses a network of receivers that use the transmissions from an aircraft's transponder to triangulate the position of the aircraft. The aircraft's position is then forwarded to the ATC control facility and displayed on the controller's scope.

Multilateration systems can also work with ADS-B. As pilots, we only need to have our transponders on and the rest is transparent. The following is a link to an excellent article on MLAT in *Avionics Magazine*: www.aviationtoday.com/av/categories/commercial/9891.html.

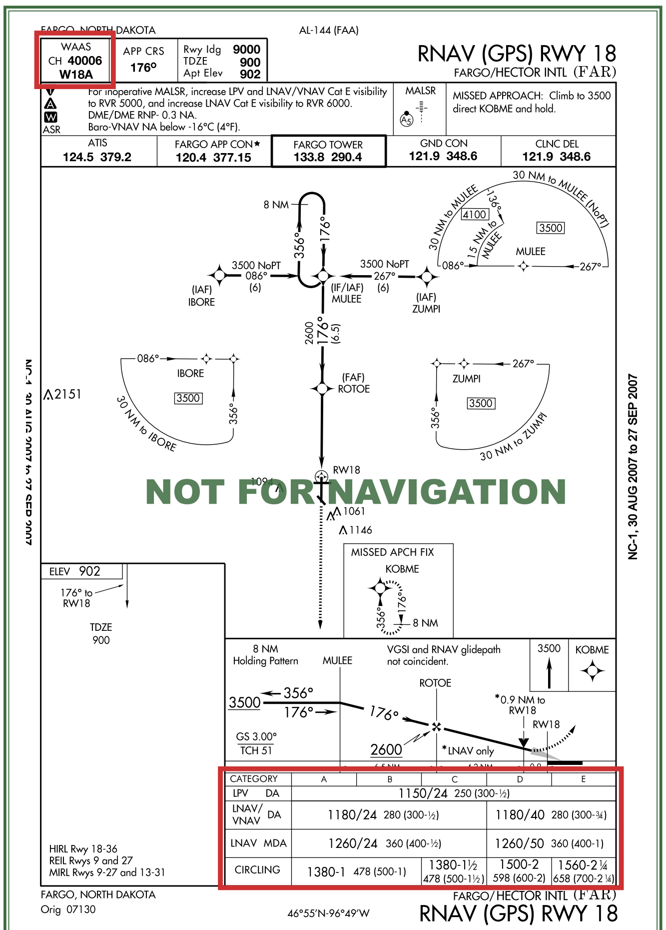


Figure 5: *Approach plate showing approach minimums in Fargo, North Dakota.*

TAWS is the acronym for terrain awareness and warning system. This is the modern version of the ground proximity and warning system (GPWS). *Figure 6* shows a typical TAWS display. If you stay on the track depicted you will crash into a mountain peak!

The following link will take you to an excellent pilot briefing sheet on TAWS from the

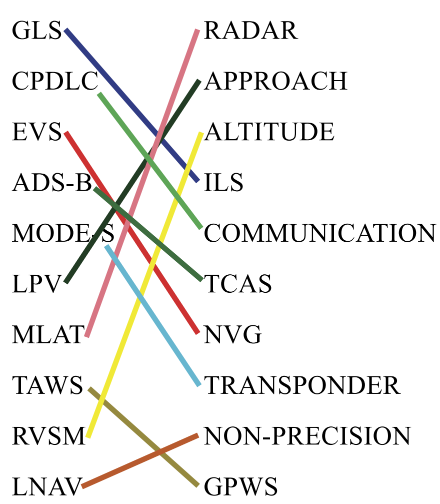
Figure 6: *TAWS display*

Aircraft Electronics Association: www.aea.net/Pilot/TAWSPG05.pdf.

RVSM stands for reduced vertical separation minima. This program should be familiar to most of you: this is where they reduced the altitude separation from 2000 ft to 1000 ft from flight level 290 and above, worldwide.

LNAV stands for lateral navigation. LNAV approaches are space-based non-precision approaches. These approaches require GPS avionics. The approach plate in *Figure 5* has LNAV minimums. ◆

Quiz answers



ICING

HOT Tables

By Mr. Ken Walper, Directorate of Technical Airworthiness and Engineering Support, Ottawa

You're tasked to launch on a search and rescue mission but it's cold and snowing outside, plus the visibility is low because it's windy. Sound familiar?

De- and anti-icing is probably (should be!) coming to mind as a likely requirement before takeoff.

Removing frozen contaminants from an aircraft's critical surfaces can be an onerous task, which can make getting an aircraft to the runway for takeoff during ground icing conditions a serious safety challenge.

Perhaps the most time-efficient way in which to remove frozen contaminants is with heated aircraft deicing fluids (ADFs). Protecting an aircraft's critical surfaces from persistent precipitation, such as snow, can then be accomplished using aircraft anti-icing fluid (AAF), which will usually be applied at ambient temperature.

But there is more to the use of de- and anti-icing fluids than meets the eye.

What is HOT?

Transport Canada defines holdover time (HOT) as follows:

> *Holdover time is the estimated time that an application of anti-icing fluid is effective in preventing frost, ice, slush or snow from adhering to treated surfaces. Holdover time is calculated as the beginning with the final application of the anti-icing fluid, and as expiring when the fluid is no longer effective, as measured in endurance time tests and published in the "Holdover Time Guidelines".*
> – TP14052 *Guidelines for Aircraft Ground Icing Operations,* Glossary[1]

ADF fluid is designed primarily for the removal of frozen contaminants from an aircraft's critical surfaces in preparation for flight. But it has an extremely limited capability to protect the aircraft surfaces, especially during active precipitation such as snow. AAFs, on the other hand, are specifically designed to protect the aircraft's critical surfaces from continuing frozen precipitation and have a significant protection time, which is what the *Holdover Time (HOT) Guidelines* describes.

How HOT is determined?

The ability of a particular fluid to prevent frost, ice, slush or snow from adhering to treated surfaces needs to be established by test. Every fluid must undergo testing, without exception. Tests are conducted in a controlled environment in accordance with

1 www.tc.g'c.ca/CivilAviation/publications/tp14052/Chapter18.htm

an accepted procedure to establish their specific HOT values. The tests simulate out of doors conditions on real wings, and the results are collected, processed, and evaluated. HOT values are established in consideration of each precipitation type, the precipitation rate, the fluid dilution, and the temperature. Once the HOT values are established, they are placed in a HOT table for ease of reference and published by both Transport Canada and the United States' Federal Aviation Administration (FAA). Transport Canada has published the Winter 2007/2008 *HOT Guidelines* online at http://206.222.76.45/tables/Publications_HOT_english_20070724.pdf.

It is interesting to note that all of the HOT testing of SAE qualified fluids for the international aviation community is currently conducted in Canada.

HOT limitations

The use of HOT tables for aircraft ground icing operations requires that certain limitations be observed.

The principle limitations are as follows:

1. **Precipitation type**
   a. HOT tables are applicable only to those precipitation types depicted in the table.
   b. HOT table values do not apply to the following precipitation types: heavy snow; ice pellets; snow grains; and moderate or greater freezing rain.
2. **Precipitation rate**
   a. The testing of the fluids is only conducted up to the equivalent of a moderate snowfall rate. It is based upon an equivalent liquid water content value, which in turn equates to a specific precipitation rate.
3. **Temperature**
   a. Each fluid is tested down to a temperature that is considered the minimum, either because the fluid freeze point is reached or the viscosity of the fluid starts to unacceptably effect the aerodynamics of the aircraft during takeoff.
4. **Fluid dilution**
   a. Undiluted glycol and plain water each freeze at or near 0°C. A mixture of glycol and water results in a mixture that doesn't freeze until much colder, e.g. as low as -40°C or colder. The concentration of the mixture also affects the fluid viscosity.
   b. The fluid concentration – the ratio of water to glycol – can vary considerably and determines the performance of the fluid. There is a lowest operational use temperature (LOUT) associated with each specific fluid and fluid concentration. The fluid manufacturer must be consulted for this information.
5. **Approved fluid**
   a. Both chemical and physical properties of fluids are tested in accordance with an SAE specification, including aerodynamic tests. If the fluid meets the specification then the fluid is approved.
   b. If a fluid has not been evaluated and approved in accordance with the SAE specification, then the published HOT tables cannot be used with that fluid.
   c. The fluid approval must be current. This can be determined by reference to the published Transport Canada or FAA list of approved fluids (included in the HOT Guidelines).
6. **OEM approval**
   a. The civil authorities typically require that an approved fluid also be sanctioned by the aircraft original equipment manufacturer (OEM), e.g. Boeing, Airbus, Cessna, Lockheed, Bombardier, etc.
   b. This final step assures the regulators that a fluid works acceptably on the OEM's equipment. This is a particularly important step from an aerodynamic perspective.

Training

It may not be immediately evident to the reader that the effectiveness of the fluid and the value of the HOT tables in operational use are highly dependent upon the training of the individuals doing the anti-icing and deicing function, including training on using the proper technique with the correct equipment. The job must be done right or the HOT values could be meaningless.

Typical operational issues when using HOT tables

Ground icing conditions are highly variable, and the pilot will therefore need to be continuously vigilant during ground icing conditions so that a safe takeoff is assured. Be watchful for the following:

- Blowing snow can result in snow deposits on aircraft surfaces.

- Jet/prop blast from other aircraft can result in frozen deposits on aircraft surfaces. This is particularly evident during taxiing.
- The HOT clock starts when the final application of fluid commences.
- The pilot needs to establish the precipitation rate using the best information available.
- Given the variability of ground icing conditions, the pilot will need to continuously monitor the applied fluid for failure, including within the published HOT.
- Ensure that the current HOT table in use is applicable to the fluid being applied to the aircraft, and that the fluid is currently approved.
- Pilots have difficulty identifying fluid failure: proper training is required. A web-based training video is available on the NASA website: http://aircrafticing.grc.nasa.gov. ◆

Photo: Master Corporal Robert Bottrill

The Editor's Corner

Flight Comment Evolves

Following in the footsteps of the fashion industry, we're bringing a former style of *Flight Comment* back to life to spice up the usual three issues per year. I present *On Target*, a themed magazine that will allow us to explore single issues to a greater depth than one article in *Flight Comment* permits. This is a reprise of a short series of *Focus On…* issues of the magazine that were published only twice (1999 – Discipline, and 2001 – Fatigue). Look for the first issue in 2008.

I would also like to introduce our next editor of *Flight Comment*, Captain Stéphane "Pacman" Paquet. His flying background includes the CF188 *Hornet* as well as the CC144 *Challenger*, and he has just completed a four-year tour as a DFS aircraft accident investigator. As such, he comes excellently prepared to promote flight safety with enthusiasm in 2008. Pacman's contact info is included under the submissions column on page three.

By this point in the winter flying season, I hope you've long-since relocated your long underwear and toque, been keeping your cold weather brief in mind, and just read the next icing article to better equip you for the snowy days ahead. ◆

Fly safe!

Correction: *Flight Comment* Issue 2 2007, page 11 photo

The article is about an engine wash, but the photo is actually of the *Aurora* being rinsed after operations in a hot, dusty environment. It has been brought to my attention that the stance of the member on top of the engine is extremely discouraged (i.e. not allowed) where there is no harness system: the top of the engine may be wet and slippery, and the lack of a harness would make a fall a long and painful one.

EPILOGUE

TYPE: ***Hornet* CF188745**
LOCATION: Bagotville, Quebec
DATE: 16 August 2005

During a basic fighter manoeuvres (BFM) training mission conducted in the Saguenay training area northeast of 3 Wing Bagotville, the wingman's aircraft of a two-plane formation departed controlled flight and entered a spin. The attempt to recover from the spin was unsuccessful and the pilot ejected. The pilot sustained minor injuries during the parachute landing. The aircraft sustained "A" category damage upon ground impact. Post-impact fire consumed the majority of the wreckage.

Shortly after takeoff, at about 18,000 feet above sea level (ASL), the lead pilot initiated the exercise with a simulated attack on the wingman. While manoeuvring in response, the wingman allowed the aircraft's angle of attack (AoA) to reach approximately 30 to 35 degrees. The pilot attempted to reposition the aircraft towards lead but the aircraft did not respond. A second attempt was made with no response. The aircraft initially yawed left then went into a right hand spin. The aircraft descended in the spin for 28 seconds to approximately 7,500 feet ASL at which point the pilot ejected.

At the time of the occurrence, the aircraft was operating with a 1000 lb fuel imbalance and a 200 lb aircraft store on the left wing. The resultant lateral weight asymmetry limited the aircraft to a maximum of 20º AoA. This limitation was exceeded during the manoeuvre, which precipitated aircraft departure and spin entry. Checklist corrective actions were not fully completed to effect recovery.

Preventive measures that have been implemented include training limitations, for CF188 aircraft with lateral asymmetries, and publication amendments to emphasize briefing items for training rules. Outstanding recommended preventive measures include enhancement of departure/spin recovery training and accelerated completion of the F18 flight control computer software upgrade (version 10.7) to mitigate the risks associated with CF188 flight characteristics. ◆

EPILOGUE

TYPE: *Griffon* CH146468
LOCATION: Valcartier, Quebec
DATE: 08 February 2006

Two CH146 *Griffon* helicopters were assigned to support four *Griffons* from another squadron in an Army exercise in the area of Quebec City.

Upon arrival in Valcartier at 0130Z, the aircraft commander (AC) met with the aviation mission commander (AMC) and the aviation liaison officer (ALO) and was briefed on the night mission. The profile of the mission was to be flown using advanced night vision goggles (NVG) techniques.

After flying the insertion phase, there was a three-hour stop over at Valcartier Heliport, during which the AMC and the ALO briefed the extraction phase. Given the severe snowball effect that crews had experienced during the insertion, the AMC decided to complete the extraction using a loose, non-tactical formation referred to as a "daisy chain". CH146468 was the third of six aircraft in the formation.

During the start procedure (0625Z), the occurrence pilots set the radio altimeter (RADALT) warning to zero feet to avoid continuous audible warnings. As they were about to take-off for the extraction, they received a last minute change of pick-up zone (PZ) over the radio. The new PZ had a road in the middle that crossed the field at a near perpendicular angle, with three-foot snow embankments on each side of the road.

Neither the AMC nor the ALO had briefed this entirely new PZ to the crews. No actual PZ condition was reported to the crews since there was no reconnaissance completed by the AMC or ALO. No map reconnaissance of the new PZ was completed by the occurrence crew.

During its landing, the lead aircraft created a massive snowball, which drifted backward, thus reducing the overall ground visibility in the area. Given the reduced visibility, the second aircraft decided to overshoot. The crew from the occurrence aircraft, third in the formation, proceeded with the landing.

During the final phase of the approach, the flight engineer (FE) provided no information on obstacles or height above the ground. None of the crewmembers noticed the road that was crossing the PZ. Immediately after the FE called, "Snowball at the door," the helicopter touched down and the front of the aircraft hit the first snow embankment. The aircraft then skidded across the road and finally came to a stop against the other snow embankment. Following a partial inspection of the aircraft at the PZ, the crew noticed damage to the right-hand chin bubble and searchlight sustained during the landing sequence.

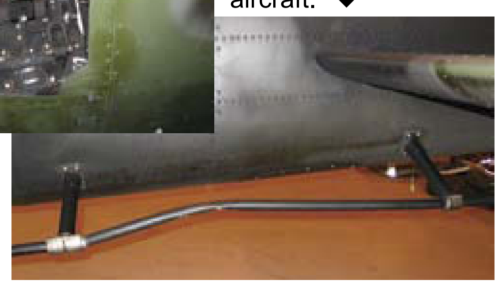
They advised the AMC that they were unserviceable and would not continue with the extraction. The crew then decided to fly the unserviceable aircraft back to Valcartier Heliport without prior communication with maintenance authority and the chain of command to seek advice or authorization. The aircraft landed at 0725Z, where it was shut down and recorded unserviceable. Inspection revealed that the aircraft had sustained serious damage.

The investigation found that the occurrence crew was qualified on the CH146. However, the AC was not current for an instrument flight rules approach in the last 30 days, and the co-pilot was not current in snow operation. Additionally, both pilots had medical employment restrictions secondary to vision limitations, which at the time restricted them from combat tactical flying. As a result, the mission was improperly authorized, as the authorizing officer was unaware of, and did not confirm, the currency status of the crewmembers and the flight was not scheduled for the purpose of regaining the lapsed currencies. Furthermore, the authorizing officer was unaware that the pilots had medical employment restrictions.

This occurrence illustrates the risks involved in operating at night in LZs/PZs when no prior reconnaissance of terrain or conditions is done.

The investigation revealed four main contributing factors to this accident. The first was environmental, in that a perceptual error caused by the reduced visibility and poor perception of contrast prevented the crew from noticing the snow embankments along the side of the road in the PZ. The second factor was a generalized failure to adhere to orders, directives, doctrines and standard procedures in favour of non-standard procedures. The third factor was a suboptimal communication of key information, from dispatch to planning to execution of the mission. The last factor was complacency related to the crew's familiarity with the training area.

Preventive measures focussed on authorization procedures, and improving processes to track aircrew qualification and currency, and to track/employ aircrew who are assigned medical employment restrictions with potential impact on flying operations. Other preventive measures addressed procedures for reporting the status of LZ/PZ, and cockpit/crew procedures related to night tactical operations. Finally, recommendations were made to reinforce compliance with the need to seek appropriate authorization prior to flying a damaged aircraft. ◆



EPILOGUE

TYPE: *Sperwer* **CU161009**
LOCATION: **Kandahar, Afghanistan**
DATE: **6 May 2006**

During the recovery phase of a mission in support of Op ARCHER, the uninhabited air vehicle's (UAV) parachute failed to deploy. The UAV descended freely, impacted the ground at high speed and exploded. The UAV was consumed by post-impact fire and sustained "A" category damage. There were no injuries or collateral damage.

The mission was conducted without incident until the recovery phase. At initiation of recovery mode, all Ground Control Station indications were normal and a successful recovery was anticipated. The pilot chute deployed; however, the main parachute failed to deploy.

Due to the extensive post-impact fire, a conclusive analysis of CU161009's parachute deployment failure was not possible. Through analysis of an intact CU161 *Sperwer*, one probable deployment failure scenario was identified: the pilot chute lanyard might have been mis-routed around the pilot chute bridle line during installation, or during subsequent opening and closing of the parachute bay door. Entanglement of these two lines could prevent main chute deployment.

CU161 *Sperwer* maintenance procedures did not incorporate an independent check to mitigate the risk associated with lanyard/bridle entanglement during main parachute deployment. Additionally, the *CU161* Sperwer *Technical Guide* did not provide explicit written instructions to mitigate the risks associated with incorrect installation of these lines.

Preventive measures taken include amendment of the Technical Guide to provide explicit written instructions pertaining to parachute installation. Outstanding recommendations include incorporation of an independent check into the parachute installation procedure. The potential hazard from carbon fibres being released during the crash has also been addressed in emergency response planning. ◆

EPILOGUE

TYPE: ***Hornet*** **CF188761**
LOCATION: Yellowknife, NWT
DATE: 19 June 2004

The occurrence aircraft was number two of a three plane formation transiting from Cold Lake, Alberta, to Inuvik, Northwest Territories, via an en-route refuelling stop at Yellowknife, NWT. The landing runway was 7500 feet long and was bare and wet, a rain shower having passed over the airfield approximately 30 minutes prior. The occurrence pilot performed a flared landing touching down 5 knots (kts) fast, approximately 900 feet from the threshold of the runway. Maximum braking was applied however, the pilot felt that the braking action was insufficient and believed that an undetected anti-skid failure had occurred. Emergency brakes were selected, and almost immediately the main wheels started to skid and entered reverted rubber hydroplaning resulting in reduced braking action and a loss of directional control. The pilot ejected when the right main wheel dug into the gravel and sustained a serious injury during the parachute landing. Very shortly after the ejection, the aircraft came to rest upright having yawed through more than 270 degrees.

Damage to the aircraft included both an Aim-7 and an Aim-9 missile mounted on the aircraft's right wing stations. The right aileron and trailing edge flap were damaged from ground contact, and both main tires and the right wheel spacer had to be changed. Finally, ejection system components were also damaged as was expected following their activation and subsequent fall to the ground.

Although the aircraft sustained only "D" category damage, this occurrence is classified as an accident due to the serious injury sustained by the pilot.

Overall, the escape system functioned normally. Following his ejection as the aircraft departed the runway, the pilot's parachute landing injury was found to be directly related to the current parachute's high descent rate.

The investigation revealed that the aircraft's braking system had also functioned normally, and that the pilot's initial perception of loss of braking was due to a lack of proficiency for landing in less than ideal conditions, as well as a misconception about the normal functioning of the aircraft's anti-skid braking system.

Contributing factors for the accident also included inadequate pre-mission planning and insufficient aircraft-to-aircraft spacing given the landing conditions, which precluded the pilot from conducting an overshoot.

As a result of this accident, several preventive measures were taken, including a decision to purchase a new ejection seat, incorporation of landing data on the standard mission briefing card, pilot briefings and, although not directly contributive to the accident, a plan to provide enhanced aeromedical training to medical respondents in remote locations.

Other preventive measures have been recommended, including the procurement of a flight data and cockpit voice recorder (FDR/CVR) system for the *Hornet* fleet, further direction on the use of the video tape recorder (VTR) system, the acquisition of planning software for takeoff and landing data, as well as additional training and education for pilots in the fields of landing technique and contaminated runway operations. ◆

EPILOGUE

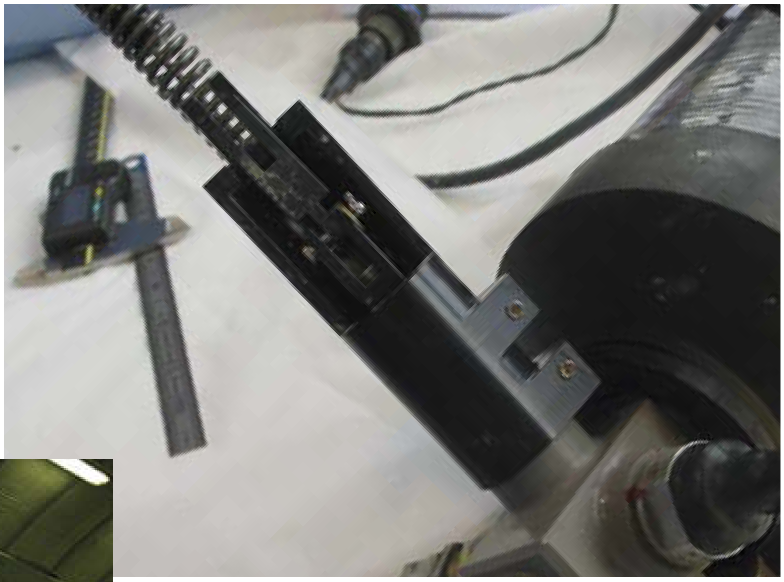
TYPE: *Sperwer* **CU161001**
LOCATION: Kandahar, Afghanistan
DATE: 21 November 2006

The accident occurred during an uninhabited air vehicle (UAV) mission in support of Op ATHENA. Immediately following launch, the UAV's airbags deployed, rendering it incapable of sustained flight. The UAV impacted the ground approximately 250 metres from the launcher and sustained "B" category damage. There were no injuries.

The launch followed a successful pre-flight inspection in which all ground control station (GCS) monitored performance parameters, including the airbag system, indicated normal. GCS tape replay indicated that after launch the UAV's high-pressure (HP) air bottle had a rapid, uncommanded decrease in pressure, followed by airbag deployment.

Analysis focused on the airbag high-pressure opening control system. The system contains a small piston and spring which act as a valve between the high-pressure air bottle and the UAV's three airbags. Normal operation occurs when the opening of the UAV's parachute acts to unseat the piston that in turn permits airbag inflation. The analysis determined that the spring, which acts to seat the main piston, was out of design tolerance. Launcher acceleration forces acted to overcome proper seating of the piston precipitating the uncommanded discharge. The investigation also found a number of maintenance deficiencies associated with the HP system which may have contributed to the malfunction.

Limitations inherent with the opening control system have prompted a redesign of the system by the manufacturer. Fitment of the improved system, to mitigate the risk associated with uncommanded airbag deployment, is anticipated in the near term. ◆



EPILOGUE

TYPE: ***Tutor* CT114064 & CT114173**
LOCATION: **Mossbank, Saskatchewan**
DATE: **10 December 2004**

The *Snowbird* solos (#8 opposing solo and #9 lead solo) were conducting training over the abandoned Mossbank aerodrome, about 30 nautical miles south of 15 Wing Moose Jaw. At the time of the accident, the solos were performing a “co-loop”, which consists of the two aircraft performing opposing direction loops. As the two aircraft neared the top of the loop, it became evident that there was potential for a collision. Accordingly, one aircraft maintained a predicted flight path (as briefed prior to the mission) so that the other pilot could manoeuvre his aircraft to make the miss. When it was evident that a collision was still imminent, one pilot initiated an evasive manoeuvre to the inside of the loop, his briefed safe exit direction. Immediately following this action, a collision occurred at the top of the loop at about 3500 feet above ground level with the two aircraft having a closing speed between 360 and 400 knots. Both aircraft were destroyed during the collision.

The collision caused a fireball, which engulfed both aircraft. The pilot of #8 was killed instantly in the collision. The pilot of #9 was expelled from his aircraft without initiating ejection. He pulled the “D” ring for his parachute and manually released the lap belt of his ejection seat. Shortly thereafter his parachute blossomed. About five seconds later he landed in an open field, having sustained minor injuries. He was assisted by local citizens and taken by civilian emergency medical services (EMS) to the Moose Jaw Union Hospital.

The investigation found no mechanical problems with either aircraft, and focused on the human factors involved. Possible physiological, orientation and perception cause factors were examined. As well, an analysis of *Snowbird* training was conducted. It was assessed that *Snowbird* #8’s

training to conduct the co-loop manoeuvre was deficient, in that he did not have either the dual training or experience to develop the appropriate sight-picture for a 30-foot miss at the top of the manoeuvre.

The preventive measures for this accident include recommendations regarding squadron manning levels and training, including adjustment to the requirement for dual training. Changes regarding how the co-loop manoeuvre is flown were proposed. As well, a risk assessment of all the solo specialty manoeuvres was recommended. ◆

EPILOGUE

TYPE: ***Hornet* CF188931**
LOCATION: **Cold Lake, Alberta**
DATE: **28 September 2006**

The incident occurred at 1645 UTC on 28 September 2006 during landing on runway 22 at 4 Wing Cold Lake, Alberta. The incident aircraft was returning single-ship from a two versus one air combat training mission. The winds were from 290 degrees at 15 gusting to 25 knots.

One second after landing, the aircraft was reported to have lurched to the left followed by a loud “bang” and then the landing gear unsafe/planing link audio tone was heard. Subsequently, there was a loud rattling accompanied by the aircraft shaking and the left wing settling towards the runway as the left main landing gear collapsed. The aircraft came to rest on the runway centreline approximately 7000 feet from initial touchdown. The crew performed a shut down and evacuated the aircraft without further incident and with no injuries.

The aircraft suffered “D” category damage to the left main landing gear (MLG) assembly, the left MLG doors, the left MLG rim and tire and the left external fuel tank.

The investigation revealed that the approach resulted in a hard landing with a final sink rate of approximately 1200 feet per minute and a landing G between 2.4 and 3.0 with significant left drift and the left wing low. This resulted in a very large strain being imparted on the left landing gear. The investigation also revealed that the left and right MLG were out of rig in a number of key areas that are known to contribute to MLG collapse and/or planing mechanism failure.

Several preventive measures were taken, including special inspections on all CF188 landing gear to inspect and correct the tolerances, rigging and general condition. The Canadian Forces Technical Orders (CFTO’s) were amended to better address landing gear maintenance. As well, pilots were briefed on the occurrence and the enforcement of training requirements was stressed.

Other preventive measures were recommended including additional revisions to the CFTO’s, maintenance requirements and other airworthiness aspects of the landing gear. Additional training for pilots was also recommended, as well as a revision of the landing techniques currently used on the CF188 fleet. ◆

EPILOGUE

TYPE: ***Hawk* CT155202**
LOCATION: **Moose Jaw, Saskatchewan**
DATE: **14 May 2004**

The crew of two had completed a low level navigation syllabus mission, and were utilizing their remaining time conducting proficiency flying in the traffic pattern at 15 Wing Moose Jaw. The instructor pilot (IP) had just taken over aircraft control, with the aircraft accelerating and positioned near the departure end of Runway 29 Right. At about 70 feet above ground level (AGL), 239 knots indicated airspeed (KIAS) with the landing gear up and combat flaps selected, a bird struck the left side of the aircraft. This was immediately followed by several engine warnings and very high engine temperature indications. The IP initiated a climb to trade airspeed for altitude, confirmed that the engine temperature remained high, and told the student pilot (SP) to prepare to abandon the aircraft. As the aircraft descended through 3000 feet mean sea level (MSL), (about 1000 AGL) and after confirming the student was ready, the IP initiated ejection. Both pilots survived the ejection, but the IP was seriously injured and the SP received minor injuries in the ejection. The aircraft crashed in a farmer's field about one mile north of 15 Wing and was destroyed. Investigation revealed a gull hit the angle of attack probe, then entered the left hand engine intake and was ingested by the engine, causing serious damage.

The investigation report addresses numerous aviation life support equipment (ALSE) issues. This occurrence was the first aircraft loss in Canada involving the miniature detonation cord (MDC), which was used to shatter the canopy. Preventive measures aimed at reducing injuries from MDC have been implemented. The automatically activated personal locator beacon of the CT155 *Hawk* did not function adequately. Since this accident, an improved version has been developed and installed on the aircraft with an external antenna that will fall clear of the survival pack after its release, ensuring adequate distress signal propagation.

The report recommends that a new or modified life preserver be put into service which has better puncture resistant properties. Changes to the pilot's harness system as well as the introduction of an improved parachute are also recommended.

The preventive measures already taken, and adoption of those further proposed preventive measures, should mitigate the risks to the aircrew in the event of a similar occurrence in the future. ◆

FROM THE INVESTIGATOR

TYPE: *Tutor* **CT114159**
LOCATION: **Malmstrom Air Force Base, Montana**
DATE: **18 May 2007**

On Friday, 18 May 2007, the *Snowbirds* had completed a transit from Moose Jaw, Saskatchewan to Great Falls, Montana. An afternoon practice was planned in preparation for flying displays on Saturday and Sunday at the Malmstrom Air Force Base open house, located eight miles away from Great Falls International Airport. One of the manoeuvres to be flown was an inverted photo pass in which the *Snowbird* (SB) lead flies across the show line upright with SB 2 flying inverted on his left wing, SB 3 flying inverted on his right wing, and SB 4 flying inverted above and behind SB Lead.

At approximately 22 minutes into the show, as SB 2 was rolling inverted for the inverted photo pass, the aircraft was seen to dip low, waver, and then depart the formation. Still inverted, the aircraft climbed, then subsequently rolled upright. Upon reaching a nearly wings level attitude, at approximately 750 feet above ground level, the aircraft nosed over. The aircraft impacted the ground approximately 45 degrees nose down. The pilot did not eject and was killed on impact.

Initial analysis has determined that the pilot's lap belt became unfastened when SB 2 rolled inverted, causing the pilot to fall out of his seat and lose control of the aircraft.

The investigation is focussing on how the lap belt became unfastened. Preventive measures taken to date include modifications to the pilot restraint system, as well as enhanced training for aircrew and passengers. New procedures as well as changes to the Aircraft Operating Instructions (AOIs) have been implemented to reduce the likelihood of a recurrence. ◆

FROM THE INVESTIGATOR

TYPE: ***Hornet* CF188720**
LOCATION: Bagotville, Quebec
DATE: 16 May 2007

A formation of two CF188s was carrying out some pre-briefed air-to-ground training in the Bagotville training area during a return flight from 14 Wing Greenwood after participating in a monthly armament training session for technicians.

After 20 minutes of air-to-ground training the wingman in aircraft CF188720 advised the lead that he was experiencing an "engine left" warning. This indication was followed by an engine fire as confirmed by the lead. The wingman secured the left engine in accordance with the checklist. Damage sustained by the aircraft caused flight control problems and led to operation in mech mode.

The routing from CYA 661 to 3 Wing Bagotville was executed so that the formation would not over-fly populated areas due to the extensive damage and the possibility of an ejection. During the return to base, the wingman fought with the controls to maintain level flight and had to use afterburner occasionally to maintain altitude. The aircraft landed at 3 Wing on Runway 11 via a straight in cable engagement. The pilot secured the right engine, opened the canopy, and exited the aircraft using the emergency egress procedure.

Investigation revealed that the left-hand engine had suffered a catastrophic failure of the low-pressure turbine disk. The engine was found to be separated into two sections. Only a small portion of the low-pressure turbine (LPT) disk was recovered.

The inspection of the engine also revealed that the actuating ring attachment plate for the inlet guide vanes was missing 2 bolts and nuts at the 9 o'clock position with 4 inlet guide vane arms not connected to the actuating split ring. As a result of this finding, the F404 engine technical authority immediately directed field units' engine bays to conduct a sampling inspection to confirm the presence of all attachment hardware for the high-pressure compressor (HPC) variable guide vanes actuating split rings. All HPC modules were found with the appropriate hardware.

The focus of the ongoing investigation is to conduct detailed laboratory analysis of the engine and its components to determine the cause of the catastrophic failure. Also, ground searches are underway to locate the missing fragments of the LPT disk. ◆

For Professionalism

For commendable performance in flight safety

CORPORAL DOUG STEPHENSON

After a heavy rainstorm a flight engineer was carrying out his walk-around on Canadian patrol *Aurora* aircraft CP140118, when he noticed water on the work table in the aft part of the galley.

Corporal Stephenson was tasked to investigate this issue; he initially checked the outside of the aircraft and then inspected the inside area in the vicinity of the leak. After locating where the water was dripping from he also noticed in the general area what appeared to be dirty brown particulate surrounding some cracked aerospace sealing compound. In order to conduct a more detailed investigation he scraped away the compound and revealed an apparent crack at the right hand side of pressure bulkhead flight station 1117. Concerned that there may be similar defects on the L/H side he scrapped away the sealant in that location and again revealed an apparent crack. Realizing the critical nature of these potential cracks to the structural integrity of the aircraft, the non-destructive testing (NDT) section was called and it was confirmed that a crack did indeed exist in both locations.

As a result of this discovery and the consequences that might have developed had this flaw gone unnoticed, a local special inspection (SI) was initiated which resulted in the finding of cracks as well as a cracked stringer on another aircraft at flight station 1117. This cracked stringer caused a fleet wide SI, NS-268 to be initiated that ultimately resulted in the development of a 110 hour flight time inspection to monitor the cracks.

Cpl Stephenson actions demonstrated his outstanding professionalism, determination and pride in a job well done. These fine traits make him very deserving of this For Professionalism award. ◆

Corporal Doug Stephenson is currently serving with 407 Maritime Patrol Squadron, 19 Wing Comox.

SERGEANT SERGE RANCOURT

In April 2007, while doing a 25-hour inspection on *Griffon* CH146425, Sergeant Rancourt noticed a greyish oily deposit around the two right-hand bolts on the 42-degree gearbox. Although the gearbox initially appeared to be mounted correctly, he immediately associated what he saw with the problem of friction and decided on the spot to investigate further.

Sgt Rancourt discovered that the washers under the bolt heads could be moved easily, which meant the gearbox could vibrate and shift when the helicopter was started up. He then alerted flight safety so an incident report could be initiated.

When the gearbox was uninstalled and thoroughly examined, it was observed that the mounting holes were severely elongated. The hole measurements indicated that two of the four were beyond the allowable limit, although the condition of the gearbox shims was normal.

Sgt Rancourt repeated the gearbox installation procedure in order to find out what went wrong. He had to put one more washer under each bolt head, as authorized by the Canadian Forces Technical

Order (CFTO), so the assembly would not move after applying initial torque. Adding extra washers made the assembly very secure after final torque was applied. It is clear that an additional washer under each bolt head would have been needed on the initial installation. Unfortunately, this fault allowed the gearbox to move, which caused the mounting holes to become elongated.

Sgt Rancourt distinguished himself through his performance by recognizing the telltale signs. He went beyond the visual inspection that was required for a 25-hour inspection. Owing to his vigilance, the problem was identified and the aircraft was kept safe. He is commended for his excellent attention to detail. ◆

Sergeant Serge Rancourt is currently serving with 438 Tactical Helicopter Squadron, 1 Wing Kingston.

MASTER CORPORAL FRANÇOIS DESJARDINS

On 11 May 2007, Master Corporal Desjardins gave proof of exceptional savoir-faire and expertise when, under difficult conditions, he identified a hazardous situation that had the potential to compromise the safety of the crew and helicopter.

During the pre-flight check on a CF188 *Hornet* before a return trip to CFB Bagotville, MCpl Desjardins discovered a scratch and a small cut in the paint on the tail rotor blade. When he advised the site technicians of the problem, they said they thought the scratch was within the limits prescribed by the Technical Service Orders. Not comfortable with their evaluation, MCpl Desjardins asked that the paint be removed from the blade so that the nick could be examined more carefully. When the paint was removed, a small crack measuring 1.5 mm long and 0.010 mm deep was discovered approximately 6.6 mm in from the end of the blade. The crack exceeded the prescribed limits, thereby making the blade unserviceable.

MCpl Desjardins's wealth of knowledge, perseverance and professionalism enabled him to discover a defect that could easily have gone undetected. This crack could have caused a catastrophic malfunction in the tail rotor blade and possibly the loss of lives and an aircraft. MCpl Desjardins's high standards and exceptional commitment to uncompromised airworthiness attests to his very high level of professionalism. Through his attitude, he has promoted flight safety and most definitely deserves the For Professionalism award. ◆

Master Corporal François Desjardins is currently serving with 439 Combat Support Squadron, 3 Wing Bagotville.

SERGEANT DARCY MEAD

On 23 March 2007, Sergeant Mead, an airborne electronic sensor operator (AES Op), was carrying out an external pre-flight inspection on *Sea King* CH124433. This inspection examines the aircraft's overall condition and does not require any specific external item checks.

While examining the tail rotor located 10 feet above the ground, he detected that two of the tail rotor blades' pitch link bolts were installed incorrectly. These bolts are difficult to see even for a trained and experienced technician, and although he lacked the technical expertise, his thorough understanding of the tail rotor components enabled him to detect this fault. He immediately informed the aircraft commander, who subsequently declared the aircraft unserviceable.

The investigation revealed that the bolts were installed opposite to the direction of rotation contrary to the Canadian Forces Technical Order (CFTO). If the nuts had loosened, the centrifugal force may have expelled the bolts causing a catastrophic tail rotor failure and the possible loss of the helicopter and crew.

The aircraft had flown approximately 34 hours since the estimated/probable tail rotor maintenance activity. Although AES Ops are not technicians, Sgt Mead's keen eye and attention to detail detected an anomaly that was not identified by aviation technicians or pilots on previous missions.

Sgt Mead's professionalism, combined with his overall knowledge of the CH124 aircraft and attention to detail prevented a potentially catastrophic situation from occurring. He is very deserving of this For Professionalism award. ◆

Sergeant Darcy Mead is currently serving with 443 Maritime Helicopter Squadron, 12 Wing Patricia Bay.

For Professionalism

For commendable performance in flight safety

CAPTAIN MICHAEL O'KANE

On 15 June 2007, Captain O'Kane was conducting a pre-flight inspection on a CH146 *Griffon* prior to a maintenance test pilot (MTP) test flight. During his inspection of the tail rotor, he discovered that one of the bolts used to attach the counter-weight to the drive shaft had been installed with the bolt head on the wrong side of the component. Further inspection of the remaining three identical bolts revealed that they also had been installed backwards, creating the illusion that all bolts were installed correctly.

After verifying his finding by inspecting several other aircraft on the hangar floor, he notified maintenance personnel, who told him the bolts could be installed in either direction. Unsatisfied with this response, Capt O'Kane informed the MTP and sought clarification from the Canadian Forces Technical Orders (CFTOs). Examination of the CFTOs revealed that the bolts were indeed installed incorrectly. The aircraft was rendered unserviceable and a flight safety occurrence report was initiated.

Capt O'Kane's attention to detail during the conduct of this pre-flight inspection was noteworthy and displayed a superior level of technical knowledge and tenacity. His efforts are commendable and played a major role in averting a serious aircraft incident or accident. He is most deserving of this For Professionalism award. ◆

Captain Michael O'Kane is currently serving with 408 Tactical Helicopter Squadron, Canadian Forces Base Edmonton.

CORPORAL DOMINIC POITRAS

On 30 January 2007, Corporal Poitras was conducting a 300-hour engine inspection on *Griffon* CH146485.

While performing this inspection he heard an unusual clicking noise when traversing across the cabin roof; being unfamiliar with this occurrence, he immediately informed his supervisor. After carrying out extensive Canadian Forces Technical Order (CFTO) research and through consultation with a senior avionics (AVS) technician, he pinpointed the problem to the starter relay, which was engaging when pressure was applied to a certain area of the roof.

Further investigation revealed that, under certain conditions, a broken wire was inadvertently touching the airframe roof. Once identified and located, the faulty wiring was quickly repaired and the aircraft returned to service.

Cpl Poitras is a performance of maintenance (POM) level technician who demonstrated a level of expertise and competency well above expectations. His prompt actions and diligence prevented a possible fire hazard, personnel injury and the loss of a valued asset.

Cpl Poitras is to be congratulated for his professionalism and job well done. His high level of awareness of his work environment makes him very deserving of this For Professionalism award. ◆

Corporal Dominic Poitras is serving with 427 Special Operations Aviation Squadron, Canadian Forces Base Petawawa.

MASTER CORPORAL STEVE COPELAND, MASTER CORPORAL STEVE GRAHAM AND SERGEANT STEPHEN BEGGS

On 16 August 2006, Master Corporal Copeland, an AVN technician employed in CP140/A Periodic Inspection, was conducting a survey of the main electrical load centre wiring on an *Aurora* aircraft. Upon closer examination he discovered corrosion and burn marks on the lugs for the wires attached to the corresponding circuit breakers for both heat exchanger fans. MCpl Copeland then alerted MCpl Graham (another AVN tech) who validated that the extent of the corrosion made the lugs unserviceable. A subsequent inspection found similar corrosion in the same circuit to the wire lugs on the control relays for both heat exchanger fans.

MCpl Graham then alerted his supervisor, Sergeant Beggs who immediately opened a flight safety incident and then with the assistance of MCpl Graham began to formulate theories as to a possible cause. Sgt Beggs researched the maintenance record set for this aircraft and found that the wires in this circuit were replaced in 2000. Fearing that the replacement wire may possibly be incorrect, he alerted MCpl Graham who verified the specifications for the wire in the aircraft against the WIMS (Wiring Information Management System). MCpl Graham then cross-referenced the wire specifications with the C-17-010-002/ME-001.

The wire specifications in the aircraft were found to be incorrect. The wire in place was shielded with tin, which is prone to corrosion as opposed to the non-corrosive copper shielding required in high temperature circuits IAW the CFTO. The tin shielded wire is a lower temp wire that was being utilized in a circuit that called for high temperature copper shielded wire. The wire heated up past its operating temp due to the higher electrical resistance from the corrosion causing the burn marks on the circuit breaker lugs.

MCpl Graham expanded his inspection area and found similar incorrect wire types in the entire circuit; in total 300 feet of wire was the incorrect type. As a precaution MCpl Graham and MCpl Copeland requested permission to do a survey inspection of two additional aircraft. Incorrect wire types were found in the same circuitry of both the aircraft they inspected. The Life Cycle Materiel Manager (LCMM) was then alerted and later determined that the wrong wire specifications were installed back in 1997 as part of Phase 2 wiring MOD C-12-140-000/MD-030. It also prompted the LCMM to order a directive to replace all the heat exchanger fan wiring for the CP140 *Aurora* fleet.

Collectively, MCpl Graham, MCpl Copeland and Sgt Beggs exhibited extreme professionalism, attention to detail and initiative, preventing what could have been a serious aircraft incident. Their actions clearly make them deserving of this For Professionalism award. ◆

Master Corporals Steve Copeland and Steve Graham, and Sergeant Stephen Beggs are currently serving at 14 Wing Greenwood.

For Professionalism

For commendable performance in flight safety

MASTER WARRANT OFFICER ANDY DODD AND SERGEANT PAT CHARBONNEAU

On 8 March 2007, during a CH146 *Griffon* helicopter pre-flight inspection, Master Warrant Officer Dodd found a roll pin and screw head on the cabin floor behind the pilot seat. This type of hardware is not typically used on helicopters and it makes common sense to suspect that it could have fallen off from a passenger's equipment.

MWO Dodd wasn't satisfied with this reasoning and he requested technical assistance to confirm that the hardware found wasn't from the helicopter. The maintenance crew chief, Sergeant Charbonneau, further investigated the provenance of the hardware and found that these items were used to hold the fire suppression system activation fire handles to the fire handle arm. Should an emergency have occurred, requiring the activation of the fire suppression system, the aircrew would have pulled the fire handle and it would have separated from its arm without activating the system. Sgt Charbonneau immediately inspected the fire handles on other aircraft to confirm that they were properly secured.

The exemplary diligence and professionalism of both MWO Dodd and Sgt Charbonneau prevented an essential system malfunction and avoided possible injuries, resource damage or loss of life. MWO Dodd and Sgt Charbonneau are congratulated for a job well done. Their dedicated efforts and thorough diagnostic efforts make them deserving of this For Professionalism award. ◆

Master Warrant Officer Andy Dodd is currently serving with 408 Tactical Helicopter Squadron, Canadian Forces Base Edmonton. Sergeant Pat Charbonneau is currently serving with 427 Tactical Helicopter Squadron, Canadian Forces Base Petawawa.

CORPORAL STEVE TURPIN

In mid-January 2006, 441 Squadron was maintaining a hectic flying program, busily readying itself for deployment and fully engaged with a modification (MOD) involving the wing root and wing tip of aircraft 757.

The task required the removal of numerous wing panels, two wing-attachment bolts and the replacement of all upon completion. On 20 January, it was determined that the aircraft structures (ACS) and non-destructive testing (NDT) techs had completed their work and re-panelling could begin at the wing root. The assigned aviation (AVN) master corporal consulted the ACS supervisors, received the "good to go" and panel installation was started.

The following day, the same crew chief was tasked to complete panelling the wing tip as all inside work was accomplished. The MCpl approached the ACS techs and this time the "good to go" came from Corporal Turpin. It was at this point that Cpl Turpin expressed concern regarding reinstallation of the bolts at the re-panelled root. When challenged, the AVN MCpl could not confirm their replacement. Cpl Turpin then requested the AVN MCpl remove the panels and when removed, the bolts were not installed. A CF349 support entry documenting the removal of the two attachment bolts had been inexplicably omitted.

Had the aircraft flown in this condition, the additional stress applied to the remaining attachment bolts would have eventually caused fatigue damage to the structure and possibly the ultimate catastrophic failure of the wing root. Cpl Turpin's commendable keen work ethic and attention to detail make him very deserving of this For Professionalism award. ◆

Master Corporal Steve Turpin is currently serving as an instructor at Canadian Forces School of Aerospace Technology and Engineering, 16 Wing Borden.

MASTER CORPORAL CLARENCE SMITH

Master Corporal Smith, a flight engineer serving with 430 Squadron, was carrying out a pre-flight inspection on his assigned Canadian Forces *Griffon* CH146446 in preparation for a mission. As he commenced the inspection of the main rotor and blades, he recognized an error in the installation of a bridge damper set.

Upon carrying out a further detailed inspection, MCpl Smith realized that all four bridge damper sets were installed backwards. Acknowledging the seriousness of this error, he immediately brought this to the attention of the maintenance supervisor.

Maintenance personnel had installed the four bridge damper sets the previous day. The work was signed off and the aircraft was certified serviceable after the test flight. The dampers are difficult to inspect so an improper installation is easy to miss. Only an outstanding attention to detail allowed MCpl Smith to catch the error.

MCpl Smith has been a flight engineer for only 3 years. His uncommon awareness enabled him to visually detect the incorrect installation of a key component of the main rotor head in a very confined and hard to see area; even though it is not normally checked as part of a standard pre-flight inspection.

MCpl Smith's notable attention to detail and in-depth knowledge of the *Griffon* helicopter and its components, eliminated the potential for a catastrophic accident and the loss of personnel and material resources. He is to be commended for his diligence, professionalism and tenacity. He is a credit to the flight engineer trade and is very deserving of this For Professionalism award. ◆

Master Corporal Clarence Smith is currently serving with 430 Tactical Helicopter Squadron, 1 Wing Valcartier.

CORPORAL REGINALD POTTER

On 22 March 2007, Corporal Potter was assigned the task of carrying out special inspection (SI) NS 267. This SI required gaining access to the inside of the centre control pedestal on the CP140 *Aurora* aircraft to determine if the pedestal lighting wiring was misrouted and interfering with the rudder trim control. While the SI itself did not reveal any problems, Cpl Potter's keen attention to detail did however turn up a fault with potentially catastrophic consequences.

Prior to closing out the pedestal and replacing the components removed for access, Cpl Potter stressed the importance of FOD checks and a thorough visual inspection of the work area to the Apprentice Technicians he was training. While conducting the inspection, he found a screw missing from the wire bundle leading to the tactical air navigational (TACAN) control. Knowing the hazards associated with loose hardware in a confined closed area containing so many flight critical control inputs, he immediately began a detailed search. This additional area examination located a non-related screw and washer wedged behind one of the pulleys for the nose landing gear (NLG) emergency release system.

Had this situation not been rectified, the emergency release system would not have operated properly and the nose gear would not have been able to free-fall into position for landing. This in turn may have resulted in the aircraft being forced to conduct a wheels up landing.

Cpl Potter's professionalism and attention to detail averted potentially catastrophic damage to a valuable asset and ensured the safety of the aircrew. These notable efforts make him very deserving of this For Professionalism award. ◆

Corporal Reginald Potter is currently serving with 407 Maritime Patrol Squadron, 19 Wing Comox.

For Professionalism

For commendable performance in flight safety

PRIVATE MARK DUECK

On 7 December 2006, while undergoing Apprentice training, Private Dueck was tasked to assist by carrying out an engine "A" check on a coastal patrol CP140 *Aurora* aircraft. During the check on number two engine, he noticed that an engine control rod and 'jam' nut were not lock-wired. This observation was exceptional considering that the lack of lock-wire would appear to the untrained eye as a normal configuration.

Fully aware of the potential hazard to the aircraft and personnel, Pte Dueck immediately informed his supervisor of his suspicions that the lock-wire on both the control rod and 'jam' nut were missing. An inspection of the other control rods associated with the engine showed that, contrary to technical orders, none of the control rods on the number two engine were lock-wired.

Having caught a problem that had been repeatedly missed by much more experienced technicians, Pte Dueck displayed an attention to detail well beyond that expected of an apprentice with minimal training and exposure. The investigation of this incident also uncovered several deficiencies in the Periodic Inspection package that were subsequently corrected.

Through his remarkable aptitude and innate professionalism he averted a potentially dangerous situation; clearly displaying that he possesses the attributes that warrant his receipt of this For Professionalsm award. ◆

Private Mark Dueck is currently serving with 407 Maritime Patrol Squadron, 19 Wing Comox.

PRIVATE RENE ROSSIGNOL

Private Rossignol, an avionics apprentice, was working with a Level "A" technician in the Aircraft Repair Organization (ARO) during the snags phase of the periodic inspection on *Sea King* CH124407. While investigating a wiring snag at the tactical control officer's (TACCO's) station, the TACCO's radio transmitter selector panel intercom system master control and receiver selector panels were removed to gain access.

During this process, Pte Rossignol was tasked to support wire bundles to lessen the tension on a clamp that required removal. At this point Pte Rossignol who wanted to be actively involved in the de-snagging process, took the initiative to inspect the wire bundle and discovered a charred wire. He immediately informed his supervisor who investigated further and found that a number of wires were affected including one that had completely burned through.

Although he had no formal on type aircraft technical guidance and was participating in an on-job-training program, awaiting qualification Level 3 instruction, he showed excellent judgement in bringing this problem to the attention of an authorized technician.

The nature of this un-serviceability was such that, had it gone undetected, it could easily have led to an electrical fire. The energized damaged wire was exposed to the atmosphere in an area that is not visible during any regular servicing checks.

Pte Rossignol demonstrated a level of attention to detail beyond that expected of an apprentice with minimal training and exposure. Despite his lack of formal instruction, he instinctively took action to rectify a hazardous condition. His initiative, professionalism and attentiveness led to the elimination of a potentially serious condition. He is very deserving of this For Professionalism award. ◆

Private Rene Rossignol is currently serving with 12 Air Maintenance Squadron, 12 Wing Shearwater.