National Defence Défense nationale

Flight Comment

ISSUE 1, 2009

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Views on Flight Safety

By Lieutenant-Colonel Steve Brabant, 1 Canadian Air Division Flight Safety Officer, Winnipeg

As the 1 Canadian Air Division Flight Safety Officer I've had the privilege of working closely with our current Flight Safety Team members and have seen first hand the newest crop of Basic and Advanced Flight Safety course graduates who are joining the team. Based upon the calibre of people assigned to Flight Safety roles and their interaction and leadership with the professional men and women of the Canadian Forces, I maintain a fundamental belief and confidence that the finest attributes which exist in our personnel will continue to provide a highly effective and successful Flight Safety program. Together we are charged to rapidly adapt to an evolving environment while preserving our focus on being a safe, mission oriented Air Force. A cohesive and capable team within any organization is a strong motivating force, and we have these characteristics solidly ingrained across our safety culture and in our ability to conduct operations at home and abroad. Our foundation and strength across the Canadian Forces persists in our people.

This time of unprecedented change in aircraft fleets, automation technology, operations tempo and personnel shifts are creating challenges to be sure. There are few, if any, units in the Air Force which are not transitioning to new equipment or learning something different all while performing their current tasks to the highest standard. Our experience levels continue to decline as we adjust training methodologies and course contents to meet new expectations and requirements while maintaining or even expanding operations. Our recent Wing Flight Safety surveys have confirmed that the "Pipeline Air Force" that was looming in the near future as our demographics transform is actually upon us already. We are not just in a time of change; we have already changed our business in many areas and we need to recognize and rapidly adjust to conditions that already exist. Opportunely the shift that is taking place in our demographics is introducing personnel into our units who arrive with new ideas, fresh perspectives and enthusiasm. These attributes can and must be turned into assets through smart leadership and mentorship. Our capacity to conduct and maintain safe operations will depend on our ability to adjust to fluid situations.

The current ops tempo and introduction of new equipment is rapidly bringing technological advances, increased capability and improved man-machine interfaces. As we adapt, all of these changes can be melded into new training methods and operating procedures to improve our ability to conduct operations effectively and safely. It is during these changing times that a functional, robust and effective Flight Safety program, combined with a safety culture that promotes the values, ethics and professionalism of our organization, is required most. Our great challenge as a Flight Safety organization is not only to adapt with the environment but also to recognize potential hazards, identify where risks may develop, and then mitigate these potential pitfalls through prevention activities. It's in this role that we can most effectively contribute to conducting safe, mission oriented operations. Unchanged in the midst of all this activity is that professional, dedicated people and cohesive teamwork will continue to form the basis for our current and future successes. ◆

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Good Show

For Excellence in Flight Safety

Capt Parker is currently serving with Cadet Air Operations East, 3 Wing Bagotville.

Captain Daniel Parker

On 31 August 2008, during Air Cadet Gliding Operations in Smith Falls Ontario, the gliding site crew were re-setting the launch point on runway 06 following a shift in the wind direction. A Cessna 172 (C-172) not associated with the gliding operations had also switched runways and was now flying circuits to runway 06.

An unsafe situation arose when a Cessna 206 (C-206), which had recently departed the airport, was observed overflying the airfield and entering a circuit for runway 24.

The C-172 had completed a touch-and-go to runway 06 and was unaware of the C-206 who continued the circuit for the opposing runway 24. The C-206 was turning short final for runway 24 while the C-172 was taking off from runway 06, each unaware of the other's position. A collision appeared imminent.

Captain Parker, the Air Cadet Glider Launch Control Officer, observed the civilian aircraft activity and responded with immediate action. Capt Parker made a radio call to advise the aircraft that they were on a collision course. Both aircraft immediately altered heading sharply to the right and narrowly avoided each other.

Even though all the Air Cadet aircraft were on the ground, Capt Parker's vigilance, situational awareness, and rapid intervention in an event not related to his gliding site functions eliminated the potential of a catastrophic mid-air collision. His outstanding leadership, dedication, and decisive actions make him fully deserving of this Good Show award. ◆

Good Show

For Excellence in Flight Safety

Major Zlatko Neral

On 24 July 2008, Major Neral was the Maritime Helicopter Mission Commander of a Sea King helicopter, call-sign Stinger 36, during an Anti-Submarine Warfare mission in support of Rim of the Pacific (RIMPAC) exercises, being staged around the Hawaiian Islands Operational area.

Stinger 36 was entering a 40-foot hover over the ocean to operate the acoustic sonar when the crew heard a loud bang. Maj Neral directed his co-pilot to abort the hover and ordered the navigator to declare an airborne emergency. Smoke started entering the cockpit as Maj Neral scanned the instruments to ascertain what was happening to the aircraft. He directed his crew to use their Emergency Breathing System (EBS) as the smoke filled the cockpit. He then told his co-pilot to fly to the nearest ship for immediate landing. Once within visual range of the closest ship, he determined that the deck of the ship was occupied by a static helicopter and he was unable to land. Major Neral immediately directed his crew to close on their mother warship, HMCS Ottawa, 14 nautical miles away.

Concurrent to all this, Maj Neral was faced with numerous puzzling secondary indications. These included audio cues (loud bang suggesting compressor stall), cockpit indications (showing two serviceable engines), smoke (suggesting fire, but no fire was evident upon which to use a fire extinguisher), limited breathable air, and reduced visibility. Maj Neral demonstrated excellent adaptability in ordering the donning of the EBS and opening windows to clear the obscuring smoke in the cockpit. Once within a few miles of the ship, Maj Neral took control of the helicopter and executed a flawless landing and emergency shutdown on HMCS Ottawa's flight deck.

Faced with a confusing emergency situation and conflicting information, Maj Neral rose to the challenge and demonstrated exceptional cockpit resource management and professionalism. His response to this unusual situation confirmed a high level of preparedness and proficiency. He efficiently completed checklists and maintained excellent cockpit communications. His communications with the fleet formation were timely and resulted in enhanced situational awareness among the nearby ships. He demonstrated superior judgment in his choice to wear the EBS, which was designed primarily as a breathing tool when submerged under water. Maj Neral is to be commended for his calm demeanour and continuous reassessment of the condition of the helicopter. His outstanding leadership and judgment prevented the loss of both personnel and material resources and clearly make him most deserving for this Good Show award. ◆

Maj Neral is currently serving with 443 Maritime Helicopter Squadron in Patricia Bay.

Good Show

For Excellence in Flight Safety

Corporal Denis Cloutier

Cpl Cloutier is currently serving with 408 Tactical Helicopter Squadron in Edmonton.

On 6 August 2008, Corporal Cloutier, an Aviation Technician with 408 Squadron, was tasked to complete a 25 hour / 30 day inspection on aircraft CH146437. While inspecting the number one engine firewall with a mirror, he discovered a gap between the firewall stiffener and the aft firewall. Further inspection of the assembly revealed that the stiffener was not properly seated within the firewall retaining clip. Insertion of the stiffener into the firewall retaining clip is required to provide a complete seal within the engine compartment in the event of a fire.

Recognizing the implications of this incorrect installation, Cpl Cloutier inspected another CH146 Griffon helicopter and discovered that its firewall seals were also improperly installed. As a result of Cpl Cloutier's initiative, a local survey was initiated and a total of seven power sections were found with firewall seals improperly installed.

The CH146 Griffon firewall retaining clips are obscured by the engine and are not readily accessible; they are only visible through the use of a mirror. The CH146 Griffon's 25 hour / 30 day inspection requires only a general visual inspection of the engine firewalls. Cpl Cloutier's use of a mirror during his inspection was well beyond the required inspection criteria and led to the discovery of the improperly installed firewall seals. This find identified a deficiency that possessed the potential to develop into an extremely serious, if not catastrophic, in-flight event.

Cpl Cloutier is commended for his exemplary level of diligence and professionalism exhibited while performing a routine task. His impressive focus and outstanding attention to detail while performing his duties removed a potentially hazardous condition from several CH146 Griffon helicopters. Cpl Cloutier is truly deserving of this Good Show award. ◆

From the Flight Surgeon

Aerospace Medicine Capability

in Support of Flight Safety

By Captain(N) Courchesne, Director of Medical Policy, Ottawa

As the current Director of Medical Policy (DMedPol) within the Canadian Forces (CF) Health Services and the former CF Aerospace Medical Authority (AMA), it concerns me greatly that despite great advances in Flight Safety over the past few decades, one fact remains constant, that despite remarkable declines in accident rates, of those that do occur, over 80% are still due to human error. As the AMA, I was responsible for the human airworthiness aspects of the CF Airworthiness Program. This might sound odd for some, as those concepts are more readily associated with the technical and operational aspects of aviation. But as I am fond of saying, I was responsible for the most complex weapon system in aviation: the human.

Back when I was the DFS Flight Surgeon in the early 1990s, a lot of emphasis was placed on Human Factors or Human Error Reduction Training. Since then, accident investigators have come a long way in their understanding of human error causation and human factors in general. Today few in aviation haven't heard of Reason's Swiss cheese model of error and we have moved away from the classic pilot error cause factor to the more sophisticated Human Factors Analysis and Classification System (HFACS). But when you look closely at what the majority of accidents are due to, it doesn't matter whether we call it human error or call it an unsafe act, the bottom line is that it still boils down to the pervasive human factor. What can be done to break through this seemingly last bastion of Flight Safety?

Like the AMA's counterparts, the Technical Airworthiness Authority (TAA) and the Operational Airworthiness Authority (OAA), the Aerospace Medicine community has adopted a risk management approach to fitness to fly and put in place strategies to mitigate risks associated with health, well being and human performance. As expounded by Reason the best defense against human error is a number of redundancies in a given system. The civilian aviation industry has a remarkable safety record but when compared to military aviation it is very predictable. It is important however to accept the fact that no matter what, humans are fallible and are prone to error. Humans have physiological and psychological limitations, just like aircraft structures have physical limits.

How can we apply risk management principles to humans? It is the AMA's responsibility, as medical advisor to the Airworthiness Authority, to ensure that the CF has an Aerospace Medicine Capability to support Air Operations and to provide advice on human airworthiness.

This capability covers more than a book of rules on when to ground and un-ground aircrew. It ensures that the CF has fit healthy aircrew to complete its mission. Thus the Aerospace Medicine capability is composed of several elements. On the health side the first element is in the establishment of aircrew medical standards. These standards are established to ensure that at the time of recruitment the CF is enrolling candidates that have the best chance of success in training and are likely to be employed over a certain period of employment. It also ensures that candidates are free of illness and injuries that pose evident risk for flight safety (e.g. seizures). Because the standards are based as much as possible on the best available medical evidence, we don't require that candidates be "perfect". Extending this further, the aeromedical risk management approach to fitness to fly will follow established risk management models and in combination with good medical evidence will allow us to return more aircrew to the cockpit and flight line with a high degree of confidence that they will pose little or no threat to flight safety. This aspect is relatively straightforward although it does have limits as we have no crystal ball able to predict the future.

On the other hand the realm of human physiology, psychology, and performance presents more challenges, but it is my belief that it is in this area that we must make progress if we want to make advances in the reduction of human error. Also, it's important to understand human physiology but more importantly to accept as mentioned earlier that humans have limitations. For example the human body cannot sustain much more than +5 Gz without protection (G-suit or anti-G straining manoeuvre). In a relaxed state the physiological response becomes overwhelmed and the individual passes out. One cannot function above a certain altitude without supplemental oxygen. Similarly the human body cannot function without adequate sleep. It cannot cross 9 time zones and recuperate in 48 hours. It is not physiologically possible. Just like putting a torch under an egg will not make it hatch faster than 28 days, unless you intend to cook it. The challenge is that without the evidence of serious accidents many are reluctant to accept these limitations.

So how do we mitigate human physiological limitation? Well we have a range of strategies starting with training and education through the aeromedical training program with specific focus on critical areas such as hypoxia recognition training and the CF high sustained Gz course.

"It's when we start deviating from plans and start improvising that we get into trouble."

You should be aware that the Aerospace Medical community has been working with the Air Force for several years now (since December 2001) through the Aeromedical Policy and Standards Committee (APSC) to develop policy and standards affecting aircrew and Air Force personnel. It is through this committee that we were able to successfully amend the entry anthropometric and vision standards for aircrew and the policy on laser refractive surgery for CF aircrew. The APSC monitors and keeps abreast of current issues or situations requiring particular attention or specific mitigating strategies. The committee's current area of interest lies with issues of circadian shifts (due to jet lag but also shift work) and the entire area of fatigue management. Thanks to work from scientists from Defense Research and Development Canada (DRDC) Toronto we now have good evidence that jet lag and shift lag seriously affect human performance and thus pose a risk for flight safety. Armed with this evidence we will be developing and proposing strategies to cope with jet and shift lag and fatigue in general. Also DRDC Toronto has developed over the years a special capability that enables us to test the effect of drugs on cognition and human performance. Now I am in no way suggesting that we use or should use drugs to enhance performance. What I'm referring to is drugs for clinical use like for hay fever or high blood pressure. It is thanks to this capability that we were able to develop a permissible list of medications that do not require grounding knowing that they do not affect performance, and a world leading policy on the return of aircrew to flying status while taking certain anti-depressants. This capability will be extremely useful as we develop strategies to deal with fatigue and jet lag.

Automation has contributed significantly to the reduction of accidents in tasks such as monitoring and where repetition and or vigilance are critical but prone to error. Automation however can go just so far. Another time proven strategy is standard procedures, since these are usually developed as a result of lessons learned from accidents.

In order to be successful though they need to be followed (plan the flight-fly the plan). Humans being creatures of habit, standard designs or configurations are other well proven strategies in mitigating human error. Just think of the many accidents due to transfer of habits from one cockpit to another. It's when we start deviating from plans and start improvising that we get into trouble.

It is interesting to me that the medical community at large is just starting to embark on human error reduction programs, and a blame free culture, to come to grips with many of the issues that Flight Safety has been addressing for many years. And who are they looking to but no other than the Aviation community and their Flight Safety programs. In the medical realm the most frequent error made is medication administration errors- either because different drugs are packaged in similar vials and/or stored together; or people have to do several manipulations with the drugs such as mixing/calculating based on weight/ administrating, etc. at night after a double shift. You get the picture, it's a recipe for disaster and people have died because of these types of human errors. The solution: large scale strategies such as asking the pharmaceutical industry to change confusing labeling; removing dangerous drugs from hospital wards to reduce the likelihood of them being administered by mistake; pre-mixing of dangerous drugs by pharmacists to reduce the likelihood of errors by fatigued staff, automatic dispensers of medications to reduce errors, etc. and the establishment of standard procedures. Sound familiar? I have no doubt that if the medical community were to adopt an HFACS approach to accident investigation they would come up with causes that are very much the same as what is listed as cause factors today in the CF Flight Safety Program: Unsafe acts-Errors-Skill based, attention failure, interruption in process, Errors-Decision-Procedural error, situation misdiagnosed; Conditions of Personnel-Mental states-Personality traits and attitudes, expectancy or complacency; Practices of Personnel-Resource Management, ineffective communication or on the Supervision side: Level of Supervision-Inadequate Leadership, inadequate oversight or guidance.

While the introduction of automation in aviation and medicine has proven to be a successful strategy that has helped eliminate human errors in critical areas (think of ground proximity warning devices or automatic drug dispensing machines), we cannot write policies that dictate to follow policy or that prohibits inattention. Where we are going to succeed is in our continued pursuit to better understand human physiology and behaviour and continue to do trend analysis so that we can "fool-proof" or introduce further redundancy in the system. This will require continued reporting from the line and collaboration with such bodies as the APSC where aerospace medicine specialists and line operators work together fostering trust for the overall improvement of our Flight Safety record. ◆

The Editor's Corner

It is my privilege to be the new Editor for the Flight Comment Magazine! While Flight Comment has had a variety of Editors over the years, it has remained true to its focus under the steady hand of Mr Jacques Michaud, DFS 3. Hailing from the Maritime Helicopter community, I also have experience as a QFI and a DFS Accident Investigator. Initially I was somewhat tentative about coming to this job, as it has been several years since I have been on an operational flying unit. Many things have changed, most notably the type of missions being flown and the advancement of cockpit technology (ok, maybe not in my community). But as I was putting together this magazine, I realized that many aspects of Flight Safety Education and Promotion have not changed all that much over the years.

A regular column titled "Check Six" reprints old articles that were previously published in Flight Comment and are still considered relevant. This issue covers an article titled 'This is My Life' originally printed in 1960. It is a humorous anecdote written from the point of view of a Sikorsky H-5 helicopter. According to the article, pilot error accounted for over 50% of helicopter accidents. A recent study showed that over the last 10 years in the CF, human factors accounted for 75% of all A and B Category accidents. Capt (N) Courchesne's article in 'From the Flight Surgeon' explains that despite the increase in automation, which has reduced aviation accidents overall, the major limitation remains human physiology, ie) HUMAN FACTORS. What was true in 1960 remains a major source of concern for all those involved in aviation some 50 years later. Only last year, DFS re-designed the framework of the CF Human Factors Analysis and Classification System (HFACS); we are still learning and the process continues to evolve.

You will find another article titled "So now you're a Qualified Flying Instructor!" which was originally printed in an Australian Flight Safety Magazine in 1990. This article highlights the Human Factor hazards associated with QFI type missions. As the requirement for CF pilot production increases over the next few years, many more personnel will take on the QFI role. Have a read, it is a good article; the message was relevant 19 years ago and it is even more so today.

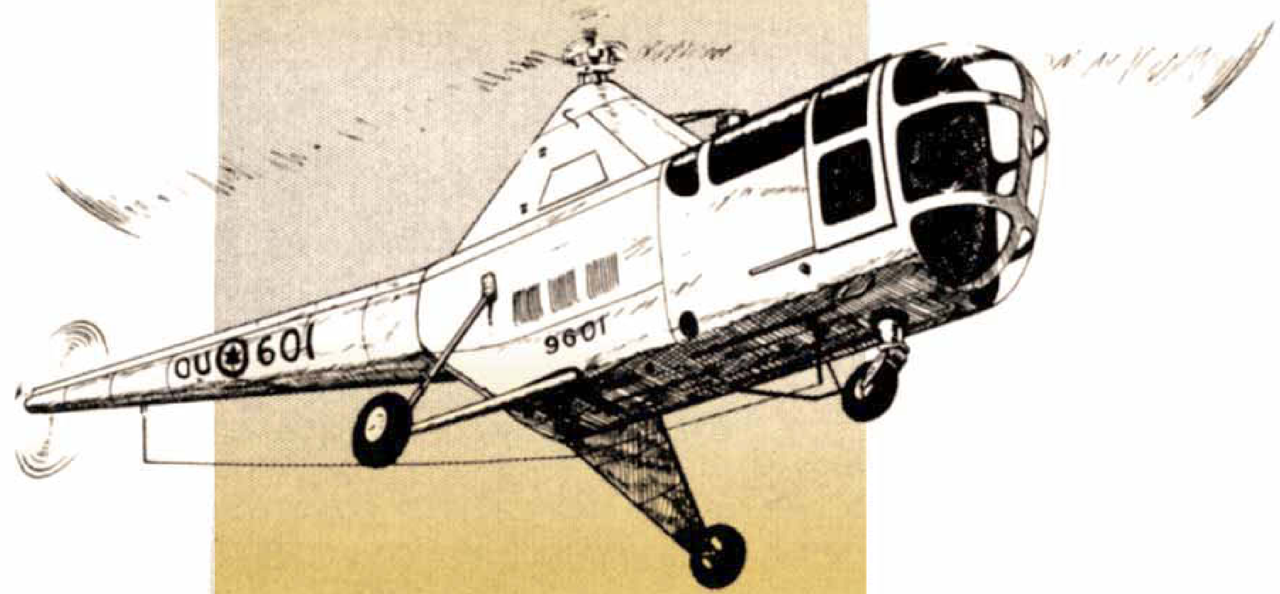
The CF Flight Safety Team, the CF Medical Community, and DND researchers/scientists are all very interested in reducing human factor related occurrences, but they need YOU to be involved. You can help through submitting hazard reports, Flight Safety reports, and sharing your lessons learned through Flight Comment magazine submissions.

Human Factors have generated so much interest among the Flight Safety community, that we are devoting the next issue of "On Target" solely to Human Factors. The magazine will include articles from the scientific community, the medical community, and of course lessons learned from you the readers! ◆

Think Safety, Fly Safe!

Capt Kathy Ashton
Editor Flight Comment

CHECK SIX



THIS IS MY LIFE

By Sikorsky Helicopter 9601 as told to S/LT Wallnutt

Most notable characters, when they feel they have reached a venerable position in life, contribute to posterity by publishing their memoirs. I, Helicopter Sikorsky 51, RCAF designation H5, registration number 9601 have attained this position. My memoirs will provide a word to the wise (pilots). You see, I am the oldest helicopter in the Service, mainly because I was the first one owned by the RCAF. Most important though, I have the longest accident record of any helicopter in the RCAF. At this moment one of the Inspectors of Accidents at DFS is closing my sixth accident file, no incidents mind you, all accidents and some involving extensive damage. The latest one was caused by my pilot trying to squeeze me down into a narrow clearing in the woods and whacking my rotors unceremoniously against a dead tree. My injuries were given Category "D", all my rotor blades were replaced and my engine was changed. Actually, my life in recent years has been quite peaceful; this was my first accident in seven years, the last one happened in June 1952. On that occasion my pilot simply let me get out of control on takeoff, and I immediately crashed, suffering Category "C" damage. After takeoff he neglected to let me hover for a moment to ensure control before assuming forward flight. When I look back over my twelve years of life I see that my real misfortunes took place in my youth, the first four years of my life were the hectic ones. In fact, at some time in every one of those terrible years I was being repaired and rebuilt following a major catastrophe. My first accident occurred no less than one month after I left the Sikorsky factory at Bridgeport, Connecticut, in February 1947. My pilot ferried me across the Canadian border to Trenton. For several weeks I was the center of interest, I was beginning to like Trenton and to trust my pilot. Then, on a practice autorotation he flared me a little too much and my tail rotor blades touched the ground and flew to pieces. Without my tail rotor I lost directional control and spun violently until I crashed. It was years before I could forgive my pilot's error in judgement. For awhile I thought I was doomed to the scrapheap. (I have some pictures here.) However, thanks to the wise engineers I was spared. The following year I suffered another accident during a practice autorotation landing. This time the pilot, after flaring me, applied coarse collective pitch to break the descent, but he erred in retaining the cyclic pitch control in the aft position. The result was a loss of rpm and a condition known to all pilots as "power settling." I hit the ground hard getting thoroughly shaken; my nose wheel was damaged too. In my third year of life I was damaged during a landing accident in bush country. My port wheel dropped into a depression on a gentle slope. The pilot applied power to prevent my toppling, but my somewhat protruding tail tangled with a tree. Finally, I completed the trials of my youth with my second major accident, and once again I faced the prospect of being written off. The year was 1950 and to add insults to my injuries I was subjected to the indignity of crashing in an air show in front of hundreds of eager spectators. This time my pilot landed with drift in a crosswind and to avoid drifting into the crowd he forced me on to the ground on one wheel. I toppled over beating the ground furiously with my rotors as if to stave off the crippling disaster. When the dust settled and the silent crowd resumed its murmur, there I lay, battered and torn. That is my life. Six accidents, five during landing and one on take-off. Mind you, my yearly accident rate has declined throughout my life. As someone once said, "The first four years are the worst." This surely applies to me. Maybe the twilight of my life will be free of catastrophe, and I will continue to escape the clutches of the scrap dealer. What are my odds? Well, let us glance at the overall "egg-beater" accident picture in the RCAF. I see it is a little shattering. The helicopter accident rate is approximately twice the rate for jet aircraft and three and one-half times the rate for reciprocating aircraft. Similar to jet and reciprocating aircraft, pilot failure accounts for over 50% of the helicopter accidents. Now, I am loathing pointing the proverbial digit, but as patriarch among helicopters I feel it is my duty to implore the pilots to be kinder to us. Mind you, it is with no rancour that I speak of pilots. For them I have the greatest affection since without them I could not break the clutch of gravity and sail off into the blue. Nevertheless, they are humans and thus have inherent failings which DFS categorizes as "Negligence," "Carelessness," "Error in Judgement," "Poor Technique," and "Disobedience of Orders." These weaknesses can be avoided under most circumstances; after all the pilot is highly trained to conquer them. There are only a very few exceptions, when adverse conditions are compounded against the pilot, or he fails because of physiological or psychological conditions (Human Factors) over which he has no control or means of correcting. I appreciate we helicopters are difficult machines to control, even tougher than the jets, since our lifting surfaces are in constant motion during flight. All the more reason, my beloved pilots, to adhere to the strictest personal discipline in flying at all times. Above all, acknowledge your inherent weaknesses and be on guard against them, especially when you take us whirlybirds in hand. I am an old egg-beater qualified this year for the CD Medal-I would like to enjoy my superannuation. ◆

1st accident, March 1947.

4th accident, August 1950.

5th accident, June 1952.

"This is My Life" was first published in Flight Comment, Second Quarter, 1960. This issue as well as all other issues of Flight Comment can be viewed on the DFS website: www.airforce.forces.gc.ca/dfs/


Photo by MCpl Eduardo Mora Pineda


Photo by Pte Lori Geneau


Photo by Cpl Andrew Saunders

Operating in Brownout

By Jacques Michaud, Directorate of Flight Safety, Ottawa

The term brownout can mean many different things depending on your perspective. For a doctor it represents the dimming of the vision caused by loss of blood pressure or hypoxia. It is sometimes referred to as grey-out. For an electrician it represents a voltage drop in an electrical power supply which typically causes lights to dim. For a pilot it means a reduction in flight visibility due to airborne dust and particles. This article will provide statistical data on brownout accidents, describe the training done by Canadian Forces helicopter pilots to prepare for the challenges of operating in brownout conditions expected in Afghanistan and describe a few technological initiatives to alleviate the problem.

Brownout conditions can be encountered enroute when flying through a sandstorm or during take-off and landing where downwash produced by the helicopter rotor blades raise dust particles in the air and may cause the loss of outside visual references. Operating in brownout conditions is very challenging and is particularly dangerous during the landing phase of flight.

Brownout-related incidents account for a significant number of accidents resulting in severe injury, loss of life and aircraft. An article published in Jane's Defence Weekly magazine[1] states that "helicopter brownouts are probably the most significant of all military operational concerns when landings are required in the desert environment." The article indicates that a researcher from the US Air Force (USAF) Research Laboratory/Defense Advanced Research Projects Agency estimated that since 1973 there have been 21 MH-53 and 10 HH-60G brownout mishaps as pilots lost visual reference due to blowing dust and debris.[2]

In 2005, two CH47D Chinooks were lost due to brownout. In the first accident, a US Army Chinook helicopter crashed near the city of Ghazni in Afghanistan, killing 18 people on-board, having encountered spatial disorientation during a severe dust storm. In a second brownout-related accident, a Royal Netherlands Air Force Chinook was forced to make a hard landing at Spin Buldak in Afghanistan that ultimately led to its destruction by fire.

The aircraft was operating 80 NM south of Kandahar under marginal night-time conditions. Shortly prior to landing, a left drift developed in brownout conditions. The drift was detected too late to take corrective action and the aircraft rolled over on touchdown, coming to rest lying on its left side. A fire started in the rearward part of the helicopter and destroyed it. Luckily, of the seven occupants, only one suffered serious injuries.

The Canadian Forces have recently deployed helicopters to Afghanistan. The threat caused by brownout is taken very seriously because the dust is extremely fine thus generating thicker clouds. This threat in Afghanistan is compounded by having to operate helicopters at high altitude where the lift from the rotors and the thrust from the engines is less effective. For operational and tactical reasons, the luxury of an overshoot is simply not an option.

A PowerPoint presentation made by a USAF team to the 9th SE Conference in October 2006[3] on the Solutions Analysis for Helicopter Brownout discusses the problems associated with brownout landings and explains what pilots do to maintain visual references and why it fails in certain conditions.

In preparation for the deployment to Afghanistan, 408 Tactical Helicopter Squadron (THS) conducted specific training in desert and brownout conditions. During Exercise Desert Gander, forty-four squadron members and four CH146 Griffons were deployed on short notice to the Western Army National Guard Aviation Training Site in Marana, Arizona. Major Rob Bayes was the Detachment Commander and organized the training for this deployment. He had previous experience in brownout conditions when he deployed to Somalia in 1993 on Twin Hueys and when operating Chinook helicopters for three years in Fort Rucker as a US Army exchange pilot. He indicated that "brownouts are particularly difficult during take-off and even more so during landing. During the last few seconds before touching down, the aircrew is virtually unable to see the ground due to the sand being stirred up by the downwash."[4]

Captain Mike Allard, the Exercise Deputy Commander explained that "the take-offs in snow and dust are quite similar. Where we noticed a big difference was on the landings. Landing in snow is quite predictable; the snow pretty much does the same thing every time," says Capt Allard. "However, the talcum-like sand always keeps you guessing. Sometimes it would hardly blow up at all; the next time you were engulfed in a huge dust ball and couldn't see anything for the last five feet."[5] He also cited engine performance deterioration in relation to cooling; "By the end of a day of thirty or so landings in dust balls, the sand was caked on to the blowers, not allowing for complete engine cooling. In temperatures of 25 to 30 degrees Celsius, that can become critical." Temperature in Afghanistan during the summer months can easily reach the high 30s.

Everything is done by the helicopter crew to ensure visual references are maintained with the landing site by approaching it with enough forward speed to touch down before references are lost or by preparing the landing site beforehand. Christina Martin states in an article published in the Winter 2007/08 edition of the Aviation Aftermarket Defence Magazine that "today's deployed helicopter pilots do the best they can to cope with brownout conditions. They use roll-on landings, (extending the landing for as long as the terrain and obstacles allow), and rely on their crews to call out the dust as it moves from the rear to the front of the aircraft. If the crew is lucky enough to be landing at a predetermined and, presumably, friendly site, preparing the landing zone is an option. This can be done by chemically treating the landing area with sprays that hold down the dust or by laying down transportable landing mats."[6]

As can be seen, in an operational theatre like Afghanistan, the mission calls for more flexibility and the conditions related to a landing site will vary greatly. The accidents related to brownout show these measures partially work. Despite good training, the threat caused by brownouts is very serious and is likely to cause more accidents until technology is introduced to help pilots see through the brownout in this critical phase of flight. Christina Martin explains in her article[7] that "adding to the existing technology is the preferred approach" in the short term to reduce the threat caused by brownout. The USAF Team at the 9th SE Conference gave examples of technology that can be used for "replacing the information lost" during brownout. (See Table 1).

The following research projects are in the work to develop advanced technical solutions to reduce the risk of landing in brownout.

- The USAF Laboratory Rapid Reaction Team has successfully integrated and tested a science and technology solution called the Photographic Landing Augmentation System (PhLASH). This "see and remember" system would reduce aircraft accidents resulting from the loss of visual cues during take-off and landings in dusty conditions.[8] PhLASH is "a combination of an electro-optical sensor and infrared strobe lights which image and geo-register (matches the image to a coordinate on the earth's surface) the ground prior to landing in brownout conditions."[9]

Table 1 – Technologies Available to Replace Information Lost

- **Aircraft Navigation Systems**
  GPS/INS, Doppler, Radar Altimeter
  Mission Computer (Waypoint Navigation)
- **Low Speed Aircraft Control Symbology**
  Drift Vector, Vertical Velocity, Altitude, Heading, etc.
- **Geospatial Information (What's out there?)**
  Digital Map (Imagery, Terrain, etc.)
  Sensor Information (FLIR, Radar, etc.)
- **Reduced Aircraft Control Workload**
  Stability Augmentation
  Self Contained Approach Guidance

- Rockwell Collins and Optical Air Data Systems, LLC (OADS) have teamed to introduce a new solution called LandSafe(TM) to help helicopters navigate and land safely in degraded visual environments, especially brownout conditions. The LandSafe solution was developed through an exclusive licensing agreement between the two companies and incorporates commercial off-the-shelf fiber-optic laser technology to "sense through" particulate matter such as dust, snow, rain, smoke or fog while providing altitude, groundspeed and airspeed information to the flight crew.[10]

- The Sandblaster is an initiative lead by the US Defense Advanced Research Projects Agency. "It involves the participation of the US Army, Air Force and Marines to varying degrees. It integrates four distinct interrelated advanced concepts as follows:

  » A radar sensor sending radio frequency pulses and receiving the returns from objects in the field of view for three-dimensional scanning. The scans are processed as three-dimensional images through the use of algorithms.

  » A database that captures and integrates the images produced by the scans with a stored image of the surrounding terrain.

  » An advanced three-dimensional synthetic vision system with predictive state of-the-art aircraft information to restore the pilot's lost visual cues.

  » An agile flight control system tailored for low-speed helicopter operations during landing, giving the pilot the option to let the helicopter land itself."[11]

These technologies are very promising and could serve to alleviate problems encountered in brownout and even whiteout conditions. Unfortunately, no plans exist at this time to have similar systems installed in the Canadian Forces helicopter fleet. In the meantime, our crews will have to be very vigilant and rely on their training and operational experience in order to reduce the hazards associated with brownout. ◆

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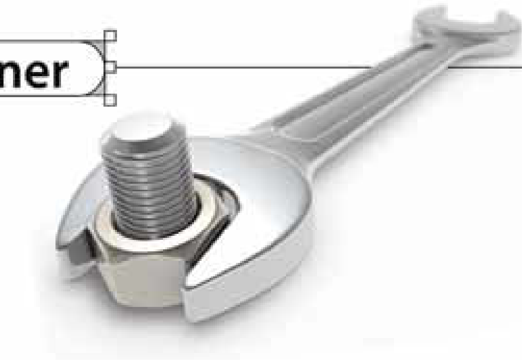


F.Ø.O.D. *for* Thought.

By Sergeant Mike Brown, Directorate of Flight Safety, Ottawa

There are plenty of documented reports detailing aircraft incidents and accidents caused by Foreign Object Debris (FOD). One of the most infamous occurrences took place in 2000. You will certainly remember the event; it involved an Air France Concorde. The aircraft was taking off from Charles de Gaulle airport near Paris when it ran over a strip of metal just before rotation. The FOD caused a main landing gear tire to shred and the resulting flying debris ruptured a fuel tank. This started a sequence of events that caused a fire which eventually led to two engine failures and the loss of the aircraft. All 100 passengers and nine crew aboard the flight, as well as four people on the ground, were killed.

Could such an event take place at one of our Wings? There is always a possibility; however most of us will think that it would be unlikely. After all, each Wing has established a strong FOD program to prevent these occurrences. Think again! In 2008, there were 169 Flight Safety occurrences involving FOD. Fortunately, none were as destructive as the Concorde accident, but these occurrences still had an impact. They diverted valuable resources (i.e., manpower, money) and, in some cases, significantly reduced aircraft availability.

How good is your FOD program?

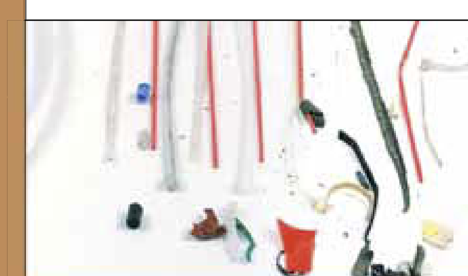
FOD comes in many shapes and sizes. They include such varied objects as:

- Loose bits of lockwire, rags, nuts, bolts, and washers
- Plastic bags, packing foam, and boxes
- Loose documentation
- Uncontrolled tools and consumables
- Rocks, insects, and vegetable matter

The recurrence of FOD finding its way onto aircraft clearly shows that our FOD program and the related controlled measures are not always effective. You only have to think of the occurrences where a plastic bag with consumables was ingested by a gas turbine engine, where rags were found clogging a fuel pump, or where a stray piece of lockwire was found to have shorted a circuit breaker panel. FOD can severely affect the safety of flight.

The control of FOD involves more than FOD walks on the flight line. FOD control also includes workspaces and maintenance hangars. A recent article published in the Australian Navy magazine Touchdown showed examples of FOD picked up in maintenance hangars after a FOD walk was completed. Subsequently, we asked a few of our Wing Flight Safety Officers to do the same for one of the Squadrons at their Wing.

The pictures below show the bounty that was picked up following a FOD walk. How effective is your program? ◆



Trial & Error

By David Learmount

This article was originally published in the January 2009 Edition of Flight International.

As aircraft and engines have become more reliable the safety focus has shifted to human factors and the drive for improved global standards.

In the 1930s the relationship between flying and safety was summarised cryptically by a First World War pilot who became an aviation insurer, Capt A. G. Lamplugh. He provided the industry with what is still recognised as the definitive description of the risks faced by those who would fly: "Aviation in itself is not inherently dangerous. But to an even greater degree than the sea, it is terribly unforgiving of any carelessness, incapacity, or neglect."

> *"Aviation is not inherently dangerous. But it is terribly unforgiving of carelessness"*
>
> **Capt A G Lamplugh**, *First World War pilot and aviation insurer*

Somewhat earlier, Wilbur Wright had written to his father: "In flying I have learned that carelessness and overconfidence are usually far more dangerous than deliberately accepted risks." Wright's assessment of the safety issue is more or less synonymous with the well-established concept of "calculated risk," and pre-dates by about 90 years today's increasingly precise science of "risk management." This science is based on a tacit acceptance that no activity, including flying, can be completely risk-free, but that risk should be managed so as to remain within acceptable bounds. What is deemed acceptable is subjective and varies according to societal perceptions.

In the hope of globalising the approach to risk in aviation, the International Civil Aviation Organisation and the world's leading aviation regulators have, in recent years, required that a closed-loop "safety management system" (SMS) should be a part of every commercial flying organisation. But the SMS concept took 100 years of aviation to emerge, and it will be years before it has been globally implemented.

No aviation safety expert today could add anything of substance to the wisdom contained in Lamplugh's and Wright's observations. Aviation is, however, clearly far safer than it used to be in the early 1900s. So what other factors have brought about the improvement?

The accumulation of knowledge naturally plays its part. Here is a classic example: the father of the Flight Safety Foundation Jerry Lederer said in 1939 that "strange as it may seem, a very light coating of snow or ice, light enough to be hardly visible, will have a tremendous effect on reducing the performance of a modern airplane." As Lederer observed, some phenomena and their consequences – especially pertaining to meteorological factors like icing, windshear, and microbursts – can only be learned from experience or experiment. After the experience has been documented, however, to become useful, the knowledge has to be disseminated to, and then learned and applied by, every individual aviator.

But knowledge and wisdom often gets lost or goes unheeded. Lederer's icing advice did. In 2005 the US Federal Aviation Administration echoed the essentials of his statement on icing in an airworthiness directive (AD) issued 70 years after he drew attention to the problem. The agency said: "Even small amounts of frost, ice, snow, or slush on the wing leading edges or forward upper wing surfaces can cause loss of control at take-off." The stimulus for the AD was an accident report about the crash on take-off of a Bombardier Challenger 604 business jet at Birmingham, UK in January 2002. It had been left on the ramp overnight and not de-iced before take-off was attempted.

An obvious factor in safety improvement is the progressive gain in the robustness and reliability of airframes, engines, and systems, including avionics, navigation equipment, and techniques. But in parallel with these advances, aircraft were designed to fly much faster, perform a greater variety of tasks, and operate in worse weather conditions. As the equipment's capabilities advanced, so did aviators' aspirations to get more from it.

The arrival of the turbine engine, in the form of both turboprop and turbojet, brought a huge increase in power, speed, and range to aircraft, at the same time delivering significantly improved reliability compared with the big piston engines that were reaching their development limits in the late 1950s.

As the machinery became more reliable, and therefore the causes of accidents were less often technically caused, the role of the human became the focus of those who would improve aviation safety, and the study of human factors in aviation got seriously under way in the 1970s. This covered not only the on-board crew, but human factors in maintenance.

Cockpit or flight deck design was slowly improved in ergonomic terms during the 1960s, and when – at the dawn of the 1980s – cathode ray tube instrument displays (later replaced by liquid crystal displays), digital avionics, and flight management computers became ascendant, a new piece of human factors terminology was born: crew situational awareness.

The need for crew situational awareness had always existed, but the new potential for integrating all the flight, performance, and navigational information graphically on large displays provided an opportunity to feed the pilots with intuitive information, rather than disparate pieces of data from which the pilots had to create a situational picture in their heads. This not only reduced the potential for individual confusion, but provided both pilots with the same picture of what was going on, rather than allowing each to develop a picture of what the situation was, which might not be identical to that of the other pilot. Any difference could not be assessed unless the non-flying pilot noticed a trajectory or performance divergence from what he was expecting to see.

In the 1970s KLM had invented the concept of crew resource management (CRM) with the objective of improving the way crew communicated and worked together, and that concept has, at least officially, been accepted globally as a critical part of multi-crew pilot training.

Technology alone has rarely eliminated a serious risk, but since the mid-1990s it looks as if it has achieved that, virtually wiping out what had been the worst killer accident category – controlled flight into terrain (CFIT).

Photo by Cpl David Cribb

Flying a serviceable aircraft into terrain without realising that is what is happening until too late is the result of a loss of situational awareness. When Honeywell upgraded the ground proximity warning system (GPWS) to the Enhanced GPWS (EGPWS), pilots were provided with a graphic picture of their position and height relative to terrain, plus audio alerts. Since the EGPWS (generically know as a terrain awareness and warning system – TAWS) has been introduced there have been no CFIT accidents involving aircraft fitted with it – but CFIT disasters continue in the remaining 5% of the world's big jet airline fleet that do not have it.

WINDSHEAR ALERT

Another piece of equipment, developed since the late 1980s, which has had a major impact on safety is the windshear alert. This emerged as meteorologists came to a fuller understanding of phenomena such as windshear and microbursts associated with storm cells, and how these can affect aircraft close to the ground just after take-off and on approach. This knowledge did two things: it changed pilots' awareness of the risk represented by storm clouds close to their approach or departure paths, and led to the development of windshear alert systems. This has not eliminated accidents caused by windshear, but it has reduced the numbers and severity.

With the arrival of information technology, not only did the potential for creating individual operators safety information databases arise, but also the potential for industry-wide sharing of the derived knowledge of occurrence trends (see historical perspectives). The ability conferred on airlines to download operational and technical diagnostic data from aircraft through digital flight data recorders or quick access recorders enabled them to recognise

Photo by Cpl Simon Duchesne

Photo by Cpl David Hardwick

Photo by Cpl Simon Duchesne

where operational best practise was breached – intentionally or otherwise – and to spot the technical signs of impending equipment failure. This has pushed the aviation world into an era where risk management has become a data-driven science rather than an experience-driven art.

From the 1970s, more of the world's emerging economies – some of which did not have a long aviation tradition – developed airlines with spreading international networks, so the need arose for more effective systems to police global aviation standards. To this end the ICAO was given a mandate for its Universal Safety Oversight Audit Programme in 1999, under which it carries out a review of each state's aviation safety oversight system and makes a synopsis of the results available on its website.

At operator level, the International Air Transport Association announced in 2006 that its biennial operational safety audit (IOSA) would become compulsory for all its member airlines. Any member carrier that fails the IOSA, or does not arrange to undergo one, loses its membership, as some have done.

But apart from these direct pressures on the aviation industry to raise its safety standards, the airlines became subject to another powerful incentive to improve: since the 1980s, the business of international commercial aviation has been gradually liberalised, allowing greater competition and therefore greater passenger choice. Where there is a choice of another airline to fly with, a carrier that has suffered an accident also suffers commercially.

In the 105 years of powered flight the world has moved from fragile, failure-prone machines to robust, reliable ones, and from cerebral risk awareness to data-driven risk management, but the people who operate and regulate the system remain its greatest variable. ◆

Photo by Cpl Robert Bottrill

So now you're a

Qualified Flying Instructor

This article was originally published in the Aviation Safety Spotlight Magazine Issue 02-2008. It is reproduced with kind permission of the Australian Directorate of Defence Aviation and Air Force Safety.

Okay, so now you're a QFI! You've completed all the exams, passed your final handling test and been checked out at your unit. Your prestige has just jumped up a notch or two, and you're probably well satisfied with your accomplishment, and rightly so! However, are you aware that historically, QFIs are involved in a considerable percentage of air incidents?

"Why?" you ask. "I'm more proficient, more knowledgeable and more qualified than ever before. I should be less likely to be involved in an accident". You're right, you should be safer than the average driver, but the statistics show that it just isn't the case. QFIs have their own special place in the accident statistics. For a lot of reasons, you could be another instructor-involved accident just waiting to happen.

"Oh yes, you're going to tell me about increased exposure and all that. I've read about how instructors are exposed more often and for longer periods of time to the more hazardous phases of flight than anyone else. That must be what you're driving at. Well, yes, increased exposure is one of the things that I had in mind. There are several other things too. You see, there are a number of hazards that an instructor must live with that do not affect the average line driver. There are others that affect both, but are felt by the instructor in a different way. It's these hazards that are peculiar to the QFI's task that you need to know about. They have been discovered the hard way by your instructor and his instructor and his instructor before that.

You've already mentioned exposure. Along with increased exposure goes FATIQUE. Fatigue brought on by an instructor's constant high level of physical and mental activity is the particular kind of fatigue I'm talking about. The instructor on board any aircraft feels responsible no only for his activity but for the actions of everyone else as well. He must be constantly paying attention to the actions of the student and all the while making sure that essential tasks are performed correctly. The stress brought on by increased activity causes the instructor to become fatigued faster than anyone else on board.

You're aware, of course, of how fatigue can have an adverse affect on one's judgement, perception and reaction time. Here's our QFI on final approach at the end of a six hour route check. He's thirsty, hungry, and his bladder is about to burst. His students have been in and out of the seat for relief a couple of times or more, but not our QFI. He's been too busy minding the store and keeping the whole game together.

THINK ABOUT IT.

Then there is a special hazard I like to call the STUDENT SYNDROME. It is a fancy label for a type of mental set experienced by a student when he's flying with a QFI. He tends to depend on the experienced QFI to make, or at least review, the decisions that are made. He will sometimes do things with the aircraft that he would never do if he weren't "backed-up" by the QFI. His decision making process is almost always altered by your presence. He nearly always considers what he thinks you want before he reaches a decision on anything. All this flip-flop thinking takes time. Here he is closing on the formation leader: Damn, I've never closed this fast before, but my instructor doesn't seem to be worried. Meanwhile, our QFI thinks: Looks like a high closure rate to me, but I'll wait a little longer to see if he corrects.

THINK ABOUT IT.

COMPLACENCY is a tender trap that has killed many aviators, but it has a special meaning for instructors. It's the root of that old maxim: "It's the good student that will kill you". You can be lulled into complacency by a pilot who has been showing you a flawless performance. You may even temporarily forget why you are on board. It can be a temporary, but fatal, memory lapse.

THINK ABOUT IT.

More of the time while you are flying as an instructor you will really just be watching, or monitoring. The other guy will be moving the controls. It is possible for him during critical phases of flight to make control inputs so quickly and so wrongly that recovery actions, even if initiated as quickly as is humanly possible, may not be soon enough to avert disaster. This is a CONTROL ENVIRONMENT that you live in as an instructor. Guard the controls, expect that other guy to make mistakes with them, and take the aircraft at the first sign of a deteriorating control environment. Consider also that each time you change students the control environment will change. You must adapt to that change. Adapting places stress on you, the more frequent the change the greater the stress.

OVERZEALOUSNESS has taken its toll of eager young instructors. They want to do such a fine job and are so concerned that their student gets the full benefit of their expertise, that they completely overlook routine actions. Here's an example of the overzealous instructor: He's talking his pilot through one of the best ILS finals the world has ever seen. Right on glide slope, the VSI is rock steady, power changes are minute. He is giving verbal encouragement and is reinforcing the learning process of the student by earned praise in the best possible manner. The only thing wrong is our instructor has forgotten to put the wheels down!

THINK ABOUT IT.

PRESSURE is one of the seldom mentioned items that can start you down the primrose path. Real or imagined it makes no difference. It makes you do things you wouldn't ordinarily do. It can come from many directions to force you into a coffin corner. From programming: "Get this guy his night solo or you're going to have to cancel your leave to get him done". From the Flight Commander: "Try those flaps a few more times because maintenance thinks it's an electrical problem and not a jammed segment". From the student: "Isn't the weather good enough for just one more approach, sir? I need it to finish my IRT requirements". From yourself: I've got to show this guy the superb skill that makes me a QFI.

THINK ABOUT IT.

After a year or so of instructing you might feel like you've seen and done it all. You've had your share of hairy recoveries, you've seen all of the mistakes the students make time and time again. Because of your frequent flights as QFI you have honed your flying skills to a razor's edge. You take great pride in demonstrating aerial manoeuvres with flawless precision. There is still one little hazard that may trip you – OVERCONFIDENCE.

THINK ABOUT IT.

Photo by CFTS Southport

Up to now I've been busy giving a lot of reasons why instructors are involved in more than their share of accidents. Really though, these things don't cause the human error accident that I'm talking about. The accident in which the instructor and student let a flyable machine make an unscheduled ground contact is caused by DISTRACTION. All the things I've talked about so far are only some of the many ways an instructor can become distracted. Distracted from what? From flying the aircraft of course.

THINK ABOUT IT.

Now, there is another aspect of flying and flying accidents that you might consider. It deals with a characteristic of humans called emulation. By that I mean that some of your attitudes will rub off on your students. Your attitudes towards professionalism, safety, and air discipline are particularly important for your student's continued safety. ◆

NEAR GEAR UP LANDING

C90B King Air, Southport MB, 13 August 2008

The following abstract is taken from the Flight Safety Occurrence Report no. 135411

The incident King Air's planned approach was a full procedure NDB 31L, circling for a stop to 13R, the active runway. There was a Jet Ranger also doing instrument approaches, and there was another King Air conducting an opposite direction approach, with tower calling the go once the incident King Air commenced the circling portion of its approach. Near the end of the procedure turn inbound, the QFI introduced a simulated electrical emergency. The new Manual of Flying Training (MFT) requires the gear and pre-landing check to be completed before the Final Approach Fix (FAF). This call was omitted by the student and was not corrected by the QFI. As the approach continued, the QFI called 'visual', and the student commenced the circling procedure. The QFI's previous technique was to link the call of 'visual' to a 'final check'; however in this instance he first wanted to advise ATC of commencing circling so that the King Air on the opposite direction could continue its touch and go. Adding to the potential for missing the final check, the new MFT calls for the 'final check' to be completed at 500 ft above aerodrome elevation (AAE) or upon clearance to land, neither of which had yet occurred. Both the QFI and the student noted that though the power setting during the circling portion of the approach was lower than normal, neither questioned the setting, nor was the setting low enough to trigger the landing gear warning horn.

The turn to final was very busy for the QFI; ATC had cleared the aircraft to land, the student descended out of minimums, the QFI corrected the student's phraseology, the TCAS gave two traffic warnings (which the QFI attempted to locate as per the SOPs), the student called for the final check and the QFI incorrectly noted the gear down. The Enhanced Ground Proximity Warning System (EGPWS) then called '500' followed quickly by 1 1/2 beeps of the landing gear warning system.

Shortly thereafter, ATC advised the King Air to 'check gear'. The inner runway controller advised the outer runway controller of the King Air's gear status. A go-around was initiated by QFI and student.

This occurrence report highlights many of the hazards described in the accompanying article, 'So now you're a Qualified Flying Instructor'. These include Fatigue, Student Syndrome, and Distraction. The investigation report determined the following cause factors relating to the QFI:

- Active Failure- Error- Perception- Detection Errors: Inaccurate detection of visual clues- In that the pilot called the gear down, when the green gear position enunciator displayed the gear up.

- Latent Conditions- Working Conditions- Physical Environment- Physical Hazards: Noise - In that the high level of noise in the cockpit from the altitude alerter, EGPWS, & TCAS caused distraction, which resulted in minimal attention being paid to yet another noise, the gear warning horn.

- Latent Conditions- Conditions of Personnel-Mental States-Attention Deficiencies-Reduced Attention: Stress- the QFI was distracted due to known opposite traffic and unease over location of other possible traffic. ◆

Downwind DEBRIS

By Wayne Rosenkrans

This article was originally published in the Flight Safety Foundation Journal, AeroSafety World September 2008. It is reproduced with kind permission of the Flight Safety Foundation.[1]

The full implications of shattered or burning fibre composite materials sometimes are not considered adequately in the protective measures, strategies and tactics of civilian aircraft rescue and fire fighting (ARFF) services and accident investigators says a report by the Australian Transport Safety Bureau (ATSB). Tapping readily available information, however, airports and airlines can raise awareness of composite-specific risks before conducting evacuations/rescues from damaged large commercial jets, aircraft fire fighting, accident investigations and site cleanup operations. The report also discusses fibre composites in light general aviation aircraft and military aircraft, and accident investigation techniques for all types of composite aircraft.

Since the earliest industry experience with fibre composites 50 years ago, standards have evolved in aircraft design, manufacturing and maintenance that enable the aerospace industry to safely capitalize on composite materials' greater strength and stiffness, lighter weight, durability and resistance to fatigue relative to aluminum and other metals. Fibre composite refers to laminates made of alternating layers of long, strong reinforcing fibres – usually glass or carbon – woven into a ply with a binder, a tough plastic glue that shapes the fibres into a carbon/epoxy or glass/phenol matrix, for example. The binder also bonds the plies of matrix together into stiff structures of the desired thickness. In many applications, two sheets of laminate are bound to a core of plastic foam, aluminum or Nomex honeycomb to create structures of the required shape and strength.

Materiel safety data sheets list the precautions for normal handling, fabricating and repair for each type of fibre composite, and those relevant to other possible activities involving human proximity to fibre composites in fires, crashes and other emergencies. "There is a lot of conflicting or incorrect information in the aviation community about the safety and capability of fibre composite materials," the report said. "First responders involved in post-crash cleanup operations [in the late 1990s] expressed concerns about the long-term effects from exposure to carbon fibres released from burning composites. Fibre dust can pose an inhalation risk similar to asbestos. Released fibres or splinters are needle-sharp and can cause skin and eye irritation. In the event of a post-crash fire, smoke and toxic gases are also released from decomposing composites, presenting further health risks." From the standpoint of firefighter/investigator response to transport aircraft crashes, a rule-of-thumb distinction between two broad categories of composites has proven useful. Major load-bearing structures and skins for fuselages, wing boxes, control surfaces and empennages typically are made of carbon/epoxy materials. Many cabin fixtures and furnishings are made of glass/phenol materials. The carbon/epoxy materials will "burn easily and produce thick, toxic smoke" and possibly noxious gases as the epoxy bonding matrix burns away. "Carbon/epoxy has poor fire resistance, easily igniting and burning when exposed to fire," the report said. "The smoke from epoxies and vinyl esters can be extremely dense, making it difficult and disorienting for first responders to fight the fire. Toxic gases produced by decomposing bonding matrix materials are one of the most serious hazards for first responders and people in the vicinity of the accident site. The greatest [toxic gas] hazard is the carbon monoxide released in the fire epoxy-based composites release the highest amount of carbon monoxide."[2]
In contrast, the composite cabin materials have intrinsically low flammability. "Glass/phenol structures have excellent fire-resistance properties, superior to most next-generation advanced composite materials," the report said.

Airborne Fibre Debris

The report makes distinctions between crash impact/fire scenarios involving an aircraft built largely of structural composites and those involving an aircraft built primarily with an aluminum structure. For fibre composites, a key concern is the physical characteristics of fibre shards and debris at ground level, and fibres and dust released into the air from structures shattering during impact, explosions or fire because of potentially serious skin and eye irritation. "More importantly, glass fibres can pose an inhalation threat if handled improperly," the report said. "Less is known about the health effects of inhaled carbon fibre dust; however, laboratory tests show that unlike glass fibres, carbon fibres do not cause pulmonary fibrosis in animals.[3] "After an accident, fibre composite materials can reduce passenger survivability of an accident due to the unique hazards they pose. Composite fibres are very small and lightweight, and are likely to be in the atmosphere. They are also easily carried by wind currents and may travel substantial distances from the crash site. In the event of a crash and post-impact fire, it is critically important for emergency services to evacuate passengers to a location upwind of the accident and away from fibre composite debris. Timely action will minimize passengers' exposure to these risks."

The Australian study learned from an informal telephone survey that a disparity existed among states and emergency services in their levels of awareness of fibre composite issues in aircraft accidents. International[5] and national health and safety information on relevant equipment choices, procedures and training was used extensively by military services but not consistently by civilian agencies. "This survey found that knowledge of composite hazards and appropriate response methods are very disjointed between different emergency services in different states," the report said.

Aircraft-Specific

The report recommends that personnel sent to the site of a composite aircraft accident be briefed on the aircraft type and its major composite components before they begin this phase of their work. "There should not be any rush for accident investigators to enter the site until personnel have been briefed on the hazards present and the risks posed by fibre composites," the report said. In the current fleet of large commercial jets built since 1985 and operating in Australia, the report said, first responders and accident investigators could encounter examples of composite materials in structures such as:

- Vertical fins made of carbon-fibre reinforced plastic on the Airbus A310 and A300-600 series, and other types of composites forming the wing leading edge, control surfaces and fairings
- Empennage, control surfaces and engine cowlings on Boeing 777s

- Floor panels of cabins and cargo holds in 767s and some 747s
- The fuselage and wing of the 787
- Vertical fin box and ailerons on the Lockheed L-1011
- Composite upper rudder on the McDonnell Douglas DC-10/MD11
- Empennage, control surfaces and engine cowlings on the A320 series
- Empennage, control surfaces, keel beam and engine cowlings on the A330/A340 series
- A composite center wing box and an extensive list of other fibre-composite components on the A380

In the near future, some large commercial jets also will have a new generation of engines built with composite fan blades, containment casings and cowlings. Cabin components molded from glass/phenol materials typically comprise overhead lockers, cabin ceiling and paneling, galley structures, cabin partitions and doors, the report said.

Dressed for Success

Personal protective equipment should include breathing apparatus, specially designed clothing and related procedures for decontamination. Health and safety require "wearing appropriate protective equipment, protecting electrical equipment, moving bystanders away from the crash site and applying fixant solution to all damaged composite structures to limit dust dispersal." A fixant is a substance such as water-diluted liquid floor wax or polyacrylic acid that traps dust and loose fibres as it dries after application with backpack-carried spray equipment and chemical stripper solutions. Aqueous film-forming foam or other ARFF foam normally would be preferred to standard fixant, however, for fibre debris and dust on an asphalt or concrete airport surface.

The ATSB specifies what accident investigators are required to wear at the crash site of a composite aircraft. The list comprises "rubber gloves beneath heavy leather gloves (as fibres may penetrate the skin, causing irritation); safety goggles; a sturdy pair of boots; full-face dust and mist respirator capable of filtering particles[6] below 3 microns [0.0001 in] in size (plus a supply of spare filters); self-contained breathing apparatus; chemical/biohazard protective suit; and Neoprene overalls."

Training covers specific methods of donning this equipment, washing/showering on site before decontamination, and safely removing and disposing of contaminated items. "Failure to wear adequate personal protective equipment is likely to cause severe bouts of coughing and choking, extreme eye irritation and long-term health problems caused by tissue and organ damage from exposure" to some of more than 100 toxic gases that may be generated by decomposition of various types of carbon/epoxy composites, the report said.[5] The ATSB also specifies that anything used at the accident site be suitable for on-site decontamination, so some items typically taken to the site of an all-metal aircraft crash such as writing pads and tool kits must be excluded. The guidelines also call for the establishment of a temporary restricted airspace in the vicinity of the accident to prevent news media and other air traffic from inadvertently dispersing composite fibre dust over a wide area before the fixant has been applied to damaged or destroyed composite structures.

"After entering the crash site, the investigators' first priority should be to protect all electrical equipment," the report said. "Released composite fibres are highly conductive, and their small size means that they can easily interfere with and damage electrical components."

The report provides a comprehensive list of Australian and international source material with advice on the types of information each can provide. Among these is the ATSB's "Fire Safety of Advanced Composites for Aircraft," published in 2006, which "compares the fire resistance of composite materials against key criteria: time to ignition, limiting oxygen index, heat release rate, flame spread rate, smoke and toxic gas release." ◆

> "Failure to wear adequate personal protective equipment is likely to cause severe bouts of coughing and choking, extreme eye irritation and long-term health problems..."

Photo by Sikorsky

Editor's Note: The Canadian Forces authority on aircraft recovery and salvage techniques is the ATESS (Aerospace and Telecommunications Engineering Support Squadron), RASS (Recovery and Salvage Support) team located in 8 Wing Trenton. The Canadian Forces publication titled, 'Post Aircraft Crash/Accident Release of Carbon Fibre' (C-05-040-012/TS-001) addresses the hazards of carbon fibre and associated composite materials when those materials decompose through fire. Guidance is provided for the preparation to respond to emergencies involving carbon fibre material and required actions when responding to such emergencies. You can find an electronic link to this publication on the DND ATESS website: **http://atess.mil.ca/intranetclient/index.cfm.**

Footnotes

1. This article, except where noted, is based on ATSB Aviation Research and Analysis Report no. AR–2007–021, "Fibre Composite Aircraft—Capability and Safety," by R.P. Taylor; this ATSB Transport Safety Investigation Report was published June 9, 2008.
2. The report cited Mouritz, A. "Fire Safety of Advanced Composites for Aircraft," a report to the ATSB, Department of Transport and Regional Services, Canberra, Australia, 2006.
3. The report cited Gandhi, S.; Lyon, R. "Health Hazards of Combustion Products From Aircraft Composite Materials," U.S. Federal Aviation Administration, Department of Transportation, Washington, 1998.
4. International Civil Aviation Organization (ICAO). "Hazards at Aircraft Accident Sites," ICAO Circular 315, 2008.
5. The dimensions of respirable glass fibres determine the degree of hazard. "Glass fibres with diameters smaller than 3 microns and shorter than 80 microns [0.0031 in] can be inhaled deep into the alveolar region of the lungs," the report said. "Fibres shorter than 15 microns [0.0006 in] are cleared naturally from the lungs by cellular activity. However, glass fibres between 15–80 microns remain in the lungs and can lead to pathological effects such as pulmonary fibrosis, which causes diseases such as mesothelioma and asbestosis. Respirable fibres may in addition adsorb toxic chemicals from the decomposing matrix material, which then enter the lungs and possibly cause acute or chronic effects. Temporary skin and eye irritation can be caused by exposure to sharp, fragmented fibres longer than 4–5 microns [0.00016–0.00020 in]."
6. The report cited Mouritz, A.; Gibson, A. "Solid Mechanics and Its Applications: Fire Properties of Polymer Composite Materials," Springer, Berlin, 2006.

Aircrew Flying Gloves

By Major Christopher England, Aviation Life Support Equipment Officer, Directorate of Air Programs, Ottawa

This is my third article in a series of continuing topics in the world of Aviation Life Support Equipment (ALSE). In case you did not have a chance to see the previous two submissions, here is a brief recap. The first in the series had a look at the new flying clothing that will be introduced into service soon; namely the new and improved flight suit as well as the new flying jacket and winter pants – referred to as the Aircrew Ensemble (ACE). The second article explored the various versions of the new boots that have been introduced into service for all Air Force personnel, as well as some that are still being developed. The purpose of these articles is foremost one of education; to allow aircrew an inside look into the projects that have brought these new items into service. By exploring these topics, I hope to dispel some myths with respect to why certain project decisions were made, why certain choices of materials were made, in an effort to allow aircrew to better understand the equipment that they are flying with.

This article is no different and will explore the realm of aircrew flying gloves. I will begin with a very brief look at the history of flying gloves – I think it is safe to say that as we celebrate the Centennial of Flight in 2009 there have been as many improvements in flying gloves as there have been overall in the world of aviation! Following this, a brief discussion on the materials available for manufacturing gloves and the reasons that led the Air Force to a blended nomex/leather glove that is currently in service. As most aircrew realize, the Air Force is experiencing a shortage of the current aircrew flying glove (brown leather and nomex style). I hope to explain what brought us to this shortage and what actions have been undertaken to address this critical shortage. The final portion of the article will explore the potential acquisition of an improved flying glove and some of the challenges that are being experienced to that end.

Until relatively recently, in historical terms at least, the military relied heavily on the dress and sports glove industry for the provision of hand wear. Much of the demand had always been for dress gloves, manufactured from black or tan leather and cotton, principally for ceremonial duties. There were of course exceptions, especially where the gloves concerned were demonstrably protective, such as heavy duty leather gloves which were produced by industrial glove manufacturers to satisfy the needs of the military. But these early military gloves were usually adaptations of the civilian design without much thought considered for the unique environment in which the glove would be put to use.

Figure 1 shows a pair of flying gloves from the World War I RAF flying ace, Capt Albert Ball VC, DSO, MC. It is quite apparent that these gloves were fairly basic in design, with little tactility and comfort. By World War II, there had been improvements made in the choice of material

Figure 1: World War I Flying Gloves

Figure 2: World War II Flying Gloves

therefore leading to better comfort and tactility. The gloves were made from a very comfortable chamois material and if required were used in combination with a leather outer glove to provide further protection from the cold when required.

Although gloves used in the post-World War II flying era were more comfortable, (see Figure 2), the materials from which they were made offered no protection to the aircrew in the event of exposure to flame or intense heat. The use of a silk liner was introduced during World War II in an effort to provide further protection to the aircrew however it became quite apparent that this liner was still not providing the correct amount of protection during exposure to fire. The use of leather in flying gloves provided excellent mobility and tactility, but during exposure to fire the leather would shrink allowing the intense heat to be transferred directly to the skin on the hand, despite the use of the silk liner.

Even with the introduction of new and improved raw materials during the 1960s (for example, the development of perspiration-resistant leather for aircrew gloves) it was really not until the early 1980s that gloves designed specifically to protect military personnel against hazards routinely encountered during operations and training duties, became available. Initially they were designed and produced by manufacturers with experience in countering mechanical and heat risks in an industrial environment, which included flame-resistant gloves. The Canadian Air Force continued to use an all leather flying glove (with or without a liner) up until the early 1980's when a Chinook accident in Rankin Inlet led to the acquisition and use of a nomex-leather blend glove. The accident Chinook, CH147002 experienced a very intense post-crash fire and one of the recommendations that resulted from this accident was the requirement to adopt a flying glove that would provide better protection from flame, fire and intense heat.

There have been numerous styles and colours used in the last 25 years, but the aircrew gloves have consistently been made with a combination of nomex and leather reinforcement, with the provision of a liner to provide further protection. Finding the ideal glove for our Air Force is a challenge given the geography that we operate in. Our flying glove needs to cover a larger temperature spectrum (from -40C to +40C). It needs to be tactile yet fire resistant. It needs to be warm yet maintain mobility. Our current flying gloves offer excellent mobility, tactility and fire resistance, but are lacking in the areas of thermal provision. See Figure 3. In addition to the performance shortfalls of the current glove, the Air Force is also experiencing a severe supply shortage of the current flying glove. What led to this situation? I will attempt to describe the cumulative effects of numerous factors that led to what I have come to call the "perfect storm".

I am by no means a supply expert but from what I have learned over the last three years is this. When the national stock of any item, and in this case flying gloves, reaches a certain amount then there are automatic "flags" that remind the supply manager for that item to react accordingly. These "flags" exist as a last ditch effort to remind the supply manager to order more stock in a timely fashion so as to increase the national stock available. There are factors that need to be taken into consideration such as the manufacturer's availability and the time required to produce sufficient stock to ensure that the supply system does not completely run out of a specific item. In addition, the rate of consumption of that item and the population base of users for that item must be factored in to ensure availability of stock. In the case of the flying gloves, the "flags" did indeed occur, however the supply manager was remiss in reacting accordingly (i.e. the option on the current flying glove contract that would allow further gloves to be ordered was not acted upon). The rate of consumption of the flying glove was poorly calculated (assumed to be low where in reality it was much higher) in the sense that there is wear and tear on the glove attributed to a combination of the manufacturing materials and the environment to which the flying glove is exposed. Tactile gloves require softer materials to be used in the manufacturing process and this leads to a glove that is consumed at a higher rate than a glove manufactured from more wear-resistant materials.

Figure 3: Current Aircrew Flying Glove

Figure 4: Used Glove and a Combat Vehicle Crewman glove.

It is not the manufacturing process that has led to a higher rate of consumption of the current flying glove. I have witnessed personally the manufacturing process and it is solid. The fact that this higher consumption rate was not taken into consideration provided a false sense that the remaining gloves in the system would be of sufficient quantities to meet the demand. The population base of users for flying gloves was misunderstood and the supply manager was under the impression that there were approximately 2000 aircrew in the Air Force. As reported in previous articles, the population base for aircrew within the Air Force is 6000. Therefore one can already see that the predicted demand was not anticipated appropriately. So when the perfect storm hit, the system ran critically short of flying gloves; more gloves were not ordered immediately; the demand was higher than anticipated and the net result was that Wings were completely out of stock. It should also be noted that even if an order for gloves had been submitted in a timely fashion, the quantities ordered may have been insufficient based on the 2000 vice 6000 population of users. How did the ALSE system react to the problem at hand (pun intended)?

Efforts were made to find a suitable interim glove that could be used by aircrew while the supply system reacted to increase the national stock available. The Combat Vehicle Crewman (CVC) glove was investigated as a suitable interim replacement. See Figure 4. The glove is very similar to the current flying glove in that the materials used in the manufacturing process are the same with the exception that the leather is thicker and therefore more robust. The downside to this is a less tactile glove. Permission was granted to use this glove as an interim – however, feedback indicated the reduction in tactility was not acceptable in certain fleets.

The proposal to purchase local quantities of pure leather gloves was also not accepted by the ALSE chain of command (see explanation above as to why the CF went to a nomex/leather glove). Appropriate redistribution of remaining national stock helped to mitigate regional shortages. The reduction in entitlement also helped to "stretch out" the stock that was remaining. This would ensure that aircrew had at least one serviceable pair of flying gloves available (not ideal but better than no gloves at all). Two orders for more flying gloves were submitted to the two manufacturers in Canada capable of making our flying glove. These gloves are coming off the assembly line and are being shipped to Wings as fast as they can. It is crucial that the supply manager (with the assistance of the CAS ALSEO) monitors national stock so as to ensure the quantities received from the manufacturer be shipped to the units that are experiencing the most severe shortages. The system will "weather" this perfect storm – not an ideal situation but one that occurred and has been addressed successfully. But what about the future of flying gloves in the Air Force?

It is the author's opinion that there are numerous gloves currently being manufactured and used in other countries that would outperform our current flying glove. The advance in the textile industry in the last decade indicates that there are far superior material combinations that are used presently in the manufacturing of flying gloves that would provide mobility, tactility, comfort, thermal protection, fire resistance, wind and water resistance. The challenge in acquiring these gloves rests in the contractual process (i.e. buying non-Canadian made products) and the airworthiness process (gloves must be tested prior to introduction into service).

However, with the right amount of feedback to act as a catalyst, the ALSE system could acquire sufficient momentum to acquire a better glove. How can you as aircrew assist in this situation? Submit a UCR if you find that the current flying glove has limitations. Be specific in your comments – don't simply state that the glove doesn't work. Describe the specific environment that causes you concern. Describe the limitations if your hands are cold or wet. Get your unit ALSEO involved if you need assistance in submitting the appropriate paperwork. Get the Wing ALSEO involved. Involve your respective A3 Readiness staff at 1 Cdn Air Div who can then speak on your communities' behalf. With sufficient backing from the operators, the folks in headquarters can work on your behalf to find a better solution out there and eventually introduce into service an improved flying glove. ◆

Whether WEATHER Counts

By Captain Marie-France Stecum (retired)

The aviation community frequently uses the word "communication." Air traffic controllers and pilots have engraved in their training the importance of clear communications. It might seem easy to achieve but we often forget the complexity of the process of transmitting and receiving. Many factors can affect communication and in the following personal experience weather made simple communication more difficult.

While controlling in Greenwood, I noticed that I was receiving pilot radio calls from another area but not the control agency with whom they were communicating. The aircraft could apparently hear me controlling and began to doubt what the controller in their area was saying. Consequently, they started to question their air traffic controller: "Did you clear me to land? I thought I just heard 'cleared to touch-and-go." On our side, the cross feed was coming in very clearly. The Greenwood pilots could also hear other aircraft confirming "cleared to land" and then immediately hear me clear them to land, mistakenly believing that another aircraft was being simultaneously cleared into Greenwood. Consequently, Greenwood pilots began questioning their clearances, which created considerable confusion.

Photo by WO Serge Peters

Moreover, the other airfield and Greenwood were using similar runway numbers – 33 and 31. Not surprisingly, we tried extensively to talk to the pilots outside our zone but could not. We made phone calls to different areas without success. After an hour of such bizarre disruption, we were finally able to get through to an aircraft in the other zone and asked him where he was. He told us that he was in Boston. We immediately called their Centre and explained the situation. Radio technicians in Boston and Greenwood verified our frequencies and said that everything was fine. They suggested that a weather inversion might be responsible for the cross feed. Suddenly, the cross feed stopped as quickly as it had began and our operations returned to normal.

In retrospect, this situation made me think how simple communications can get very complicated and create considerable confusion. While we are often aware of the safety concerns with inclement weather such as icing, fog, and snowstorms, apparently inversions can also result in safety issues. Air traffic controllers and pilots need to be able to communicate effectively; therefore, they must stay alert to any changes that might degrade this aspect of flight safety. ◆

Photo by Sgt Frank Hudec

Out of *Nowhere*

By Captain Tim Lanouette (retired)

Editor's Note: Captain Tim Lanouette (retired) lost his life in the tragic helicopter accident on 12 March 2009 while flying a Sikorsky S-92 helicopter. This article was selected by DFS for publication prior to the accident. May the thoughts and prayers of DFS rest with the families and friends of those that perished.

A few years ago, while flying as a Sea King co-pilot with the tanker detachment, I was involved in a night crew training exercise off the coast of Puerto Rico. We were one of two aircraft that evening in the range area, tracking a target that was simulating a submarine. After successfully tracking the target for about thirty minutes, we received a radio call from the second helicopter. They said that they were five minutes back and were closing our position to join us. We were in the dip at the time and I was flying the aircraft from the left seat in an instrument meteorological condition (IMC) environment. The Tactical Air Combat Control Officer (TACCO) ordered "break dip starboard to the readout" and I proceeded with the transition from the hover to forward flight on the dials. Before I started my turn to the right, I queried the aircraft commander (AC) if I was clear to turn. He did a quick visual check and confirmed "clear right." I rolled into the turn on instruments and once on the readout levelled the aircraft.

As per standard procedures, the AC, who was the non-flying pilot, then began the subsequent in-flight checks for the next dip. It was at this point that I gave my eyes a break by letting them come up off the dials. I glanced off to the left and was greeted by a somewhat confusing sight. Although it was black, which I expected, I saw what appeared to me as aircraft lights in my left forward window. I didn't expect that! I must admit that it took a few seconds to comprehend what I was seeing. The lights were staying put – they were dead centre in the windscreen and were starting to appear larger by the second. That's bad! It was then that I finally grasped what I was seeing and I took what I now call the NASCAR evasive manoeuvre. I turned to where the other aircraft was, in the hopes that it wouldn't still be there when we got there. An aggressive pull up and left roll resulted in a windscreen full of Sea King, passing from left to right.

After levelling the aircraft, the rest of the crew expressed some concern (expletives and all) as to what just transpired. They were completely unaware of just how close we had come to welding two aircraft together. It was at that point that Tropic Tracker, the radar following service, advised us that we were to "maintain 1000 yards separation." A quick survey of the crew resulted in a "let's call it a night, because we're too messed up" vote and we returned to the base.

Upon recollection of the events that occurred that night, there were a number of interesting points to ponder. Firstly, it appeared that the second helicopter was hidden behind the windscreen pillar when the AC visually cleared right prior to breaking dip. The second point was that our aircraft radar had been giving us problems after any significant turns and would lose the radar picture. In fact, after the rollout, our radar locked onto a range torpedo recovery boat. The TACCO mistakenly interpreted this as the other helicopter. The entire time, the second helicopter was both visual with, and positively radar tracking us. Additionally, "Mother" (our ship) was positively radar tracking both helicopters, as was Tropic Tracker.

As you can see, there were a number of skilled personnel involved, watching this event unfold and, yet it still occurred. My take on it is that as a fellow pilot in the aircraft, it was my responsibility to be totally aware of any other aircraft and their whereabouts at all times. I was so busy flying the aircraft that I let my air picture suffer. I should have been cognizant of the fact that we would be turning into the oncoming traffic and should have queried the AC or TACCO as to the whereabouts of the other helicopter. We were extremely lucky that night, and I learned a valuable lesson that I take with me every time I fly. ◆

Bingo, Bingo!

Author unknown

Fuel is very important in the aviation business and it was a clear day on the Cold Lake range when I was reminded of this basic fact. It was a good day to do our one versus one (1v1) basic fighter maneuvers (BFM) trip, as the weather had finally cleared after a few days of consistent twenty thousand foot cloud cover. My flight lead briefed the trip, ensuring he included the training objectives that we wanted to cover during the mission. He then dealt with the training rules, including fuel awareness before we walked to our jets.

Once we entered the training area, we completed our warm-up and "G" tolerance checks. Then we commenced the briefed 1v1 set-up which started from a position of neutral advantage for both aircraft. The fight was going well with some good and perhaps some not-so-good lessons being learned by both pilots. As time passed with the two jets in full afterburner, we were definitely burning our fuel at a very high rate! In the Hornet we have a "fuel bug" which we can set to remind us of a certain amount of fuel remaining. When we burn off our fuel to this level, the pilots are informed by means of a "Bingo, Bingo" voice caution. However, it is still a very good idea and an excellent procedure to check our fuel gauge visually every minute or so while we are engaged to ensure our fuel state is still in the green. On this particular mission, initially I was doing a fairly good job checking my fuel. However, as time passed I became so focused on not getting "gunned" by my flight lead that I did not notice when my fuel state went below my bingo fuel level. A bingo fuel level is a minimum level of fuel required to return to base and land with a very small buffer to account for any delay that might delay your landing. As it turned out, my fuel bug did not set off the "Bingo, Bingo" voice caution and because I was focusing my attention on the other jet which was now making progress to a position behind me, I did not look into my cockpit to notice my fuel situation.

When I finally did look into my cockpit and noticed my fuel state, I immediately called "terminate" and I rapidly turned my jet towards the base and started to climb up to a higher altitude to optimize my fuel efficiency. My flight lead on this particular trip was also below his bingo fuel because he did not set his fuel bug and he was focusing his attention on "finishing me off." When I made the "terminate" call he also turned towards home and started to climb. After every mission on the way home, we are trained to do a battle damage check on one another while in formation to ensure that there is not visible damage to the jets. Since we were both low on fuel, my flight lead decided to forego this check as flying in formation calls for more throttle movements, thus consuming more fuel.

We started towards the base on our minimum fuel profile and luckily air traffic control gave us priority as I now had a "low fuel" caution light. We rejoined into tight formation as we approached "initial" and from there carried out a normal overhead break to a full stop landing. In the debriefing, my flight lead and I discussed what happened and why. It basically came down to the fact that both of us had inattention with regard to our fuel, which is arguably the most important thing in aviation. My aircraft's fuel bug turned out to be unserviceable, but that certainly did not excuse my lack of diligence towards my cross check. I was so focused on trying to "kill" my flight lead, I let my safety guard down and that is never a good thing.

This story had a good ending but it could have easily ended in tragedy if we were further away from an airport or if something out of our control had delayed our landing, which can be a common occurrence. Fuel awareness has always been important to me but after this incident, it is now a priority! ◆

The Day Started Out *Normal* Enough

By Bruce Feaver, Allied Wings, Southport, Manitoba


Photos by Dan Reeves

The day started normal enough, light winds from the north, high overcast and pleasant temperatures. April is a good time to get checked out in a new airplane and I had been looking forward to learning to fly a new design. The Light Sport Aircraft category of aircraft is becoming popular all over the world. The airplane that I was invited to fly was a TL-2000 Sting Sport Aircraft.

These aircraft are made in the Czech Republic and are good quality composite designs that look great and fly equally well. All that I had to do this particular morning was go flying with the owner so that he could see that I was competent in order to validate the insurance policy. The walk around and familiarization was typical but this design did have a few new features for me including the operation of a new engine; a Rotax 100 hp 912ULS. This is a popular four-cycle engine found in many certified training aircraft and has a good reputation among operators. I was enthusiastic about learning how the new engine operated and looked forward to the flight. The airplane started well and we taxied out to our run-up area and completed it in the normal fashion, and then called for take-off. The airplane accelerated well and we lifted off northbound to the training area about 15 minutes away. Enroute we tried a few steep turns and two stalls with and without flaps to get a feeling of the handling characteristics and then turned towards the airport. During our rejoin to the airport the engine began to run a little rough and since the mixture is controlled automatically we adjusted the choke selection and the engine returned to normal.

"During our rejoin to the airport the engine began to run a little rough and since the mixture is controlled automatically we adjusted the choke selection and the engine returned to normal."

The approach was extended slightly to adjust for another aircraft in the circuit and then we turned final in the normal manner. The owner was happy with my flying skills and we terminated the flight. On the taxi, no other indications of a rough engine were evident so we parked the airplane. The owner got out and my next flying partner got in without any further shut down of the aircraft. We strapped in and called ground for instructions to the run-up area. In the run-up we looked at each other and my co-pilot asked if we were going to do another run-up? I said yes since he needed to go through the procedure on the checklist for his first flight. We proceeded to get halfway through the checklist in the high power phase of the run-up and then all of a sudden the airplane gave a big shake and the engine came to an immediate shut down. We just sat there and I said to him, "what happened, did you shut the fuel off?" He said "no" and I shrugged my shoulders deciding what to do next.

" By the time we had extracted ourselves from the aircraft; the fire had broken through the top of the cowling and was at a stage that it could not be contained."

Just then I saw a small amount of black smoke appearing from the left side of the aircraft. I pointed to the front left side and the co-pilot saw the smoke as well. I said in a calm voice, "we have a fire on the ground, let's get out." As the co-pilot got unstrapped I did a Fire On the Ground Procedure and shut the airplane down. By the time we had extracted ourselves from the aircraft; the fire had broken through the top of the cowling and was at a stage that it could not be contained. Within 4 minutes the top of the cowling was covered in flames and the windscreen was now beginning to burn.

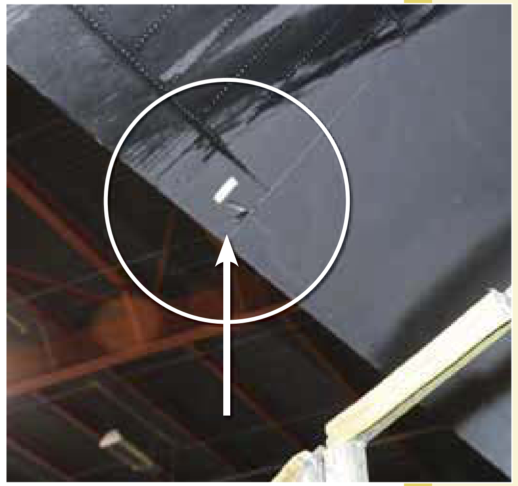
We moved further away from the burning aircraft as the fire continued to rage. After 8 minutes the fuel tank ignited with a light poof and then the engine fell off the front. Shortly after that the airplane dropped on its tail and continued to fully burn. After about 14 minutes, the Fire Fighting Personnel arrived and proceeded to extinguish fire. After 20 minutes it was all over and the tail section was all that remained.

I now think about this situation and know I was lucky to be on the ground when the fire occurred, however, had we not done a second run-up we would have been 1000 feet in the air with a full engine failure and an engine fire in the front end. I also think back to the rough running engine during the first flight. That indication was not significant enough to make me terminate the flight but sometimes indications of trouble are so subtle that we fail to respect the health of our engines. I also suffered with a bit of Halo Effect in that I was so enthusiastic to fly the plane that I neglected to use my experience wisely and curb my enthusiasm. Sometimes our haste gets in the way of good judgment. Our redeeming effort was to not neglect another run-up before launching. It's that run-up that saved us from a much more difficult day. ◆

"...sometimes indications of trouble are so subtle that we fail to respect the health of our engines."

A PIECE OF CAKE

By Officer Cadet Karl Braschuk, Royal Military College, Kingston, Ontario



Photos by Sgt Paul MacGregor

It was 0730 on Wednesday morning during the second week of a typical two-week Hercules periodic inspection. The race was on to have our aircraft pushed out of the hangar by the end of the day. Accomplishing this would give us a couple of much appreciated days before the weekend to prepare for the next Hercules inspection, due Monday morning. Since a team had arrived early to complete the functional test on the landing gear, the only two tasks standing between us and that much anticipated tow job was to lower the aircraft off its jacks and to function test the flaps. We thought it would be a piece of cake as we had all completed both of these tasks flawlessly a hundred times (at least!!) before.

As normal, we divided ourselves into groups. One group began preparing the aircraft to be lowered. That involved checking circuit breakers, connecting the jacking console to the four jacks, and removing any of the stands no longer required from around the aircraft. Another group prepared paperwork and equipment for the post tow-job activities of liquid oxygen fill, fuel job, and the post-periodic run-up. The rest of us didn't waste any time getting busy on the flap functional. Coordinating our efforts, we all agreed that the flap functional was the priority and should be completed first. Within a few minutes we were on the job and by morning coffee break, we were nearly complete. After consultation with the Canadian Forces Technical Orders, we only had a couple of adjustments that needed to be made.

Since we had been at it steadily up until that point, we decided to get our references and finish off the task after taking a quick break. Hearing this, the crew preparing to lower the aircraft approached us with a proposal. They asked if the aircraft could be lowered while we took our break. None of us had any reason to object to that request and I even heard myself saying, "It won't affect us." We ensured the flaps were in the "up" position to facilitate their task and we carried on with our break.

After our break, we hurried back to the aircraft to find it firmly seated on terra firma. The jacking equipment had been removed and, with a "thumbs up" from the person in charge of the aircraft lowering, we got into our positions. We had one person in the cockpit, two in the cargo hold, one on the hydraulic test stand, and one positioned on each side of the aircraft to monitor the movement of the flaps. With everyone at the ready, we lowered the flaps. It went without a hitch until the flaps passed 50% and a scream was heard from the left-hand side of the aircraft. Jumping up to see what was wrong, I saw the outboard flap strike a portion of railing on the newly acquired maintenance staging. I couldn't believe my eyes. We had been moving these flaps all morning with plenty of clearance and those railings were designed with clearance specifically tailored for travel of the flap. How could we now have a twelve-inch cut in the flap skin? How could this happen?

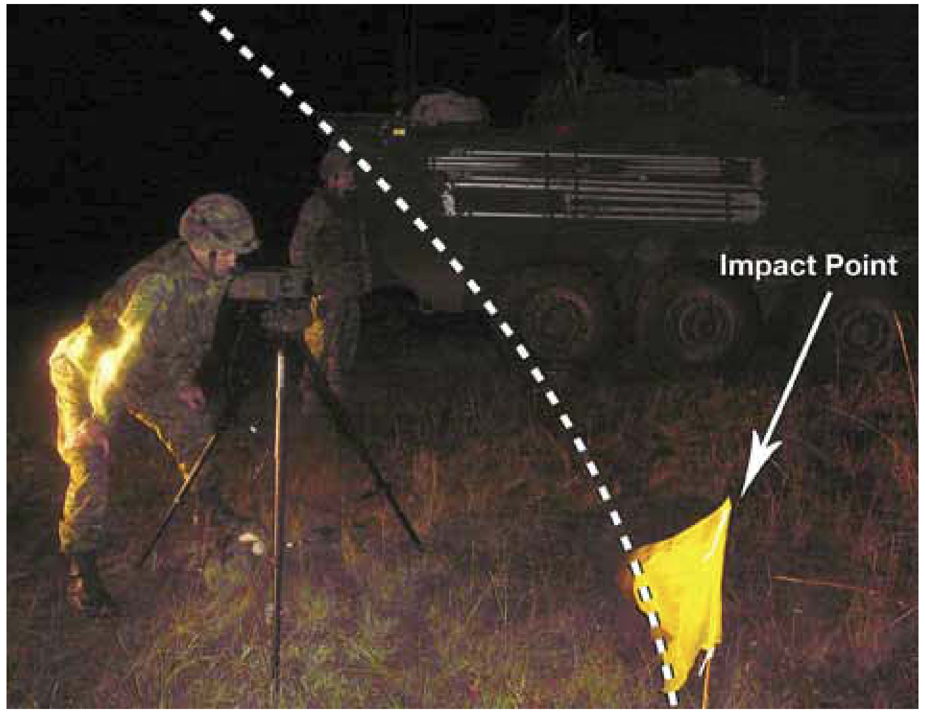
Upon closer inspection, it was discovered that this portion of the railing had been installed backwards. While the aircraft was high up on jacks, the clearance of the flap had been sufficient and the orientation of the railing had gone unchecked. It wasn't until the aircraft was lowered to the ground and the flaps subsequently lowered did we discover the error. Trying to rush this job and get ahead of the game caused us to miss an obvious hazard. You can imagine how cautious we were with our weekend spent replacing the damaged flap. ◆

Epilogue

TYPE: CF188 Hornet (188794)

LOCATION: Canadian Forces Air Weapons Range, Shilo, Manitoba

DATE: 21 August 2007



Graphical reproduction

The incident occurred during a night-time Close Air Support (CAS) training mission involving two CF188 Hornets, call signs Dagger 41 and Dagger 42, in Shilo, Manitoba. As part of the training mission, three Light Armoured Vehicles (LAVs) were assisting with their 25 mm guns. There was no significant weather at the time of incident. Both the Forward Air Controller (FAC) and the Air Weapon Range Safety Officer (AWRSO) had Dagger 42 visual during the occurrence attack and an early "laser on" was called by Dagger 42, 20 seconds prior to impact. At approximately 22:05 local, the Laser Guided Training Round (LGTR) impacted in the observation post (OP) area, 2,800 feet short of the intended target. The impact point was five feet from the Ground Laser Targeting Designator (GLTD II) and the operator. Following the impact a localized thick layer of low lying smoke was generated by the LGTR smoke charge.

The investigation revealed that the occurrence wingman was not adequately prepared for the flight. During the pre-flight briefing, the lead CF188 pilot did not brief the wingman on the specific use of ground based laser designation.

As well the ground lasing portion of the mission was never briefed between the pilots and the FAC. It was also noted that the LGTR safety template was never reviewed during the mission preparation and the GLTD II was positioned well inside the LGTR safety template. The LGTR Field Of View (FOV) at 14 seconds from impact was 20% larger then the template.

At weapon release the occurrence pilot was visual with the OP and the target, which was being marked as well by LAV 25mm gun rounds.

The investigation determined that a number of factors contributed to cause the LGTR to subsequently stray from its intended target.

The investigation recommended a thorough review of the Canadian Air Weapons Manual and Danger Area templates be undertaken to provide AWRSO's, SUP-FAC's and FAC's up to date information, to include all air weapons currently in use, or forecasted to be in use by the CF. As well, these publications should be subject to regular updates and a formal distribution list enforced. The recommended acquisition of a SEESPOT device (laser in the optic range of a night vision device) for every GLTD II would allow the operators to see where the laser was actually marking at night. Finally, this occurrence highlighted the importance of a proper brief to include all involved, for a CAS Mission. ◆

Epilogue

TYPE: Cessna 172 (C-GYAR)
LOCATION: Lac Etchemin Airport, Quebec
DATE: 02 July 2008

The accident involved a Cessna C-172 that departed St-Frédéric airport (CSZ4), QC for the purpose of conducting training as part of the Air Cadet Power Scholarship program. The initial sequence consisted of a demonstration of a soft-field landing at Lac Etchemin airport (CSC5), QC to a cadet student pilot (SP). This was the Class 4 instructor pilot's (IP) first time landing at CSC5, a 2400-foot gravel runway with a slight upslope on the first half of runway 06. Due to a combination of tailwind, excessive groundspeed and ineffective braking technique, the pilot was unable to stop the aircraft on the runway. The aircraft continued off the end of the runway at approximately 25 knots (kts) and came to rest in an 8-foot ditch. The aircraft was extensively damaged and the cadet SP received minor injuries.

The investigation focused on environmental factors and supervisory influences in addition to decisions and actions of the IP.

The Chief Flying Instructor (CFI) for the Cadets at the Flying School advised the new Class 4 IP to conduct the initial portion of the lesson at CSC5 and to use runway 06 for landing, given the upslope.

Upon arrival at the airfield the IP noticed the wind, but decided to land on runway 06 with a tailwind to take advantage of the deceleration effects of the upslope. The first circuit resulted in the aircraft being high on final, causing the IP to overshoot. During the second attempt, the aircraft landed long, which negated the benefits of the upslope. Minimal braking was initially applied as per the soft-field landing technique. Though the subsequent need for maximum braking was realized as the aircraft rounded the crest of the runway at mid-field, the technique was not correctly employed and the pilot was unable to stop the aircraft on the runway. It is believed that the damaged wind direction indicator led the IP to underestimate the wind strength (5 kts vs. 10-12 kts).

The investigation revealed three main contributing factors to this accident. The first was a generalized communication breakdown at the organizational and supervisory levels in that key information was not conveyed clearly to all pilots involved.

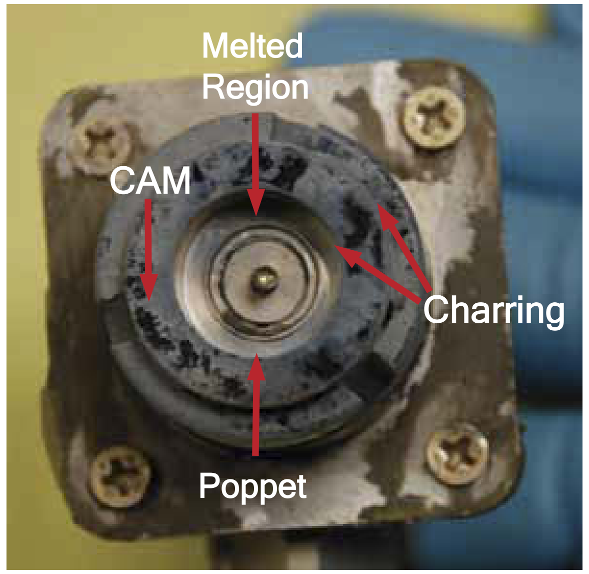
The second factor was a hasty pre-mission planning and briefing during which risk was not properly assessed, leading to unrealistic expectations on the part of the CFI and expectancy on the part of the IP.

The third factor was the decision to accept a tailwind and to continue with the landing even though the touchdown point negated the deceleration benefits of the upslope.

As a preventive measure, the Flying School has now issued a written policy that restricts IPs from landing on non-paved runways less than 3000 ft. It was further recommended that the operator of CSC5 airport ensure the wind direction indicator conforms to the recommendation contained in Transport Canada TP 312 and that the slope of runway 06/24 at CSC5 be measured and, if required, be included in the Canada Flight Supplement. ◆

Epilogue

TYPE: CC177 Globemaster III (177703)
LOCATION: Long Beach, California
DATE: 02 April 2008

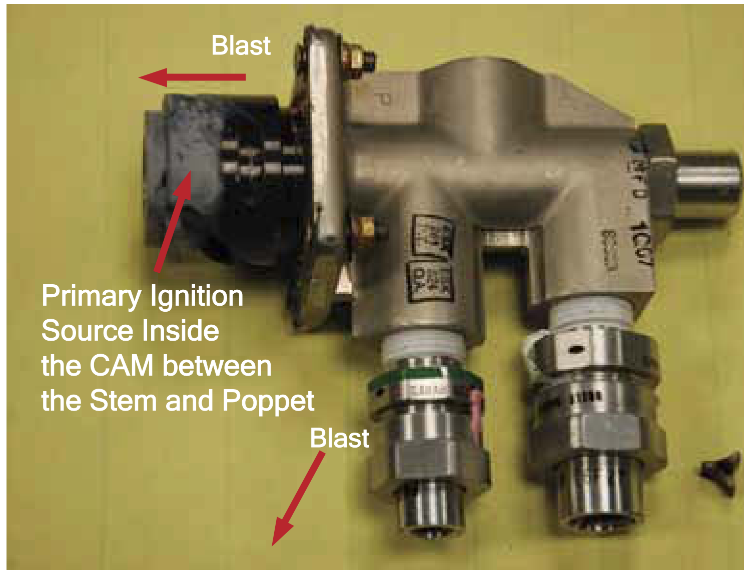


Liquid Oxygen servicing was scheduled to take place on the morning of 2 Apr 08. Several unsuccessful attempts were made to connect the servicing hose filler nozzle, part of the LOX storage tank trailer, to the crew fill, buildup and vent combination valve located in the C17 right-hand oxygen service panel. Troubleshooting did not correct the difficulty. While disconnecting the servicing hose filler nozzle from the combination valve, an explosion occurred. The technician handling the servicing hose filler nozzle was seriously injured. The aircraft also sustained serious damage.

The investigation revealed that isopropyl alcohol was used during troubleshooting to remove frost from the outside of the LOX service hose filler nozzle. The evidence shows that a small quantity of isopropyl alcohol made it to the crew fill, buildup and vent combination valve. Isopropyl alcohol is a highly flammable liquid and will ignite or explode when in contact with liquid oxygen (LOX) if subjected to a mechanical impact or an electrostatic spark. During the multiple attempts to connect, internal parts of the combination valve made contact creating the ignition source for the liquid oxygen and isopropyl alcohol. The explosion instantly destroyed the oxygen service panel and service hose filler nozzle. The injuries sustained by the technician resulted from the service hose filler nozzle destruction.

The investigation identified preventive measures to address the conditions that led to the accident. The preventive measures range from the removal of isopropyl alcohol from the tool crib and the review of LOX servicing procedures to the overhaul of the LOX storage tank trailers and the retraining of all personnel involved in LOX servicing.

The investigation team took the opportunity to review the Flight Safety program at the Contractor facility. Their program was implemented in 2005 to improve safety and reduce accidents. One facet of the program is intended to reinforce the positive as well as constructively and meaningfully address the "at risk" work habits. During the investigation, it was found that applicability of the program is limited to a few organizations at the Contractor facility. In particular, it does not include the organization whose technicians were involved in the accident. It was recommended to extend the program to that portion of the organization. ◆



For Professionalism

For commendable performance in flight safety

Mister Dave Barney

On 12 August 2008, Mr Dave Barney was the Air Traffic Controller (ATC) responsible for the inner runway at the Canada Wings Aviation Training Centre, 3 Canadian Forces Flying Training School in Southport Manitoba.

Although responsible for operations on the inner runway, Mr Barney observed a C90B King Air aircraft conducting a circling approach for a full stop landing on the outer runway. As the King Air turned inbound on an abbreviated final, approximately one mile away, he observed that the aircraft did not have its landing gear down. He quickly advised the outer runway controller and the aircraft was advised to "check the gear." It should be noted that, unlike at military airports, Southport ATC does not normally make the "check the gear" call. The aircraft subsequently initiated an overshoot at approximately 300 feet while in descent.

Mr Barney is commended for his high level of situational awareness, rapid reaction and outstanding professional vigilance. His actions resolved a situation that possessed high potential for a serious accident to occur. His timely vigilance occurred during a stressful period of extended ATC operations in support of high intensity flying training operations.

Mr Barney demonstrated beyond doubt that his notable professional ethos makes him very deserving of this For Professionalism award. ◆

Mr Dave Barney is currently serving with Allied Wings in Southport, Manitoba.

Corporal Robert West

On 6 August 2008, while performing a routine landing light inspection on a CP140 Aurora aircraft, Cpl West noticed a small hole in its outer casing. Upon further investigation, he discovered that a wire with worn insulation had arced and burned through the casing. In addition, he noted that there appeared to be a number of non-standard wiring repairs in the immediate vicinity of the worn wire.

Realizing the possible consequences that could arise from this defect, and wanting to ensure that it was not common across the fleet, he had all available CP140 Aurora landing lights routed to the Component Shop for a thorough serviceability inspection. Initially, the fault seemed to be isolated to one assembly but his persistence revealed other wire bundles that contained significant non approved wire splicing anomalies. His discovery led to the immediate initiation of an Aurora/Acturus fleet-wide Special Inspection of landing lights. This resulted in the identification of additional faulty assemblies throughout the fleet and the origin of the problem being traced back to a third-line contractor. All assemblies were immediately repaired and the preventative measures implemented at the contractor ensured that future maintenance actions would follow approved procedures.

Cpl West's attention to detail, methodical approach and immediate action resulted in the identification of a potentially hazardous maintenance practice.

His refined fault finding ethos played a major role in averting a serious compromise of Flight Safety. He is an accomplished technician and very deserving of this For Professionalism Award. ◆

Cpl West is currently serving with 19 Air Maintenance Squadron, 19 Wing Comox.

Master Corporal Craig Maclellan

On 22 August 2008, Master Corporal MacLellan, an Aviation Level A technician employed with 410 Squadron, was in charge of a right-hand engine change on a CF188 Hornet fighter aircraft. While overseeing the installation of the ancillary equipment, MCpl MacLellan recalled a recent Flight Safety Incident where the Oil Tank Chip Detector Assembly had backed out of the oil tank causing the oil to drain from the engine. This incident led to an in-flight engine shutdown and an emergency landing. On his own initiative, MCpl MacLellan decided to verify the proper installation of this engine's chip detector assembly and found that it was only installed finger tight. The engine was immediately declared unserviceable and a Flight Safety Occurrence Report was initiated.

Recognizing that experience levels within the Squadron were critically low, MCpl MacLellan took the lead to further investigate this abnormality. His investigative curiosity and technical prowess resulted in a fleet wide Special Inspection to ensure the correct fitting of the chip detector assembly on all Removed for Inspection and installed engines.

The verification of the engine chip detector installation is not part of the normal procedure for an engine change. MCpl MacLellan's professionalism and role as a mentor and supervisor played a paramount role in maintaining the CF188 Hornet fleet's safety of flight. MCpl MacLellan is commended for his professional attitude and attention to detail, and his actions prevented a potentially catastrophic engine failure due to engine oil starvation. His extra effort, corporate knowledge, and tenacity make him very deserving of this For Professionalism award. ◆

MCpl MacLellan is currently serving with 410 Tactical Fighter Operational Training Squadron, 4 Wing Cold Lake.

Master Corporal Alain Gunville

In October 2008, Master Corporal Gunville, an Aviation (AVN) technician at 427 Special Operation Aviation Squadron (SOAS) Petawawa, was conducting rotor smoothing maintenance on a CH146 Griffon helicopter. While carrying out the adjustments he noticed that the pitch link directional information decals were indicating the incorrect rotational adjustment.

Upon further investigation, MCpl Gunville realized that the decals were manufactured incorrectly and would direct an inexperienced technician to unknowingly turn the pitch link in the wrong direction and magnify an existing vibration problem instead of correcting it. He also determined that this problem was to have been corrected nearly a year earlier. Fully realizing the gravity of this fault, he immediately initiated several protocols within the Griffon helicopter fleet to mitigate and correct the defect.

MCpl Gunville's attention to detail, dedication to the task at hand and superior efforts in maintaining Safety of Flight are clear testaments to his professionalism. His notable efforts prevented the completion of incorrect maintenance, possible equipment damage and eliminated the potential for personal injury. MCpl Gunville is very deserving of this For Professionalism award. ◆

MCpl Gunville is currently serving with 427 Special Operations Aviation Squadron in Petawawa.

For Professionalism

For commendable performance in flight safety

Sergeant James Fuller and Master Corporal Darren Blair

During the spring of 2006, CP140 Aurora and CC115 Buffalo aircrews at 19 Wing Comox reported periodic problems with the Tactical Air Navigation System (TACAN). The azimuth indications would unlock while Distance Measuring Equipment (DME) indications remained reliable.

Onboard aircraft equipment was inspected and calibrated numerous times without success. Compounding the problem was the fact that the ground station was reported serviceable by crews in a variety of United States and Canadian military aircraft. As well, a NAV Canada aircraft tasked to conduct a flight check reported the TACAN ground station as functional. Over the course of several months repeated attempts to identify the source of the problem were unsuccessful.

Sgt Fuller of 19 Wing Telecommunication Information Services and MCpl Blair of 407 Squadron were independently assigned to investigate this fault. After having exhausted all known individual troubleshooting options for the aircraft equipment, ground station and test sets, these highly talented technicians combined their expertise to ensure every possible fault finding avenue was exercised. After eliminating a number of possible causes, they began to suspect that the practice of using a proxy channel on the TACAN test set did not verify correct functioning of the aircraft equipment on the Comox TACAN channel, UQQ Channel 41. Since the proxy channel was used to avoid interference from the TACAN ground station, Sgt Fuller and MCpl Blair requested and received permission to turn off the ground station to allow testing on Channel 41. This action enabled them to expediently isolate the cause of the TACAN problems to the aircraft equipment. Using their findings, all affected TACAN sets were identified and repaired, eliminating this persistent and puzzling Flight Safety hazard.

Their teamwork, diligence and maintenance prowess clearly demonstrates their notable concern for Flight Safety. These dedicated efforts display a superior professional maintenance effort that forms the cornerstone of all military maintenance philosophies. Sgt Fuller's and MCpl Blair's noteworthy combined efforts to resolve an ongoing complex fault in minimum time make them very deserving of this For Professionalism award. ◆

MCpl Blair is currently serving with 442 Transport and Rescue Sqadron, 19 Wing Comox.

Sgt Fuller is currently serving with 1 Canadian Air Division, Aerospace and Telecommunications Engineering Support Squadron, Command and Control Information Services Flight in 8 Wing Trenton.