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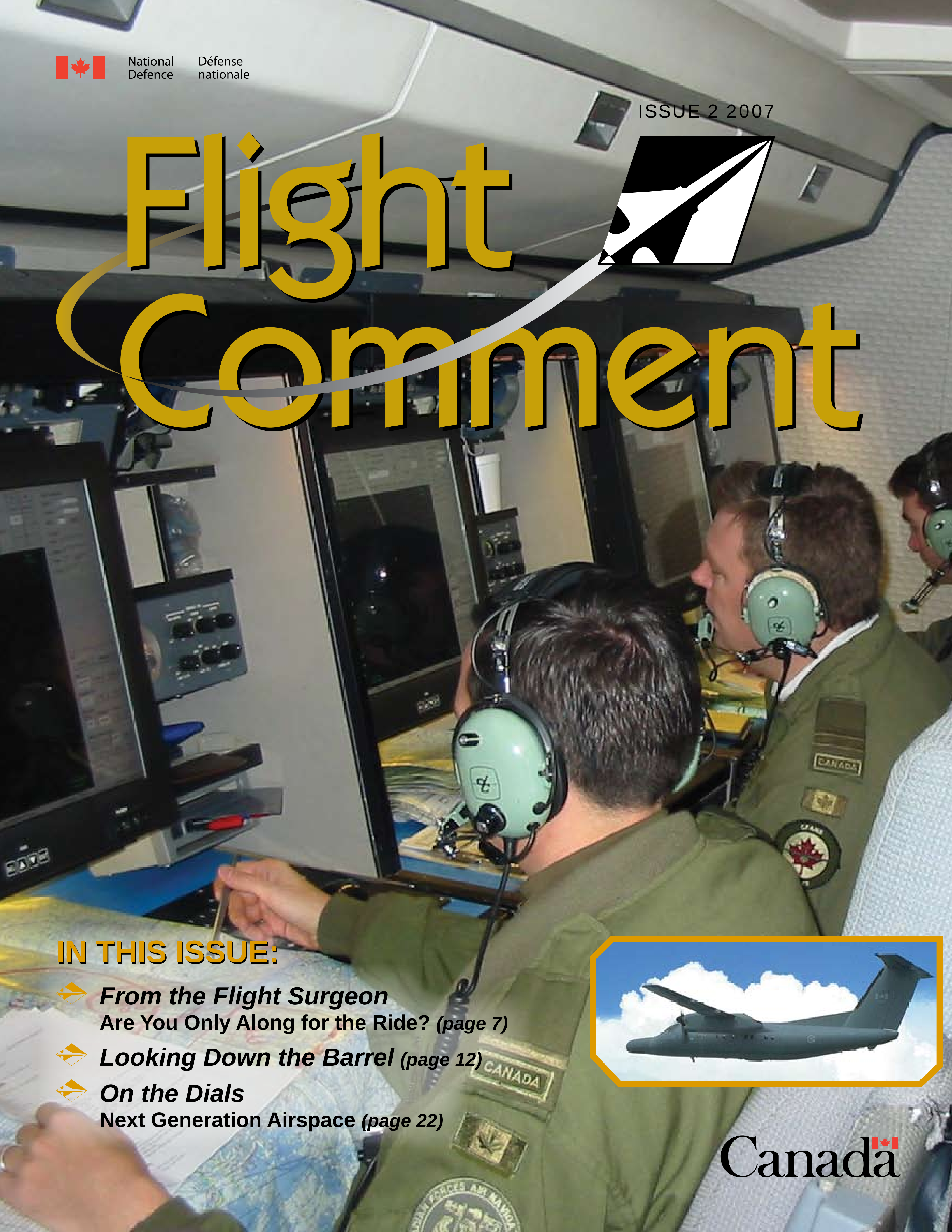
Flight Comment



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Canada

Views on Flight Safety

The Next Leap Ahead

By Mr. Jacques Michaud, Directorate of Flight Safety 3 (DFS 3 Services), Ottawa

The Canadian Forces' flight safety (FS) Program enjoys an excellent international reputation. What gives our FS program an edge is, in my opinion, a superior level of reporting. There are a minimum of 2,500 reports being input into the Flight Safety Occurrence Management System (FSOMS) every year, encouraged by the world-renowned principle that reported occurrences cannot be used for administrative or disciplinary action. DFS and the CF leadership are satisfied that our reporting culture is healthy. But I argue that what we have is not good enough. In fact, is our reporting culture as good as we claim it is? Could it be improved? Would FS staff be able to handle an additional investigation workload with increased reporting? If not, what is a logical evolution of our processes to reduce the accident rate and identify where we are at risk? Allow me to explore these questions:

Is our reporting culture as good as we claim it is? I contend that we could be reporting a lot more. I have always considered myself a strong supporter of the Flight Safety Program, but even I have failed to report occurrences. Early in my career, I thought some occurrences did not require reporting. I failed to understand that the consolidation of similar events could lead to the identification of significant trends, the implementation of meaningful preventive measures, and ultimately the prevention of accidents. And I know I am not the exception: how many more unreported occurrences have there been in the CF? If each pilot in today's CF omits to report one occurrence per year over a 10-year time span, the FSOMS database would missing at least an additional 10,000 occurrences. That is not negligible!

Could our reporting culture be improved? There are many causes that lead to unreported occurrences: pride, fear of retribution, loss of reputation, failure to perceive an event, effort required to submit a report, and down-playing the importance of an occurrence in the overall scheme of things, to name a few. In a better world, we would report everything. As a young CF pilot, I had a very close call, barely evading a controlled flight into terrain (CFIT). The leadership at the time decided that the incident was not to be reported in FSOMS because little benefit could be derived from my experience. What should have been realized was that just six months before, a Kiowa crashed under very similar conditions. There were most certainly lessons to be learned from repeated mistakes. The reality is that many occurrences like these are not reported. And why do some organizations report very few occurrences, most of which are non-threatening material component failures? If these are symptoms at your unit, you may want to take a hard look at your reporting culture and how seriously flight safety is respected within the unit. Of course the reporting culture could be improved!

Would the FS staff be able to handle the additional investigation workload with increased reporting? Ideally, more reporting is desirable. Countless lessons could be derived by the analysis of all occurrences and the identification of meaningful trends. But practically, we would have difficulty dealing with the increased workload as our FS staff has a limited capacity to conduct more investigations. To make the most of the currently stretched resources, DFS is committed to focusing its efforts on occurrences that can lead to effective preventative measures.

What is the logical evolution of our processes to reduce the rate of accidents and identify where we are at risk? Human nature being what it is, we will never achieve a reporting culture that results in the majority of occurrences being reported. We do get valuable data from reported occurrences, but it is only a partial view of the whole canvas. The CF needs to evolve toward 100% capture of occurrences. This ***can***, in fact, be done with the implementation of a Flight Operations Quality Analysis (FOQA) or similar program. If implemented, this type of program could lead to the systematic analysis of flights, the identification of omissions, the confidential debrief of personnel involved, the use of the lessons learned to improve operating procedures, and the acquainting of personnel to areas of concern. A FOQA program would not only eliminate the reluctance to report errors, but would also identify omissions due to the failure to recognize an occurrence.

Until we take the next step, the number of accidents and occurrences being reported will maintain the relative status quo to which we have unfortunately become accustomed. ◆

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Inset: *CT142* Dash 8 *"Gonzo"*

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Good Show

For Excellence in Flight Safety

Master Corporal Hélène Perreault

In June of 2006, Master Corporal Perreault, an aviation technician working in 441 Tactical Fighter Squadron, 4 Wing Cold Lake, was tasked as the servicing controller during the launch of multiple CF188 *Hornet* aircraft. An inexperienced OJT pilot had been scheduled for a familiarization flight in the back seat of a two seat aircraft. However due to an intercom problem, he was forced to exit the aircraft and return to the hangar just prior to the flight. MCpl Perreault was the only qualified technician available to tie down the harness in the now vacant back seat of the aircraft and proceeded up the ladder to perform the task. As she balanced on the leading edge extension, she noticed that the OJT pilot had started to walk across the busy flight line on his way back to the Operations area. Due to the high noise level on the flight line, the OJT pilot did not realize that the next aircraft down the line was already running and that his path would take him within three to four feet of the variable exhaust nozzle. At the distance the OJT pilot would have crossed its path, the jet blast from the idling *Hornet* engine would have had an approximate temperature of 350 degrees Fahrenheit and been travelling at an approximate velocity of 120 kts. Recognizing the danger, MCpl Perreault quickly scrambled down the ladder and ran to intercept the OJT pilot before he entered the danger area behind the running aircraft.

MCpl Perreault is commended for her high level of situation awareness while performing her duties. The stress of a last minute configuration change in a noisy and hectic flight line environment lends itself to the risks of task saturation and channellized attention. MCpl Perreault remained alert to the dangers. Her quick thinking and decisive action were instrumental in breaking the chain of events that could have resulted in a serious injury or loss of life. ◆

Master Corporal Hélène Perreault is currently serving with 409 Tactical Fighter Squadron, 4 Wing Cold Lake.

Good Show

For Excellence in Flight Safety

Captain Bonnie Blocka

On 15 June 2007, CFB Trenton was faced with a significant freezing precipitation situation. Snow and Ice Control (SNIC) barely kept the airfield open. Captain Blocka, the 8 Wing Duty Watch Officer (DWO), informed Skylink, the CF contract handler for the Ilyushin Il-76, of the poor airfield conditions and suggested a later planned departure time. As weather conditions improved, she physically carried out a runway, taxiway and ramp inspection, during which she stopped at the IL-76 and noticed a significant ice accumulation issue: at least ¼ inch of ice had built up on the engines, windows, fuselage, and wings of the aircraft.

When the IL-76 crew arrived for their delayed departure, Capt Blocka informed them of the ice accumulation on the aircraft and started to explain 8 Wing de-icing procedures. The IL-76 Captain quickly interjected and stated that they did not require de-icing. Capt Blocka, a current Embraer pilot and SIM Instructor at Air Canada with 18 years of flying experience, reiterated that she had personally inspected the aircraft and that it definitely needed de-icing. The crew continued to insist on forgoing the de-icing. Not deterred by the situation, she proceeded to the aircraft with the crew and pointed out the severely contaminated surfaces. The IL-76 crew continued to claim that the sizeable Russian aircraft did not require de-icing. In a tactful but firm manner, Capt Blocka explained that 8 Wing's regulations did not permit aircraft, regardless of the country to which they are registered, to depart with contamination levels anywhere near those currently before her.

The IL-76 Captain nodded his head and proceeded to board the aircraft. At this point, Capt Blocka remained skeptical of his intentions and decided to contact the ATC ground controller with clear instructions to route the IL-76 to the de-icing bay only. Shortly after de-icing

began, Capt Blocka's vigilance was tested again as six crewmembers exited the aircraft, attempting to speak to the de-icing crew while a considerable amount of glycol was dripping from the wings. She immediately ceased de-icing operations and demanded the crew to return inside with the doors closed as per standard operating procedures. Specific directions were given to the de-icing crew to de-ice the aircraft as they would any other. The aircraft departed safely at 1712 (L).

Capt Blocka's professionalism was nothing short of impressive. Her actions, without a shadow of doubt, prevented a possible catastrophe. Her tenacity and determination to ensure that safe practices were properly followed was remarkable. Capt Blocka is truly deserving of recognition for her efforts during this difficult incident. ◆

Captain Bonnie Blocka is serving with Wing Operations at 8 Wing Trenton.

Good Show

For Excellence in Flight Safety

Master Corporal Jocelyn Girard

On the morning of 14 February 2007, Master Corporal Girard demonstrated outstanding alertness and rapid reactions that directly prevented serious damage to an aircraft and grave injuries to himself and others in the vicinity.

MCpl Girard was waiting to connect a tow bar to a mule to bring a CH146 *Griffon* out of the hangar. The driver of the approaching mule pressed the brake pedal, but rather than slow down, the mule suddenly accelerated towards the helicopter. MCpl Girard reacted swiftly and managed to line up the tow bar and set it on the hitch of the advancing mule, preventing an impact with the front of the aircraft. But the mule was still moving forward, and the helicopter was now being pushed back toward another parked *Griffon*. Remaining levelheaded even after this intense moment, MCpl Girard moved to the side of the mule and turned off its power. The driver had been unable to immobilize the mule despite his sustained efforts up to this point, and the helicopter had been pushed approximately five feet towards the other parked helicopters.

Investigation of the mule showed that the gas pedal had been improperly assembled, such that pressing on the brake pedal could mean the operator was unknowingly pressing on the gas pedal as well.

MCpl Girard's actions that day were truly outstanding. His keen sense of situational awareness and timely actions directly resulted in the prevention of serious aircraft damage and serious injuries to anyone in the vicinity, including himself. This is clearly an act that warrants the highest recognition of the flight safety program, as a potentially disastrous situation was skilfully averted. ◆

Master Corporal Jocelyn Girard is serving with 439 Combat Support Squadron, 3 Wing Bagotville.

From the *Flight Surgeon*

Are You Only Along for the Ride?

Situation awareness in aviation

By Major Martin Clavet, Flight Surgeon, Directorate of Flight Safety, Ottawa

Ever heard of the catch phrase "*fat, dumb and happy*" used to describe someone who is dangerously unaware of his or her surroundings while operating aircraft, controlling air traffic, or performing maintenance?

It is a fact that a significant percentage of aviation occurrences have, as causal or contributing factors, loss of situation awareness (SA) on the part of aircrew, ground crew, and maintainers. The proportion is even greater when considering occurrences involving serious injury, death, or destruction of aircraft. Indeed, loss of SA has been a predominant cause of fatal accidents in both military and civil aviation. One may conclude that "loss of SA" equals "loss of aviation resources," or at least the potential for it.

SA is widely recognized as critical to success in aviation. It is considered an essential requirement for the safe operation of aircraft. More than 80% of accidents have human cause factors attributed to them; this climbs to more than 90% when only considering fatal accidents. Faulty decision-making is cited as the primary cause in a vast number of these accidents, and SA problems are far too often at the root of the decision errors.

Photo: Corporal Bernard LeBlanc

You can't lose what you don't have

The issue is not solely about losing SA. After all, you cannot lose SA if don't have it to start with! The key issue for aircrew and technical personnel is to build and develop a high level of SA from the start, and to then update or renew their "SA picture" as the task at hand unfolds through an active and cyclical process. The key for supervisors and commanders is to manage the factors that can restrict or erode SA in air operations. We can't afford to be passive; we can't afford to just be "*fat, dumb and happy!*"

So what is situation awareness?

SA refers to the degree to which your perception of the current environment mirrors reality, both the big picture and the details. It is the ability to identify, process and comprehend the critical elements of information about the task at hand. It is simply knowing what is going on around you. Getting ahead of the situation is better. Staying ahead is best. That's *Situation Awareness 101*.

The most established and popular definition of SA comes from Mica Endsley (1988, 1995, 2000): "…the ***perception*** of the elements in the environment within a volume of time and space, the ***comprehension*** of their meaning, and the ***projection*** of their status in the near future." There you have it: the three crucial levels, or hierarchical phases, of SA. Let us take a closer look:

- ***Level 1 SA: Perception** of the elements in the environment*

  The first step in achieving SA involves accurately perceiving information and recognizing relevant elements in the surrounding environment. To achieve Level 1 SA is first and foremost a function of personal attitude, a predisposition and genuine desire to get involved. More inclusively, it is also a question of attention, memory, focus, alertness, appropriate physical and mental states, viable workload, and appropriate working conditions and equipment.

- ***Level 2 SA:* Comprehension *of the current situation***
This step is based on a synthesis of disjointed Level 1 elements, such that Level 1 SA provides the foundation for Level 2 SA. Level 2 SA goes beyond simply being aware of the elements that are present to include an accurate understanding of their significance. Based upon knowledge of Level 1 SA elements, an integrated picture of the environment is formed. It is about *putting the pieces of the puzzle together*. To achieve Level 2 SA, one must first have solid Level 1 SA, as well as relevant training and knowledge of the task at hand, systems, operations, and tactics.

- ***Level 3 SA: Projection** of future status*
This step involves the ability to predict how the current situation will evolve and how it will impact future operations. Success in achieving Level 3 SA is mainly a function of previous exposure, experience, and proficiency.

Photo: .Master Corporal Jeff de Moliter

So, to have complete and fully integrated SA, you need to get involved to begin with: remember, it is a question of attitude! If you remain isolated or do not want to get involved, even to act as an honest broker, things might go sour very quickly and dramatically. The workload has to be kept within reason, and appropriate working conditions, documentation and equipment must be available. You also need to be focused, physically and mentally alert, knowledgeable of the task, systems, operations and tactics, appropriately trained, somewhat experienced, and above all, proficient. Take an honest look at yourself: do you meet the standards of the three levels of SA?

SA is crucial when handling complex tasks

Note that attaining the three levels of SA is not the same as making a decision, but the decision usually follows easily once SA is completely achieved. One could say that attaining SA (*what do I have?*) supports decision-making (*what do I do?*) by providing the framework. In fact, the key factor that determines decision quality is SA.

A high level of SA therefore allows people to function in a timely and effective manner, even when engaged in very complex and challenging tasks. Good SA is necessary for success when working in critical environments such as aviation. When people are required to make critical choices, sometimes at a fast pace, the vast majority of errors that occur are a direct result of failures in achieving complete SA. In aviation, the results of poor SA can be catastrophic.

SA: do you have it? (Clues that you're behind the curve)

The loss of or failure to achieve SA usually occurs over a period of time and leaves a ***trail of clues***. Be alert for the following clues that will warn you of lost or diminished SA:

- ***Confusion or gut feeling:*** Trust your feelings! A gut feeling that things are not right, combined with knowing that there has been incomplete planning, rushed or sidestepped SOPs, or disorder within the team or in the execution, is one of the most reliable clues. Trust it!

- ***Ambiguity or missing pieces:*** When required information is confusing, unclear, or even missing, you must clarify or fill in the missing pieces before proceeding. Of note, failure to achieve SA is almost always present when near-collisions occur. The absence of sound contingency planning and poor or nonexistent deconfliction routes and strategies are almost invariably at the root of the issue.

- ***Use of improper procedures or departure from regulations***: This can put individuals or teams in a precarious position, where the consequences of actions cannot be predicted with any degree of certainty.

- ***Failure to meet planned targets:*** Start questioning why targets were not met and systematically evaluate the situation.
- ***Unresolved discrepancies:*** When two or more pieces of information do not agree, continue to search for information until the discrepancy is resolved.
- ***No one watching or looking for hazards:*** All heads down, task saturation, information overload, or channellized attention can be lethal! The proper assignment and performance of tasks, particularly supervisory ones when dealing with a contingency, is essential to safe operations.
- ***Fixation or preoccupation:*** When someone fixates on one task or becomes preoccupied with work or personal matters, he or she loses the ability to detect other important information. Preoccupation with personal matters can often lead to subtle changes in performance. Early detection of both fixation and preoccupation is essential to safe air operations. The easiest way to recognize these clues is to know the behaviour of the team members and be alert to change. The Two-Challenge Rule has been used fairly effectively in aviation to detect fixation in a team member. If a team member fails to adequately respond to two or more challenges regarding omissions or questionable actions, the individual can be assumed to have lost SA and some action is required. Apply this rule. Be alert to subtle changes: your life may depend on it!

Barriers to SA

Some circumstances reduce an individual's ability to understand the situation. Recognizing these "barriers" and taking corrective action is everyone's responsibility – aircrew, ground crew, supervisors, and commanders alike. Barriers include:

- Excessive motivation (often resulting from selfish/personal hidden agenda)
- Complacency (the latent killer!)
- Overload, underload, or intermittent workload (resulting in partial information)
- Unacceptable working conditions, and inadequate documentation or equipment
- Mental and physical fatigue, excessive stress, preoccupation, and distraction
- Poor communication, not only as a result of poor crew resource management (CRM) and poor communication within a team, but also of deficient communication tools

Speaking of communication

As a matter of fact, SA maintenance occurs through effective communication and a combination of the following actions:

- Monitor and watch for changes in the performance of other team members.
- Be alert. Recognize and make others aware when the team deviates from SOPs.
- Identify potential or existing problems; provide information early.
- Demonstrate ongoing awareness of mission status.
- Continually reassess the situation in relation to the mission goals.
- Clarify expectations of team members to eliminate doubt; ensure that all expectations are shared for complete awareness by the whole team.

How's your SA on SA now?

Situation awareness is the ability to step out, build the big picture, and maintain it, all of which supports your ability to make sound decisions. SA is seen as the key to mission success and aviation safety, so act as if your life depends on it! Just going along for the ride can be deadly. And if your life is not on the line, someone else's may very well be. Does being "*fat, dumb and happy*" sound appealing to you now? ◆

For your Situation Awareness

On 18 June 2007, CAS endorsed new pilot entry vision standards. The new vision standard for entry into the pilot occupation will be set at V2 as defined in document A-MD-154-000/FP-000 (CFP 154) Annexe A, but with a different limitation. V2: up to 6/18 in both eyes or up to 6/12 in the better eye and up to 6/30 in the worse eye correctable to V1, i.e. 6/6 in the better eye and 6/9 in the worse eye with the following limitation: as long as the refractive error does not exceed plus or minus 5.00 dioptres spherical equivalent in either eye. This latest change is effective immediately.

From the DIRECTOR

The Way Ahead

The CF Flight Safety Program has a proud heritage and enjoys the reputation of being among the best in the world. But let's ask a simple question: are we resting on our laurels?

The flight safety program we know today is largely the result of decisive action taken by the RCAF in the 1950s to tackle its dismal flight safety record. Incremental improvements followed: the Flight Safety Occurrence Management System (FSOMS), use of automated tools for trending and analysis, construction of a strong reporting culture, and the introduction of a coherent airworthiness process all made our flight safety program stronger.

Yet year-over-year trending shows little progress in reducing accidents. Is our dependence on voluntary reporting a factor? Despite very strong emphasis on reporting, we only receive an average of 3500 new reports into our database every year. Aircrew-related cause factors are under-represented. Our culture is good; but while voluntary reporting is essential, it cannot break through to a new level in safety. Something different is needed.

Let's compare ourselves to the air transport industry, which has an impressive safety record. Serious accidents among western air carriers are so low that variations in annual loss rates owe more to chance than any other factor. New technologies such as TCAS II, Enhanced Ground Proximity Warning Systems (EGPWS), and automation have made air travel safer than ever before. Yet air carriers are extremely motivated to improve their safety records further. They know that steeply increasing global air travel guarantees the absolute number of air accidents will increase, even as the rate decreases. Industry faces the spectre of more broken airplanes and dying people on the front page and on 24-hour news networks unless accident rates move towards zero. For an industry that is extraordinarily sensitive to variations in public perceptions, this is serious business. It demands radical change, and industry is making it.

Our air force is in a like position. We are acquiring new, very sophisticated aircraft that offer outstanding performance and capability, but which come at a very high cost. While accidents have never been acceptable, future accidental losses will represent an even more exceptional cost in dollars and irreplaceable lives. Certainly the Canadian public will demand accountability if it perceives we did less than our utmost to safeguard these precious aerospace resources. Scrutiny will increase, not lessen.

So, how do we break through the low overcast to the clear skies beyond? We have to follow the same path as our colleagues and search out radical new ways of improving safety.

Technology may provide some answers. I mentioned EGPWS and TCAS above: perhaps those, and similar technologies can be applied more widely. The high levels of automation available in our new aircraft should provide significant safety benefits if used properly. Simulation training may also prove to have significant safety benefits. One major improvement would be to automate data collection and analysis via onboard systems. Most major airlines and air forces do this, gaining both operational and safety benefits. Furthermore, we can move towards data fusion: routinely mining our operational and maintenance databases to spot developing trends.

Non-technological solutions can also be pursued. Risk management methodology has been very successful in enhancing technical and operational airworthiness. Yet we do not have a workable system of tactical risk management for the field. We need to keep abreast of new concepts in CRM (crew resource management) and HPMA (human performance in military aviation). More extensive implementation of HFACS methodology is also required.

The point is that we cannot afford to rest on our laurels. The RCAF of the 1950s had some bitter failures from which they learned to our benefit. To go to the next level, we are developing long-range plans that will help structure our quest to make radical progress towards improved safety. The goal is not to just be among the best, but to be right at the forefront of safety – we can do it! ◆

Director of Flight Safety

Engine Wash + Circuit Breakers + Fuel =

Flight Safety Occurrence

By Master Corporal Raymond Girardi, 409 Tactical Fighter Squadron, 4 Wing Cold Lake

Although this story happened a few years ago, the aspects of communication, understanding aircraft systems, and stress are still very applicable to today's military environment. It was a day like any other at 407 Demon Squadron. My comrades and I had just come in for the night shift. The time was 15:00 and the sun was still shining on us.

One of our CP140 *Auroras* had landed earlier in the day with some avionics (AVS) snags, and it also required an engine wash. As a young AVS tech, I was uninterested and oblivious to what the engine wash involved. So I went to work on the snags with the other techs while the aviation (AVN) tech in charge of the wash, a master corporal (MCpl), began to prep the engine and assemble his tools. We AVS techs would be able to work alongside the wash since it wouldn't affect our work.

The MCpl had recently been reminded by his superiors of an unofficial message stating that certain fuel-related circuit breakers for the fuel shut-off system should be pulled when motoring over the props and engine for the wash. But the information had been unclear to him (***which*** circuit breakers to pull was not specified), no copy of the message could be found, and no checklists had been amended to guide the new procedure.

The MCpl knew the CFTO procedures and followed them, this time adding the pulled circuit breakers. I now know that the engines would have been turned using air from the auxiliary power unit (APU) to enhance the washing of the blades and internal parts. No fuel would enter the engine because the fuel shut-off switch would be engaged. The wash started while us AVS techs were busy doing radar and other navigation system functionals inside the aircraft.

One of the techs onboard the aircraft went out onto the wing only to find both the engines hot and smoking! The groundman could smell a burning odour too and alerted the MCpl, and people scrambled to do an emergency engine shutdown. As I exited the aircraft at breakneck speed from the alert sounded by the AVN techs running past my seat, I found myself staring at the red glow of the engine turbines! It was then that I realized I had been involved in an incident.

I later learned that if the circuit breakers for the fuel shut-off system pop while the aircraft is in the air, the last thing anyone wants is fuel to actually stop flowing. Instead, the aircraft switches to a steady fuel flow state and continues to pump fuel, bypassing the fuel shut-off switch. What had happened here was that upon pulling the breakers and motoring over the engine, the aircraft thought it had lost power to the fuel shut-off system and began to inject fuel! The engines started for real, and the commotion ensued.

As a young AVS tech, CFTO procedures were to be strictly followed. But older techs at the time would say CFTOs were guidelines. The result of the non-conforming procedure followed that day was enough to change my understanding of CFTOs and why their procedures are so detailed. I learned that CFTOs are a tech's best friend, and that following outlined procedures and paying attention to cautions and info contained in them is crucial. I also realized that the element of stress the MCpl may have self-imposed to comply with the alleged message may have helped push that already questionable situation to the edge.

I never thought an engine wash could be dangerous!

EDITOR'S NOTE

The mysterious message alluded to in this story concerned an unsatisfactory condition report (UCR) with which the Maritime Air Group Headquarters (MAGHQ) had agreed. Following this occurrence, technicians were informed that MAGHQ concurrence with a UCR did not give authority to carry out procedural changes. Further briefing was given on the importance of adhering to established checklists and the consequences of adding to these procedures. Emphasis was placed on the requirement to understand aircraft systems first and foremost. Similarly, instructions were given that any messages of the nature that had been encountered in the above story were to be clearly marked as "Info Only" to avoid premature implementation. ◆

Looking Down the Barrel

By Sergeant Jason Krzywonos, Canadian Forces Air Navigation School, 17 Wing Winnipeg

I have witnessed the best and worst of planning in Naval Operations during my time flying on *Sea Kings*. But one day in particular was a "hit or miss" with respect to flight safety.

During RIMPAC exercises off Hawaii, my crew and I aboard *HMCS Algonquin* were briefing for a typical day at sea. Just prior to brief, our mission changed and we were to conduct a crew-orientated exercise to practice our antisubmarine skills. At brief time, there was another change: we were now assigned to work with the task group while the *Algonquin* conducted a live fire pre-action calibration (PAC) with her 76mm gun.

Our brief covered timings, standard radio frequencies, call signs, the fleet's disposition, and, of course, the ship's gun firing. The ship had only a small window to conduct the gun calibration, and unfortunately it coincided with our return time to the ship.

As we departed and were about to clear "Mother's" control area, our mission was changed yet again! This time we were to conduct independent operations south of the fleet. Left to our own devices, we headed approximately 15 nm south of the fleet to conduct our exercise.

With our anti-sub exercise completed, we turned towards the fleet to make our timings. I found "Mother" on the radar and gave the pilots a vector while we called the ship and asked for "permission to close" – permission to enter the ship's defence area. The response was, "Clear to close." Once the landing signal officer (LSO) had us visual, the shipborne air controller (SAC) passed control to him for our recovery: all standard operating procedures. Just another day at sea!

Then it all went wrong! What we didn't know was that the ship's PAC had been delayed. And as we neared the ship, her internal communications system failed! This resulted in the SAC, the LSO, and the ship's Bridge not having communications with each other. The LSO gave us the "DELTA" (a 200-foot holding pattern using the ship as a turning point) since he did not have clearance to recover us and was sorting out his comms. With comms down, the Bridge didn't know that the LSO had given us the "DELTA", and they didn't know where the helicopter was. And to complete the confusion, the LSO was unaware that the PAC was not finished.

We in the aircraft *assumed* the PAC was complete since we were cleared to close and had been given the "DELTA". We were passing down the port side of the ship when the main gun ***fired a 3 round salvo*** (simultaneous firing) to starboard! Naturally, our immediate reaction was to turn 180° and get low and clear well behind the *Algonquin*. We remained there and waited for further instructions. Eventually we recovered without further incident (WFI).

What is the moral of this story? Communications is key in military evolutions, all the more so in flight operations. When the plan starts to fall apart due to lost communication, everyone involved should "wait out" until the situation can be resolved. We have to avoid falling into the "status quo" of daily operations or a blind "let's get the exercise finished on time" attitude. Failure to do so can put you on the wrong side of the firing line…literally! ◆

A Warm Summer Afternoon Stroll

Why are you walking around?

Photo: Captain Brian Cole

By Lieutenant Daniel Leslie, Regional Gliding School (Pacific), Comox

Think of the number of pilots you have seen doing walk-arounds before flight; now think about the number of pilots you've seen just walking around their airplane. There is a very distinct difference between these two!

The warm summer afternoon promised beautiful flying, so I pressed through my daily inspection (DI) to maximize my flying time – I couldn't wait! I was nearing the completion of the DI when I realized I needed oil. So I hurried to get some and get on my way.

I was savouring the beautiful afternoon view of the sun nearing the horizon shortly after takeoff. My glee was short lived when I heard radio chatter, "…smoke coming from your engine." I hurriedly scanned my instruments – all green. Oil pressure was well within the normal pressure range. I stammered that all engine parameters were green and asked the glider I had in tow if they wanted to release. Meanwhile, I was trying to figure out how I got into this predicament. I forced those thoughts out of my head as I still had a plane to fly. The glider pilot responded, "I will stay on until 400 feet, then turn back!" When the glider released, I completed the procedure and tightened my left turn to join a close downwind, levelling off at 800 ft. I was consoling myself with the thought that at least the runway was very close at hand should I have a catastrophic engine failure when I saw something climbing up the windscreen…**OIL**! My mind was racing when the tower call boomed over headset, "Tugg 5, are you declaring an emergency?" Then it hit me: I hadn't secured the oil cap!

I had lots of time to think over my mistake, my haste, my oversight, my life, and the lives of those in the glider behind me as I spent the rest of that sunny afternoon in the hangar cleaning oil off the airplane. Instead of focusing on the task at hand – the walk-around – I had hurried to take to the sky to get a few extra minutes airborne. Standing in the hanger with rag in hand, hearing the buzz of a cadet flying program in the background, I realized that the consequence of that deficit in attention was exactly the opposite of what I was aiming for. I asked myself a few questions: how could I have forgotten the oil cap? How could I have forgotten my training? Why did I rush myself to fly?

A fellow student pilot once told me of a training partner he had: "He's always looking for a field to land in; he never takes time to enjoy the view…" Maybe his training partner had a point. In any case, I quit walking around after that day, and now I only do walk-arounds! ◆

They Come with Baggage

Why traffic techs do what they do

By Master Corporal Raymond Girardi, 409 Tactical Fighter Squadron, 4 Wing Cold Lake

Taking "Service Air", traffic techs are there. Yes, we are the people with the red wheel (our trade badge) providing logistics support so that you and your kit get to destination **safely**! We may not be the pointy-end of the Air Force, but flight safety is still a major consideration in our day-to-day business.

An important step in the deployment of personnel, whether for exercises or operations, is the baggage inspection and passenger check-in process. When deploying out of 8 Wing Trenton, both processes are often done on-site through the passenger terminal. However, many deployments are not done through Trenton, and without a fully functioning passenger terminal, the processes vary. In most instances, Mobile Air Movements Sections (MAMS) are sent to Army bases to complete these processes. When deploying out of Petawawa or Valcartier, the baggage inspection is completed at their respective bases and the passengers deploy out of Trenton. When deploying out of Edmonton or Gagetown, both the baggage inspection and passenger processing is completed on-site at home base as the aircraft are forward deployed to those sites.

Members proceeding on deployment are limited to one barrack box, one kit bag, one rucksack and one carry on. This rule keeps the aircraft from being overweight, and is thus very important for flight safety.

Like the regulations at civilian airports, sharp objects are not permitted aboard the aircraft. Also, and more importantly, certain dangerous items are not permitted. Many of these items are found repeatedly during the baggage inspection process: Brasso (for badges), nail polish, nail polish remover, Permethrin repellent spray, air mattress repair kit (glue), and lithium batteries, to name a few. These items are considered "dangerous goods" and are prohibited under the Transportation of Dangerous Goods Act, 1992. From time to time, even ammunition rounds or ammunition simulators are found when personnel are returning from the field. With items such as these, MAMS representatives must complete a thorough baggage inspection in order to make certain these items are kept off of the aircraft, thus ensuring the safety of the passengers, crew and aircraft itself. Additional items that are not permitted anywhere in the aircraft, in accordance with the CFACM 7-400(1) *Manual of Air Movements, Volume 1*, Chapter 3, include strike anywhere matches, flammable liquids and aerosols, and explosives (including fireworks, flares, etc.). In the cabin, the following items are banned: sharp objects, all firearms, replica or antique weapons, or sports equipment that could be used as a weapon. Safety matches and lighters must be carried on the person and loose batteries must be taped and kept out of contact with metal objects. Hexamine tablets are permitted on dedicated tactical or contingency airlift only. Toiletry items, including shaving cream, deodorant spray, hair spray, etc, are permitted provided they do not exceed 2 kg or 2 L in size.

Photo : Sergent Frank Hudec

As you can see, there are quite a few restrictions for Service Air, and adhering to these rules is the job of MAMS personnel when checking in passengers and baggage. So when you are called up for your next deployment, or are heading out on Service Air for any reason, abide by these restrictions as part of your effort to ensure the safety of flight. If you are not vigilant, then MAMS personnel will be. Remember, if you don't bring it you can't lose it! The job of MAMS personnel is to ensure that only the right stuff gets on board an aircraft. Why? For flight safety – your safety – that's why! ◆

The Editor's Corner

A New Face

Well, hello! I am sure you will be just as surprised as I am to see me taking over as editor of *Flight Comment*! Allow me to introduce myself: I am a recent graduate of the Canadian Forces Air Navigation School (CFANS) in Winnipeg, currently waiting for my Operational Training Unit (OTU) on the *Sea Kings* in Shearwater in early 2008. I came to Ottawa to do on-the-job training (OJT) at the Directorate of Flight Safety with a shiny, new set of wings and no expectations other than to learn all about flight safety and photocopy-up a storm, as any OJT student can expect. It wasn't long before I was told that *Flight Comment* was going to need an editor. And presto, I was it!

Don't get nervous just yet about some young lieutenant taking the reins for a while. I have had months of coaching from our retiring editor, Captain Rob Burt, and an ongoing crash course in flight safety from the flight safety experts themselves here at DFS. Learning flight safety from this point of view (vice from the field) is like walking out from a shadowy black and white world into one of vibrant Technicolor™. A popular joke says that if there is an apparently pointless rule telling you not to do something, it probably means someone has tried it before, and you assume with a cautious chuckle that stupidity must have played a part. Well, DFS is where you hear about people doing these things, but it's no longer a joke; you learn there is far more than "stupidity" that can cause these things – often preventable things – to happen. And suddenly the business of investigation and prevention proves to be a legitimate and demanding job.

I am privileged to have a part in the prevention business as editor of *Flight Comment*, if only for a short while. It's a fairly easy job to follow in the footsteps of Captain Burt, who has spent nine issues of *Flight Comment* laying some solid groundwork for future editors. DFS certainly won't be the same without his talkative ways, especially in the promotions section. If you have ever read his past "Editor's Corner" articles, you will know his entertaining style was one to look forward to. I'm sure you can appreciate how the look and feel of Flight Comment has evolved to take on a more contemporary look over the past three years, and excellent changes will continue to happen thanks in large part to the initiatives Capt Burt has been pushing for. Rob, enjoy your well-earned retirement!

In addition to these changes, *Flight Comment* has its 60th anniversary coming up! The year 2009 will mark 60 years since the debut of the Canadian Forces' flight safety magazine, originally named *Crash Comment* in 1949 and renamed *Flight Comment* in 1954 (the "Check Six" article in Issue 3 2006 mentions the story). In fact, you will soon have access to PDF versions of all the past 60 years of *Flight Comment*, including the original *Crash Comment*. Look for the archived magazines on the newly renovated DFS Internet website (*www.airforce.gc.ca/dfs*) by the end of August 2007.

I will only be editor for a short time, but I thoroughly look forward to working on the next issue or two, and then to introducing the new editor when he or she arrives. In the meantime, I will be the face or name or voice or whatever it is you know me by, prodding for articles and photos. Many thanks go to those who volunteer material for publication so that the world can learn from your unique experiences and knowledge. We've got the venue, but you've got the voice! ◆

Lieutenant Jazmine Lawrence

Fly Safe

Wake Turbulence

An Invisible Enemy

All pilots need to be aware of wake turbulence. Depending on the type of aircraft, the phase of flight, and the weather conditions, the potential effect of an aircraft's wake turbulence on other aircraft can vary. Encountering wake turbulence can be especially hazardous during the landing and takeoff phases of flight, where the aircraft's close proximity to the ground makes a recovery from the turbulence-induced problems more difficult.

Wake turbulence accidents are not just limited to lightweight aircraft flying into the wake turbulence of heavier aircraft. Worldwide, there have been a number of wake turbulence incidents between lightweight aircraft. For example, a Flight Safety Foundation study of 130 wake turbulence accidents in the United States over the period from 1983 to 2000 revealed that 22 percent of the accidents involved small aircraft that were flown into the wake turbulence of other small aircraft. The aircraft in the study weighed 2300 kilograms (5000 pounds) or less.

What is Wake Turbulence?

All aircraft produce wake turbulence[1] (more correctly called wingtip or wake vortices), which consists of wake vortices formed any time an aerofoil is producing lift. Lift is generated by the creation of a pressure differential over the wing surfaces. The lowest pressure occurs over the upper surface and the highest pressure under the wing. Air

Wake Turbulence Categories of Aircraft (ICAO-DOC 4444 PANS ATM)

Heavy (H)** – all aircraft types of 136,000 kilograms or more. *
Medium (M)** – all aircraft types less than 136,000 kilograms but more than 7000 kilograms.
Light (L)** – all aircraft types of 7,000 kilograms or less.

* The B757 is categorized as heavy when applying following distances.

** Canadian weight categories are similar, but are specified in pounds. See the GPH204A Section 521.1.

will always want to move towards the area of lower pressure. This causes it to move outwards under the wing towards the wingtip and curl up and over the upper surface of the wing. This starts the wake vortex.

The same pressure differential also causes air to move inwards over the wing. Small trailing edge vortices, formed by outward and inward moving streams of air meeting at the trailing edge, move outwards to the wingtip and join the large wingtip vortex. Swirling air masses trail downstream of the wingtips. Viewed from behind, the left vortex rotates clockwise and the right vortex rotates counter-clockwise (see *Figure 1*).

Typically, a vortex develops a circular motion around a core region. The core size can vary in size from only a few centimetres in diameter to a metre or more, depending on the type of aircraft. The speed of the air inside this core from larger aircraft can be up to 100 metres per second.

The core is surrounded by an outer region of the vortex, as large as 30 metres in diameter, with air moving at speeds that decrease as the distance from the core increases (see *Figure 2*). Wake vortices can persist for three minutes, or longer in certain conditions.

Intensity and Persistence

The initial intensity of the wake vortices is determined by the weight, speed, configuration, wingspan, and angle of attack of the aircraft. The most important variables in determining the intensity of the vortex beyond a distance of 10 to 15 wingspans from the aircraft are

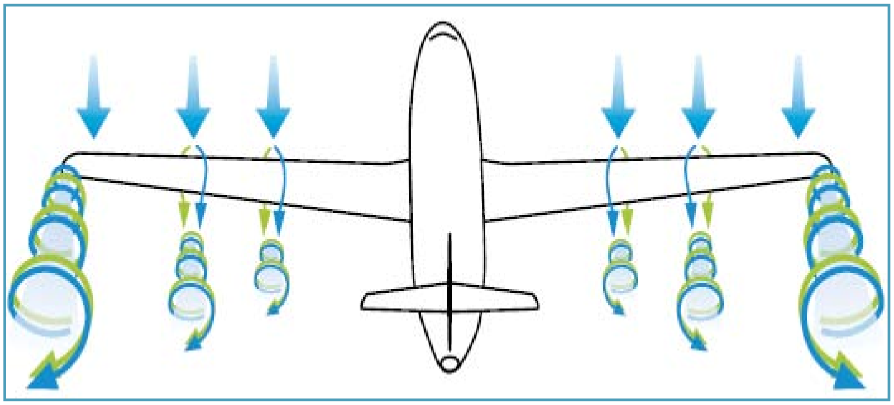


Figure 1: Viewed from behind the generating aircraft, the left vortex rotates clockwise and the right vortex rotates counter-clockwise.

[1] The definition of wake turbulence also includes jet blast, propeller wash, and rotor wash. See the DND GPH204B *Glossary for Pilots and Air Traffic Personnel*.

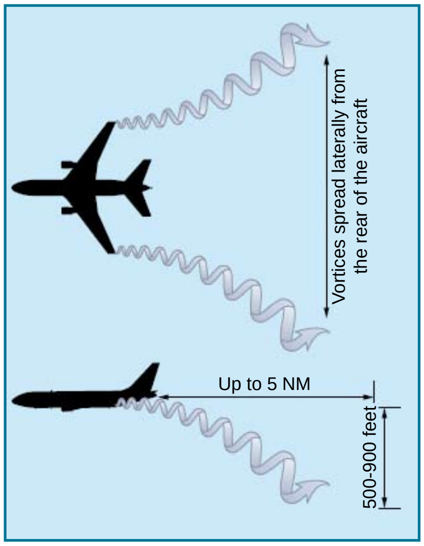


Figure 2: Wake vortices spread laterally away from the aircraft and descend approximately 500 to 900 feet at distances of up to five miles behind it. These vortices tend to descend at approximately 300 to 500 feet per minute during the first 30 seconds.

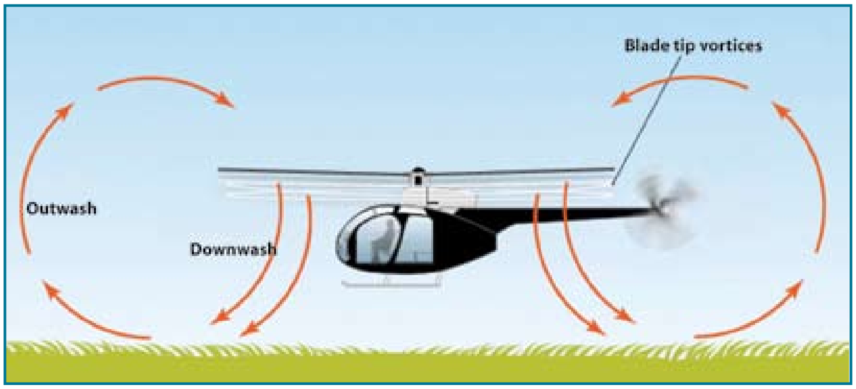


Figure 3: Simplified flow pattern around a helicopter during a stationary hover close to the ground.

atmospheric stability, wind strength and direction, ground effect, and mechanical turbulence.

The strongest vortices are produced by heavy aircraft flying slowly in a clean configuration at high angles of attack. Considerable wake vortices can also be generated by manoeuvring aircraft, for example during aerobatics. Aircraft with smaller wingspans generate more intense wake vortices than aircraft of similar weights and longer wingspans. Wake vortices near the ground are most persistent in light wind conditions (3 to 10 knots) in stable atmospheric conditions. Light crosswinds may cause the vortices to drift. A 3 to 5 knot crosswind will tend to keep the upwind vortex in the runway area, and may cause the downwind vortex to drift toward another runway. Atmospheric turbulence generally causes them to break up more rapidly.

Helicopters

Depending on the size of the helicopter, significant wake turbulence can be generated. Helicopter wakes may be of significantly greater strength than those from fixed-wing aircraft of similar weight. The strongest wake turbulence can occur when the helicopter is operating at lower speeds (20 to 50 knots). Some mid-size or executive-class helicopters produce wake turbulence as strong as that of heavier helicopters.

The majority of wake turbulence accidents that involve helicopters and small aircraft occur when small aircraft are taking off or landing while helicopters are hovering near the runway or flying in the circuit traffic pattern.

Helicopter wake turbulence takes different forms, depending on how a helicopter is flown:

- During a stationary hover, or a slow hover-taxi, a helicopter generates considerable downwash – high velocity outwash vortices that extend to a distance three times the diameter of the rotor (*Figure 3*). The outwash vortices circulate outward, upward, around, and away from the main rotor (or main rotors) in all directions. It is recommended that pilots should not operate small aircraft within three rotor diameters of a helicopter in a stationary hover or a slow hover-taxi.
- During forward flight, a helicopter generates a pair of spiralling wake vortices from the rotor blades (*Figure 4*). Wake turbulence also occurs in the rotating air beneath the helicopter. In this situation the wake vortices are similar to those of larger fixed-wing aircraft. It is, therefore, recommended that small aircraft exercise caution when in the vicinity of a helicopter in forward flight.

Flight tests conducted by the US Federal Aviation Administration (FAA) found that wake vortices are

Figure 4: Simplified wake vortices generated from a helicopter in forward flight.

generated differently, depending on whether the helicopter was climbing or descending.

The vortex cores were observed to be closer together during ascents and further apart during descent. The wake vortices also did not sink in a predictable manner and in some cases remained at a similar altitude to where they were generated.

The area affected by the wake turbulence of a helicopter is larger than the area affected by the wake turbulence of an airplane of comparable size and weight, especially at speeds below 70 knots.

A flight test by the FAA using a Bell UH-1H (weighing 9500 pounds) flying at slow speeds, and a Beechcraft T-34C (4300 pounds, a military trainer), resulted in the Beechcraft being rolled between 30 and 75 degrees while flying between 3 and 5 nautical miles (nm) behind and below the helicopter. At several test points, the effects were much more pronounced and led to a loss of control of the Beechcraft.

Light Aircraft Occurrences

Some years ago, a Fletcher pilot made a low-level pass along the airstrip to clear the strip of stock and turned back onto a reciprocal heading for the approach to the airstrip. On the approach, low to the ground, the pilot lost control of the aircraft and crashed beside the airstrip. The investigation found that one of the contributing factors of the accident, was that the pilot lost control of the aircraft when it flew through the wake turbulence generated from its previous low pass along the strip. There are several other accidents and incidents involving lightweight aircraft where wake turbulence may have been a contributing factor. Ask other pilots about their wake turbulence experiences, and you could be surprised to find that some have had some unexpected encounters of wake turbulence behind lightweight aircraft.

Separation

ATC in New Zealand will apply wake turbulence separation standards as shown by *Table 1* and *Table 2*, except for the following situations:

- Arriving VFR aircraft following a medium or heavyweight aircraft.
- IFR aircraft on a visual approach, where the pilot has reported sighting the receding aircraft, and has been instructed to follow or maintain visual separation from that aircraft.

Note that controllers will give a wake turbulence caution in both situations. Similarly, controllers in Canada issue wake turbulence cautions when pilots accept responsibility for wake turbulence separation.

Table 1

Leading Aircraft	Aircraft Following or Crossing Behind	Minimum Separation Distance
Heavy	Heavy Medium Light	4 NM 5 NM 6 NM
Medium	Light	5 NM

***Table 2:** Arriving aircraft*

Leading Aircraft	Following Aircraft	Minimum Time
Heavy	Heavy Medium Light	2 Minutes 2 Minutes 3 Minutes
Medium	Light	3 Minutes

***Table 3:** Departing Aircraft*

Leading Aircraft	Following Aircraft	Minimum Spacing at Time Aircraft are Airborne	
		Departing from same takeoff position	*Departing from intermediate takeoff position*
Heavy	Heavy Medium Light	2 Minutes	3 Minutes
Medium	Light	2 Minutes	3 Minutes

Table 1 shows the wake turbulence radar separation in New Zealand applied to aircraft in all phases of flight when an aircraft is operating directly behind (within 0.5 nm laterally) another aircraft, or is crossing behind another aircraft, at the same level or less than 1000 feet below. Note that whenever the distance between a lead aircraft of a heavier wake turbulence category, and a following aircraft at the same altitude or less than 1000 feet below, is less than the equivalent of two minutes flying time, radar controllers should issue a caution of possible wake turbulence.

Table 2 shows the non-radar separation standards in New Zealand for arriving aircraft using the same runway (or parallel runway separated by less than 760 metres), or if the projected flight paths are expected to cross at the same altitude or less than 1000 feet below.

Table 3 shows the non-radar separation standards in New Zealand for departing aircraft using the same runway (or parallel runway separated by less than 760 metres), or if the projected flight paths are expected to cross at the same altitude, or less than 1000 feet below.

Canadian radar and non-radar arrival and departure procedures are similar those in these tables, and can be found in the DND GPH 204A Section 521.

These separation standards are the minima, and the effects of wake turbulence may still occur even beyond these distances. For example, there was a wake turbulence incident recently between a Boeing 757 (200 series) and an Airbus 340 (500 series), en route at separation standards greater than the minimum required. The 757 experienced a violent

Some Important Facts

- Overseas studies indicate that more wake turbulence accidents occur during the approach and landing than during the takeoff phase.
- Most wake turbulence accidents occur below 200 feet AGL.
- The majority of wake turbulence accidents occur in light wind conditions.
- The most persistent wake turbulence occurs in light crosswind conditions (3 to 10 knots).
- Wake turbulence will persist for longer periods of time during stable atmospheric conditions.
- Wake vortices are further apart behind an aircraft flying in a clean configuration (gear and flaps retracted) than during the landing configuration. For example, the vortex spacing behind a B767 is 123 feet in the clean configuration compared with 80 feet in the landing configuration.

and uncontrollable roll of 45 degrees accompanied by a 400-foot loss of altitude, caused by the preceding Airbus climbing through its level. At the time of the incident the separation was 1000 feet vertically and 9 nm.

If you consider wake turbulence separation standards are inadequate in controlled airspace, you can request increased separation. This may be achieved by vectoring, a change of flight path, or a change in the requested altitude to be above the suspected wake turbulence. There is also the option that you can take responsibility for your own wake turbulence separation and request a waiver from the wake turbulence separations. This option should be treated with caution – you will be reminded by the controller of the category of the other aircraft, both in New Zealand and Canada.

In New Zealand (as in Canada) there are no wake turbulence separation standards between two medium-weight category aircraft or between two lightweight aircraft. In these situations it is entirely up to the pilot to ensure adequate wake turbulence separation.

In light wind conditions, it is prudent to ensure greater wake turbulence separation if you are flying a lightweight aircraft and the leading aircraft is a heavier aircraft in the lightweight category: for example, if you are in a light single-engine aircraft and are following a *Metro 3*, *Jetstream 32*, *Islander*, or a *Nomad*. In these situations it would be wise to maintain the medium to lightweight separation standards as indicated in *Tables 1*, *2* and *3*. Additionally, it is recommended that two medium-weight aircraft apply separation standards similar to that between medium and lightweight aircraft.

At uncontrolled aerodromes it can be easy to forget about wake turbulence. There are, however, a number of uncontrolled aerodromes around New Zealand where relatively heavyweight aircraft mix with lightweight aircraft. In situations where wake turbulence is a danger, for example during light wind conditions, the prudent pilot will apply increased separations on takeoff and during the approach. As a guide, refer to *Tables 1*, *2* and *3*.

How to Avoid Wake Turbulence

The following are guidelines to avoid wake turbulence adapted from the New Zealand Civil Aviation Authority Wake Turbulence GAP booklet (*www.caa.govt.nz/safety_info/gaps/wake%20turbulence.pdf*).

- **Takeoff.** Strong wake turbulence will occur at the rotation point and during the climb, as the leading aircraft will be flying slowly and at a high angle of attack. Therefore, observe the separation standards as identified in *Tables 1*, *2*, and *3*. For lightweight category aircraft, depending on the size of the leading light aircraft, it is advisable to observe the medium to light separation in light-wind conditions. Don't be afraid to request a longer period of separation from the Tower if you feel it is necessary.
- **Climb.** After takeoff, if you cannot out-climb the leading aircraft's flight path, turn off the extended centreline as soon as possible. If you cannot deviate significantly from the leading aircraft's flight path, climb slightly upwind and parallel to the preceding aircraft's course.
- **Crossing.** If you must cross behind the leading aircraft, try to cross above its flight path (preferred) or, terrain permitting, at least 1000 feet below.
- **Approach.** Most wake turbulence accidents occur in visual meteorological conditions. Therefore, think twice before accepting a visual approach behind a large aircraft, as you then become responsible for maintaining your own wake turbulence separation. When flying a visual approach, do not assume that the aircraft you are following is on the same or lower flight path. If possible during a visual approach, stay away from the localizer centreline, as the larger aircraft are more likely

to be there. Offset your flight path slightly to the upwind side of the localizer path. VFR pilots of slower light aircraft need to be especially wary of wake turbulence when flying at busy aerodromes with heavier aircraft on the approach.

- **Landing.** Land well before the departing aircraft's rotation point. When landing behind another aircraft stay above its flight path and land beyond its landing point if possible. Research has identified that wake vortices in ground effect do not necessarily move laterally away from the runway, but can rebound after reaching the ground, to the height of twice the wingspan of the aircraft. Be wary of this possibility when passing over the previous aircraft's landing point.
- **Crosswinds.** Crosswinds may affect the position of wake vortices and can be very dangerous during parallel runway operations. Adjust takeoff and landing points accordingly.

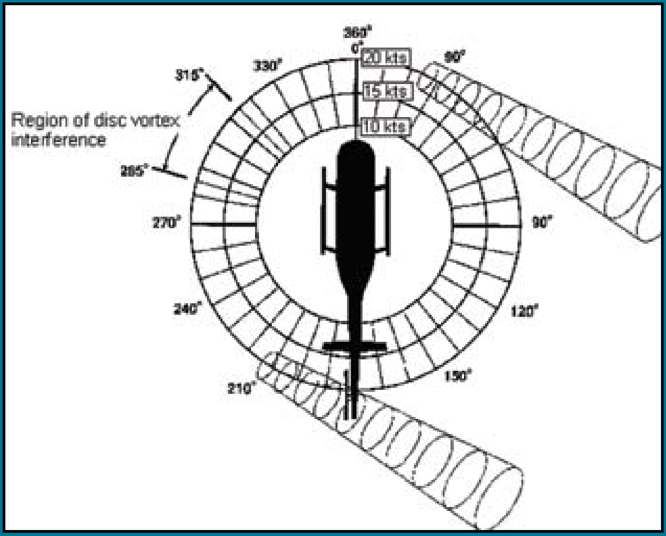
For light aircraft, be aware of the effects of wake turbulence from other light aircraft when operating in the following situations:

- **Takeoff and Landing.** Be aware of wake turbulence during stream takeoffs in light wind conditions, or landing in close proximity to other aircraft.

Editor's Note

The Transport Safety Board of Canada (TSB) investigated an accident in 1998 involving two Bell helicopters. A Bell 205 helicopter was conducting water bucketing at a forest fire site near Whitecourt, Alberta, while a Bell 206B carried a photographer filming the operation. The 206B was flying parallel to the track of the 205, about 300 feet to its right, in a westerly direction. The 206B eventually dropped behind and descended below the 205 so that it was flying in the rear right quarter of the 205, close to the treetops. The 206B suddenly began to rotate to the right, and the pilot was unable to regain control. The forestry officer onboard the 206B sent a MAYDAY call just before the helicopter entered the tree canopy in a spin. A main rotor blade cut off the tail boom, and the fuselage struck the forest floor nose-first, substantially damaging the 206B; fortunately, only the pilot was injured.

Figure 1: *Main rotor disc vortex interference. (Source: TSB)*



Studies have found that the rotor wash from a helicopter in forward flight forms a pair of rotating vortices that act exactly like those generated by a fixed wing aircraft (*Figure 1*). The turbulence intensity is directly proportional to the weight, and inversely proportional to the rotor span and speed of the helicopter. The trailing vortices settle or move downward with time, and they can be potentially dangerous for several minutes after the generating helicopter has left the scene.

A particular characteristic of helicopters in low speed flight is known as a "main rotor disc vortex". This involves a loss of tail rotor authority as a result of the tail rotor entering the main rotor vortex and causing a reduction in tail rotor blade angle of attack and thrust. The relative wind azimuth in this characteristic is from 285 to 315 degrees. This condition can culminate in a rapid, flat spin and sudden ground contact. Recovery technique would normally require a collective pitch reduction; however, in this case there was insufficient height available to prevent obstacle contact.

The loss of directional control experienced by the pilot could have been the result of a self-generated loss of tail rotor authority, or the same effect may have been caused by encountering drifting main rotor vortices from the 205; the latter was deemed the more likely. Since the wind was from the southwest, conditions were favourable for the main rotor vortices from the Bell 205 to drift into the path of the 206B. These vortices could cause a sudden reduction in tail rotor thrust with a resultant uncommanded right yaw that could develop into a high rate of turn. The pilot's low height over the trees precluded the reduction of collective pitch to effect recovery.

The complete report is available on the TSB website at www.tsb.gc.ca/en/reports/air/1998/a98w00/a98w0086.asp.

- **Gliding.** Wake turbulence can be experienced by glider pilots in certain tow positions behind the tow plane.
- **Formation Flying.** It is advisable to have training in formation flying to avoid unexpected encounters with wake turbulence – especially in a formation takeoff.
- **Confined Area**. Several aircraft operating in a confined area during calm conditions.

Effects of Wake Turbulence

The greatest hazard from wake turbulence is induced roll and yaw. This is especially dangerous during takeoff and landing when there is little altitude for recovery. Aircraft with short wingspans are most affected by wake turbulence. The effect of wake turbulence on an aircraft depends on many factors, including the weight and the wingspan of the following aircraft and relative positions of the following aircraft and wake vortices. In the mildest form there may be only rocking of the wings, similar to that of flying through mechanical turbulence. In the most severe form a complete loss of control of the aircraft may occur. The potential to recover from severe forms of wake turbulence will depend on altitude, manoeuvrability and power of your aircraft.

In general you can expect induced roll and yaw. Small aircraft following larger aircraft most often have degrees of roll in excess of 30 degrees. Depending on the location of the trailing aircraft relative to the wake vortices, it is most common to be rolled in both directions.

The most dangerous situation is for a small aircraft to fly directly into the wake of a larger aircraft. This usually occurs flying beneath the flight path of the larger aircraft. In this situation, flight tests conducted have shown that it is not uncommon for severe rolling motions to occur with loss of control. In other instances, if the aircraft is flown between the vortices, high roll rates can coincide with very high sink rates in excess of 1000 feet per minute. Depending on the altitude the outcome could be tragic.

Flight tests conducted by pilots attempting to fly into the vortex at a slightly skewed angle resulted in a combination of pitching and rolling, which typically deflects the aircraft away from the wake. Research shows the greatest potential for a wake turbulence incident occurs when a light aircraft is turning from base to final behind a heavy aircraft flying a straight-in approach. The light aircraft crosses the wake vortices at right angles, resulting in short-lived pitching motions that can result in structural damage to the aircraft from a sudden increase in load factors.

Recovery Techniques

If you unfortunately find yourself in wake turbulence, your recovery will depend on a number of factors but the following technique is suggested by Fighter Combat International (US).

POWER – Increase the power especially at low altitudes or slow speeds.

PUSH – Unload the wings or “push” on the control column until you are slightly “light in the seat.” This reduces the angle of attack of the wings, which gives you better roll control with the ailerons. It also reduces the drag on the aircraft for better acceleration and, if you are rolling over, slows your descent towards the ground.

ROLL – If possible, roll in the direction that will reduce the loading on the wings (this will depend on the direction of the roll of the vortex) or roll to the nearest horizon. If there isn’t a nearest horizon, or if you have rolling momentum, continue to roll (unloaded) in that direction to the horizon. If there is induced yaw, prompt rudder inputs will also be required.

Note that this technique is primarily designed for wake turbulence encounters for aerobatic aircraft manoeuvring in tail-chase or dogfight conditions. It may work when flying at altitude, but the ability of a pilot to “unload” or “push” may not be that great when operating close to the ground, during takeoff or landing. Wake turbulence incidents should be reported as flight safety incidents.

Summary

Wake turbulence affects aircraft of all sizes, and therefore all pilots need to be aware of it. Wake turbulence incidents are not just confined to operations involving heavier aircraft. There are incidents involving all aircraft types.

In general, the risk of unexpected wake turbulence is greatest during the approach in visual conditions where all aircraft are maintaining their own wake turbulence separation.

Be aware of the situations where wake turbulence may be encountered, and take measures to avoid it. ◆

The procedural information in this article, such as that contained in Tables 1, 2 and 3, is specific to New Zealand. Wake turbulence procedures in Canada are not much different and are described in the DND GPH204A Flight Planning and Procedures Canada and North Atlantic, *Section 521*

This article is reprinted with permission from the editor of Vector *magazine, a publication of the Civil Aviation Authority of New Zealand. The article originally appeared in the May/June 2006 edition of* Vector. *It has been minorly modified to mention Canadian flying procedures.*

On the Dials

Next Generation Airspace

It's coming sooner than you think!

Information for IFR Flight

By Captain Scott Anningson, Instrument Check Pilot (ICP) Instructor and Instrument Procedure Design Specialist, ICP School, Central Flying School, 17 Wing Winnipeg

According to aviation industry experts, the skies are supposed to become even more crowded. If you fly in Europe, you can already appreciate the situation. The Statistics Canada website shows that the number of aircraft movements went up in 2006 and are projected to keep rising here. In the US, the Federal Aviation Administration (FAA) has acknowledged that their aviation system is reaching a crisis point. Their air traffic volume is expected to rise from the current 45,000 departures per day to 61,000 per day within the next few years. With the introduction of more regional airliners, very light jets (VLJs) and even UAVs, steady growth is forecast for the next 20 years. The FAA is currently in the midst of an Operational Evolution Plan to enhance the capacity and capability of their airspace. Europe is doing the same. The goal in Europe is to develop a new air traffic management system capable of handling twice as much air traffic by 2020. Many nations are feeling the pressure to squeeze more aluminium (or composite material) into the air without it bumping into things. Many aviation authorities are now leveraging the advances made in navigation systems and accuracy found in the cockpit. Aviation is moving towards a concept known as *Performance Based Navigation* (PBN). Since Canadian Forces aircraft transit, exercise and operate in the airspace next door and around the world, the concept needs to be fully understood and appreciated.

This concept is not just going to play out in the distant future - it's the way of the *very near* future. Global Navigation Satellite Systems (GNSS), Area Navigation (RNAV), and Required Navigation Performance (RNP) technologies are emerging as the core of Performance Based Navigation. The technology is rapidly maturing, miniaturizing, weighing a lot less, and becoming more affordable. With exceptionally low purchasing, maintenance and certification costs, this capability is desirable right down to the private owner/operator. When the new NAVSTAR, GALILEO and GLONASS satellite constellations mature, there will be GNSS triple redundancy in the public and commercial realm. By harnessing the current RNAV technology, the FAA estimates it can save $2 billion annually. Not maintaining or running legacy navigation systems, let alone buying and certifying ground facility hardware replacements, is the means of realizing this saving. RNP operations and design criteria will be moving increasingly into the public domain, allowing more commercial IFR operations to more airports. The intent of Canadian future airspace navigation is performance based as well, namely: "RNAV everywhere; RNP where needed." RNAV and RNP are seen as the way ahead to "squeeze" more aircraft into the air safely and efficiently. With the associated reduced aircraft lateral and vertical protection, plus reduced terrain and obstacle separation, more "lanes" can be laid out in the air. With the increased use of Enhanced Flight Vision Systems and a reduced requirement for ground based approach aids, more airports will be opened up to more operators, more often. The navigation and instrument approach technology will give a better chance of getting in and getting out of places with more frequency.

Many nations are feeling the pressure to squeeze more aluminium (or composite material) into the air without it bumping into things.

The intent of this article is to highlight some of the changes coming and some of the capabilities that are on the very near horizon. What you'll find in the following discussion is some new nomenclature and some new concepts guaranteed to make you sound more knowledgeable and intelligent around the coffee machine or at the next staff meeting. There are also some nice drawings and pictures provided to simplify things for the pilots.

Performance Based Navigation (PBN)

Performance based navigation specifies the requirements for a system's performance along a route, on an instrument procedure or in a designated airspace. The performance requirements are defined in terms of accuracy, integrity, continuity, availability, and functionality needed for the proposed – or published – operation.

It's all about reliable, repeatable and predictable flight paths. PBN provides the framework on which future airspace will be developed and built. It provides the basis for a whole host of features that will be increasingly more common. These features include the design and use of automated flight paths; new airspace and route design; new RNAV and RNP approach procedure design; and reduced aircraft separation and obstacle clearance. Traditionally, the capability and limitations of a facility drove the design criteria, like for a radar or VOR. If you designed a VOR airway or a VOR approach, you used published VOR airway or approach design criteria. Now and in the very near future, the performance requirements and design criteria for a particular airspace or procedure will be given and it will not be based on a facility, such as a VOR. It will be up to the operator to demonstrate and document the ability of the aircraft and crew to comply with the specified performance requirements in the airspace or on a particular procedure. This may require one or more key systems on-board the aircraft, along with associated crew training and well-defined Standard Operating Procedures (SOPs). If unable to comply, the aircraft may be excluded or restricted from operating in the airspace or to the airport: shades of the Mode C transponder or RVSM saga.

> It can allow closer **route spacing**, reduced **aircraft separation**, and reduced **obstacle clearance** without necessarily having the need for monitoring or intervention by ATC.

RNAV (Area Navigation) System or Operation

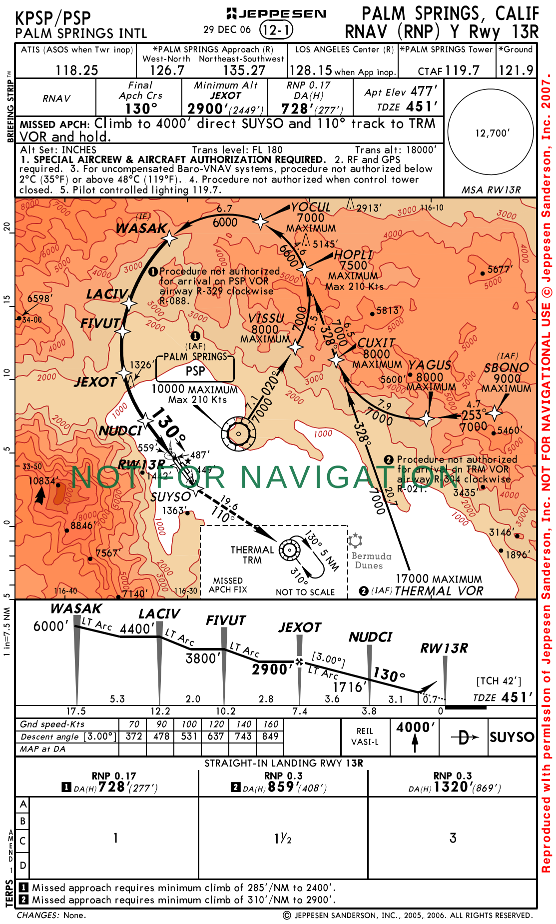
This is a method of navigation that permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of self-contained navigation aids, or a combination of these. The desired flight path might be Toronto (CYYZ) direct Vancouver (CYVR) on a great circle route. Using a common example, the RNAV function of your FMS may use DME/DME, GPS and an IRU in combination to operate on that direct route. No need to zigzag across the country going from VOR to VOR. ATC will normally monitor and ensure aircraft separation.

The increased accuracy of these systems has allowed for some pretty good performance requirements to be specified. For example, if you have a look at US IFR En Route Low Altitude charts L-27 or L-22, you will see some "T" routes depicted in blue. If you look at the US IFR En Route High Altitude chart H-3, you can see some closely spaced "Q" routes depicted in blue. These are RNAV routes. They are supposed to eventually replace the high and low VOR routes in the US. In accordance with FAA Advisory Circular AC 90-100A *US Terminal and En Route Area Navigation (RNAV) Operations (1 March 07)*, RNAV routes are flown as RNAV 2 unless otherwise specified. RNAV 2 requires a total system error of not more than 2 nm for 95% of the total flight time. Your system needs that type of documented performance in order to file and use these routes. You will also see a lot of waypoints not connected to anything. They might be connected to something later but it sure gives you more direct-to options or re-routing options in flight. With the drive for global harmonization in performance-based navigation, there should be more of these types of routes popping up throughout the world.

Terminal navigation performance criteria will be getting narrower and well defined as well. Have a look at Volume 5 of the US DOD Terminal FLIPs. Using the SMALL ONE DEPARTURE (RNAV) or RIMMM ONE DEPARTURE (RNAV) out of Phoenix Sky Harbour (PHX), look at the notes. You will see that GPS is required and RNAV 1 is required. Again, the ability to file and use these procedures, along with specific operational requirements, is outlined in FAA AC 90-100A. RNAV 1 requires a total system error of not more than 1 nm for 95% of the total flight time.

RNP (Required Navigation Performance) System or Operation

This is an RNAV system that has on-board performance monitoring and alerting.



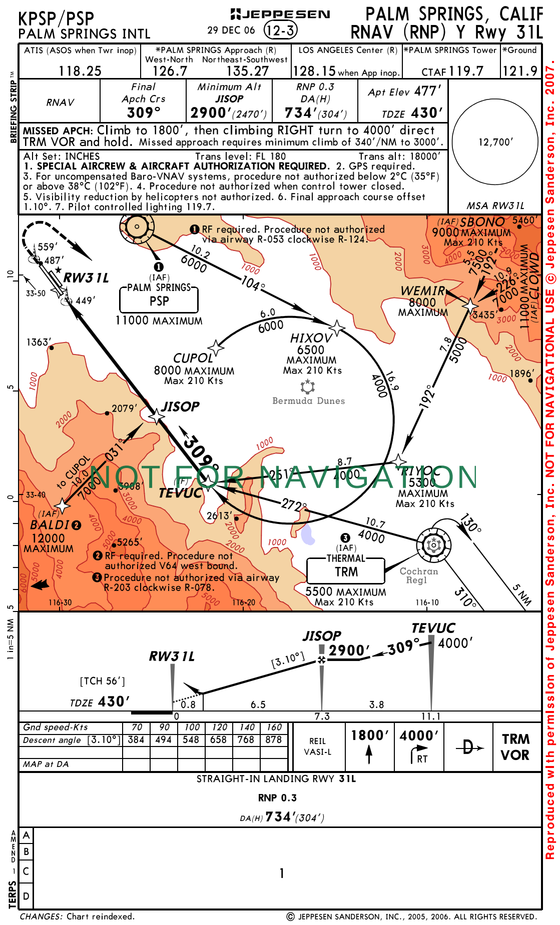


***Figure 1 :** Palm Springs, Calif, RNAV (RNP) Y Rwy 13R*　***Figure 2 :** Palm Springs, Calif, RNAV (RNP) Rwy 31L*

A critical characteristic of RNP operations is the ability of the aircraft navigation system to monitor the navigation performance it achieves and to inform the crew if the specified limits are being exceeded. In other words, it squeals on itself. This on-board monitoring and alerting improves reaction time and the crew's situational awareness. It can allow closer route spacing, reduced aircraft separation, and reduced obstacle clearance without necessarily having the need for monitoring or intervention by ATC. Under RNP, the nature of the navigational aid or aids is not specified, but rather the volume of airspace around the aircraft is. This volume, or *containment*, is smaller (in some cases, much smaller) than that of conventional navigation. A value is assigned for any stage of operation. For example, RNP 1 means 1 NM lateral containment and RNP 0.3 means 0.3 NM lateral containment on a route. Performance is not defined solely by avionics or a navigation facility. It is a total system definition of performance, which includes the aircraft, the avionics, aircrew procedures and training, ATC, and airspace design criteria. The main difference between RNP and RNAV is that RNP certified systems have on-board performance monitoring and alerting capability, whereas older RNAV systems normally do not. However, as a result of decisions made by industry in the 1990s, most of the modern RNAV systems have a monitoring and alerting feature. Consequently, these units can be designated for RNP operations as part of a more complete equipment mix, which would include a measure of redundancy.

The great thing about RNP operations and criteria is the ability to get in and out of places that have traditionally proven difficult or impossible in instrument meteorological conditions (IMC). Have a look at the Jeppesen plates for Palm Springs, California (*Figures 1* and *2*). You can see the challenges the terrain poses. Before the RNP procedures were produced, good visual conditions were required to arrive and depart. With the capability to fly RNP 0.17, the decision altitude (DA) takes you to within 277 ft of the ground on the RNAV (RNP) Y RWY 13R (*Figure 1*).

Performance Based Navigation defines the specifications to be met in terms of the following requirements:

***Accuracy*:** This is a measure between an aircraft's estimated or required position and its actual position. This

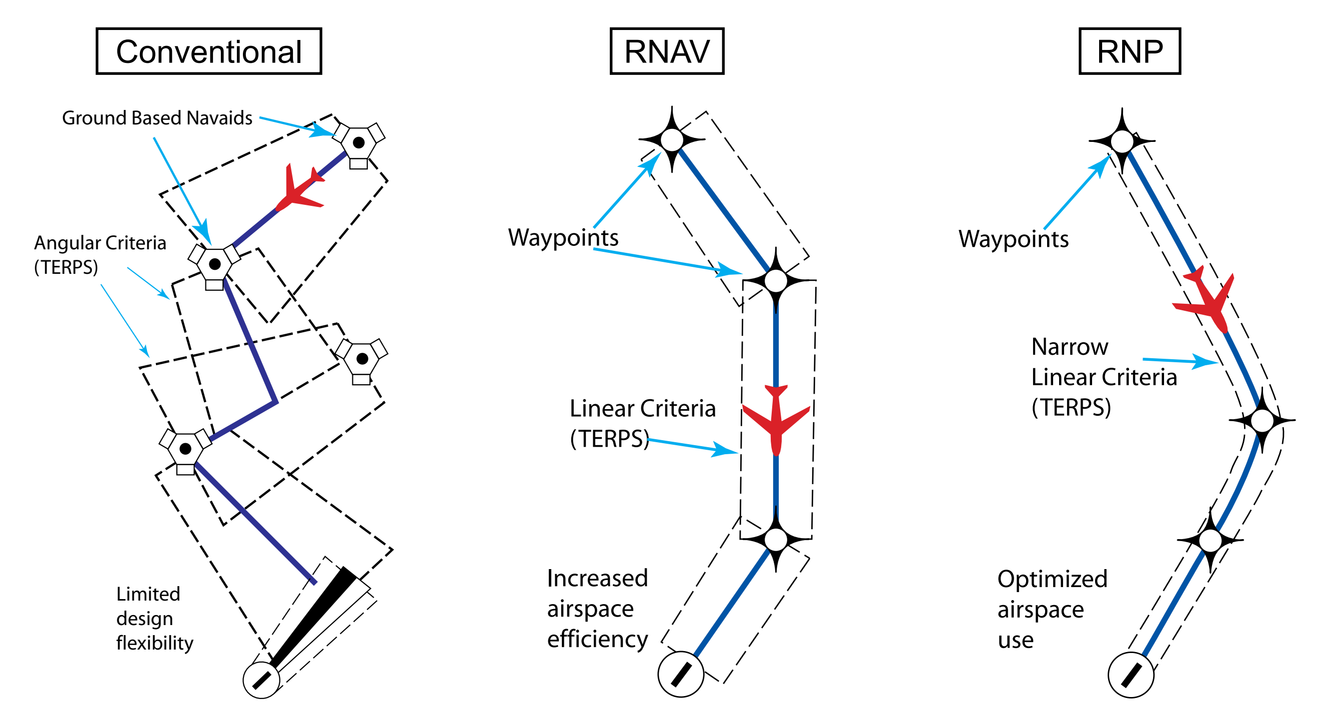


Figure 3: *Evolution of airpsace navigation*

has usually been expressed as a value left or right of track in nautical miles or tenths of a NM, for example, RNAV 1 or RNP 0.3. The accuracy levels expected in the near future will be 3D – latitude, longitude and altitude. Time accuracy will be expected further down the road, giving 4D navigational accuracy.

Integrity*:* This is a measure of trust of the system's accuracy. It also includes alerts or warnings if accuracy limits are exceeded.

Continuity*:* This is a measure of probability that a service remains available throughout a procedure. For example, if using GNSS, it is the probability that enough GPS satellites will remain in view for the duration of flight or for the approach at destination. Inertial Reference Systems (IRS), Inertial Reference Units (IRU), and DME/DME are examples of backup systems that have been used to ensure a measure of continuity is maintained throughout a procedure in case GPS has failed.

Availability: This is a measure of time during which the system delivers all of the previous three – accuracy, integrity, and continuity.

Functionality*:* This is a measure of what the system has or what it can do. Does the system use a stored database from which waypoints or procedures can be drawn? Or does a special disk of data and routing need to be built for each and every flight? Some sample functions of a system would be the ability to perform holds, parallel offsets, vertical navigation (VNAV), or temperature compensated Baro-VNAV.

Other functions are coming to the fore, such as the capability to fly established fixed radius paths (FRP). One type of FRP is the radius-to-fix leg type (RF). This is a reliable, repeatable and predictable flight path defined by a radius, an arc length, and fixes. Containment limits on the curved portion of the procedure are the same as the straight portions. Bank angle limits for different aircraft types and winds aloft are taken into account during the design of these procedures. The Palm Springs RNAV (RNP) Y RWY 31L (*Figure 2*) shows how an RF leg has been employed from HIXOV to JISOP.

With RNAV and RNP systems, further improvement in holding is available. Now, you would think that with all the improvements to efficiency and optimization that Performance Based functionality will bring into a country's airspace that there would be no requirements for holding! Unfortunately, the specifications mandate that holds be designed and the criteria is provided. But the criteria allows for more operational and design flexibility. For example, RNP holds allow for fly-by entry into the hold, rather than the requirement to fly over the hold waypoint as in RNAV or over legacy facilities. Also, the airspace to be protected is reduced, especially on the non-holding side of the pattern. This all comes in handy when designing missed approaches.

Figure 3 (page 25) shows how Performance Based Navigation is evolving, and *Figure 4* provides a simplified overview of the concept. At the strategic level, the goal of operators, air traffic management services and governments is to move forward with the present technology and improve the use of airspace, bearing in mind the following objectives:

Improved Safety: Having more RNP procedures or having more RNAV procedures with LNAV/VNAV or LPV (WAAS) minima will be a good way of increasing safety. LNAV/VNAV means lateral/vertical navigation, and LPV (WAAS - Wide Area Augmentation System) means localizer performance with vertical guidance. These procedures have vertical guidance like an ILS. Industry recognizes that having constant angle stabilized descent paths on approach is an important means of reducing controlled flight into terrain (CFIT).

Increased Capacity: RNP procedures at closely spaced parallel runways can allow a pretty good volume of departures and arrivals in poor or marginal visibility. Curved approach or departure paths can keep aircraft separated in these cases. When used, the accuracy of the Global Navigation Satellite System (GNSS) often means lower approach and departure minima, thereby increasing movements at the airport in poor weather conditions as well. For en route, more airways can be designed using RNAV or RNP criteria. They can be more tightly spaced together and, therefore, there can be more of them. There would be no need to rely on the traditional ground-based navigation facilities, such as VORs and NDBs, to define airways and air routes.

Increased Efficiency: Optimizing flight profiles on departure and arrival can make flights more efficient in terms of fuel burn.

Reduced Environmental Impact: Reduced emissions, noise preferential routes, wild life preservation, or continuous descent approaches (power levers or throttles to idle, from top of descent to the final approach fix, whatever your case may be): these are all pretty big environmental reasons for change.

Improved Access: If the ILS is NOTAM'd off for a month and a half at a regular destination, you could still get in on a fairly regular basis using RNP or LNAV/VNAV approaches. At an airport that has always required VFR weather to get into, you could design RNP or RNAV approaches and arrive IFR. Costly ground-based navigation facilities would not be required. This can all look real good to an airport operator's bottom line.

Flexibility in Design: Referring to the Washington, DC RNAV (RNP) RWY 19 (*Figure 5*), one can see the flexibility inherent in the criteria. Routing can be optimized to avoid restricted areas, noise sensitive areas, known bird concentrations, terrain, obstacles, or other airports. Approach and missed approach routes can be conformed and bent to follow mountain valleys.

So, what does this mean to us? If we take our neighbour to the south as an example, the future is pretty much happening now. Here are some highlights from the FAA *Roadmap for Performance-Based Navigation, July 2006, Version 2.0*. The near term goals are largely being realized. The "T" routes, "Q" routes, and RNP procedures cited are all examples of these goals. What is outlined here are the mid and long-term targets. These are the stated objectives of the United

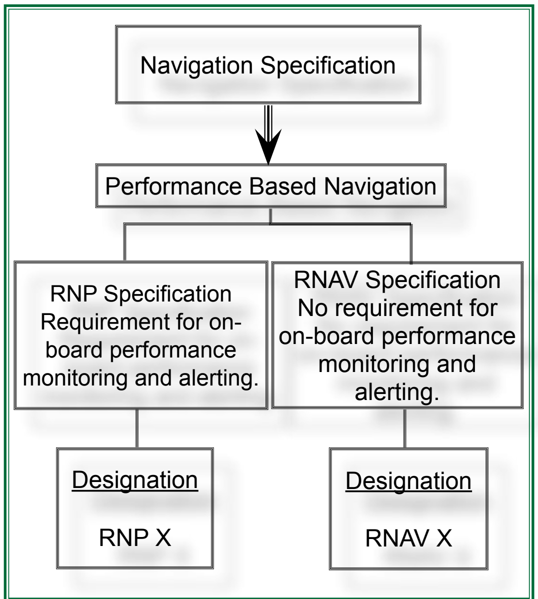


Figure 4: *A simplified overview of the Performance Based Navigation concept. "X" refers to the designated lateral navigation accuracy expected in NM, achieved at least 95% of the flight time.*

States in the restructuring of their airspace. Note the short timelines.

Performance-Based Evolution in US Airspace

Mid Term Transition Objectives (2011 – 2015)

En Route

- RNP-2 routes
- "T" routes and lower MEAs
- At the end of the mid-term (2015), mandate RNP-2 at and above FL290 and mandate RNAV at and above FL180

Oceanic

- Limited RNP-4 and 30 NM lateral spacing in the West Atlantic Route System.
- More operator preferred routes and dynamic reroutes

Terminal

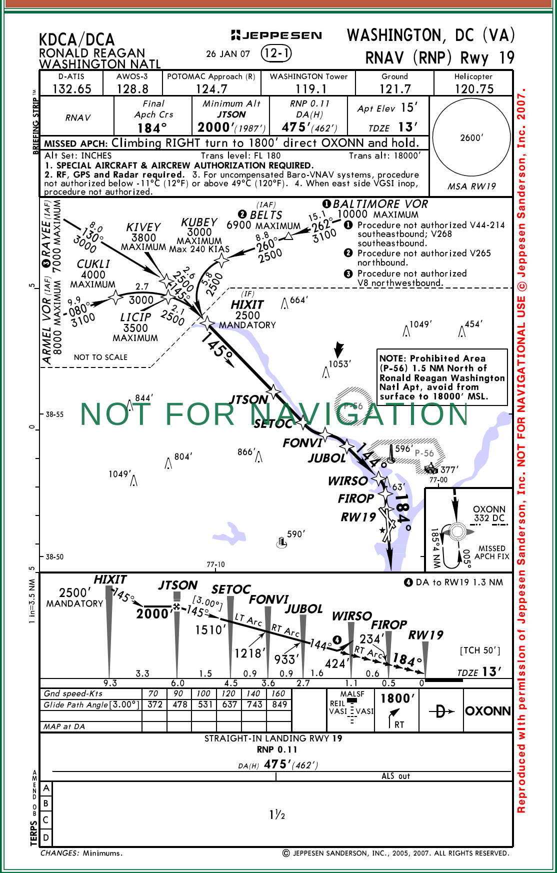
- RNAV SIDs/STARs at the top 100 airports
- RNP-1 or lower SIDs/STARs where beneficial

- Airspace redesign and procedures for RNAV and RNP with 3D (that is, with specified latitudes, longitudes and altitudes), CDA (constant descent arrivals) and Time of Arrival control.
- At the end of the mid term (2015), mandate RNAV for arrival/departure at 35 of the busiest airports (examples: St. Louis and Minneapolis.)

Approach

- At least 50 RNP procedures/year
- 300 RNAV (GPS) procedures/ year
- Closely spaced parallel and converging runway operations based on RNP
- Satellite-based low visibility landing and takeoff procedures (GLS)

Figure 5 : *Washington, DC*



Far Term Transition Objectives (2016-2025)

- Mandate RNAV everywhere in the Continental US
- Mandate RNP in busy en route and terminal airspace
- RNP airspace at and above FL290
- Separation assurance through a combination of on-board and ground-based capabilities.
- Strategic and tactical traffic flow management through system-wide integrated ground and airborne information systems.
- Optimized operations through integrated flight planning, automation, and surface management capabilities

So, to sum up the aviation and bureaucratic-speak, the plan is to build a new highway system – in the air. It will be global in nature. It should be pretty much the same from country to country. It will be up to the operators to show they can drive safely on it. The ability to get from one place to another is being shifted more to the operator and their on-board navigation and communication systems. It will be more automated. There will be less pilot-to-controller radio traffic. There will be more use of addressable data link. Consequently, the CF must understand and leverage the future capabilities and requirements in the next generation airspace. Business and acquisition planning should take into consideration these present capabilities and newly emerging technologies. ◆

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Ruffled Feathers

Anyone who has witnessed the effects of a damaging bird strike will know what grim consequences can ensue. Sure, birds often bounce harmlessly (harmless to the aircraft and crew, that is) off the side of our sturdy military aircraft, leaving only a trace of feathers or blood. Strikes even regularly go unnoticed until maintenances crews have a closer look. But it can be a matter of mere inches between a harmless bounce and ingestion into an engine or crashing through a windshield.

Between 1997 and 2007, there were 1396 reported bird strikes in the Canadian Air Force: 213 of these resulted in aircraft damage and two caused the loss of the aircraft. Seven aircrew involved in these bird strikes actually received various degrees of injuries. As the migration season intensifies, it is time to do a good review of bird strike avoidance methods to remember just how to keep these statistics from rising.

The article you are about to read is an excerpt from a paper entitled, "Reduction of Risk: A Flight Crew Guide To The Avoidance And Mitigation Of Wildlife Strikes To Aircraft." It was presented by Captain Paul Eschenfelder and Stephen Hull at the Bird Strike 2006 Conference.

A bit of background: the Bird Strike Conferences has been held annually for the past nine years as a joint effort by the Bird Strike Committee USA (BSC-USA, formed 1991) and the Bird Strike Committee Canada (formed shortly after BSC-USA). The conferences consist of practical classroom and field training sessions, exhibits and demonstrations with vendors, and, the presentation of technical papers and posters. The specific intentions of the BSC-USA are to "facilitate the exchange of information, promote the collection and analysis of accurate wildlife strike data, promote the development of new technologies for reducing wildlife hazards, promote professionalism in wildlife management programs on airports, and be a liaison to similar organizations in other countries." The Bird Strike Committee Canada further specifies that it is "dedicated to flight safety by reducing collisions with birds."

Aircrew may have heard these principles before, but take the time now to understand why you are expected to believe they work.

EFFECTIVE BIRD STRIKE MITIGATION ACTIONS FOR CREWS

By Steve Hull (Senior Air Safety Investigator, British Airways), and Captain Paul Eschenfelder (Avion Corporation)

Do not attempt to takeoff or land if wildlife is present on or near the runway. Delay takeoff for this hazard just as other aviation hazards (windshear, poor braking, conflicting traffic, deicing) require delays for mitigation. The airport operator should have personnel on duty to properly haze the birds from your flight path. Either wait for the wildlife to be removed or request another runway for departure. Likewise, on landing, if birds are present in the approach zone or runway either go around or ask for another runway.

Climb above 3,000' as rapidly as possible. If operating from an airport with a significant bird presence, on departure use the ICAO Vertical Noise Abatement Profile "A" (VNAP "A"). This will achieve three important things: since the majority of bird strikes occur below 3,000' this technique will climb the aircraft above this altitude as rapidly as possible. This rapid climb will also keep the aircraft in or near the airfield boundary, an area in which the airport operator may take effective mitigation steps. Finally, while climbing at V2+10, the aircraft will be slow.

Slow down. The force imparted onto the aircraft at impact is much more dependant on the aircraft's speed than the size of the bird. The equation

***September 2003** – A CC150* Polaris *struck a Canada goose at 200 feet AGL.*

Photo: Major Scott Murphy

October 2006 – A CH139 Jet Ranger *was struck by a 3 pound mallard while flying at night on a simulated IFR approach. There were no injuries, but it did result in $20,000 worth of damage.*

[KE = ½ (mass) x (velocity)^2] explains it most simply. KE is the kinetic energy imparted onto the airplane at impact, expressed in foot-pounds per square inch. Obviously speed is the most important component of the energy force *and* is one that can be directly controlled by the crew. Stated in another manner, an aircraft striking a small duck (4 lb) at 300 knots will experience *31% more* energy transfer than the same aircraft hitting the same duck at 250 knots (MacKinnon 2001).

The same can be said of engines. At high engine rpm (velocity) an engine is much more likely to be damaged due to the same forces (Reed). This is why an engine ingestion during takeoff (high engine rpm) is much more hazardous than during the approach/landing phase. Indeed, some birds ingested during approach have actually passed completely through the fan stages without damage to the fan and lodged against the hot section due to low engine rotation speed and the flexibility of the fan sections (Hartig 2005).

While most strikes occur below 3,000', strikes occurring above 3,000' are more likely to be damaging (Sowden). The reasons for this are the speed of the aircraft and the fact that larger birds tend to fly at higher altitudes, using the same wind and uplift benefits as human aviators. The birds have little time for avoidance at higher speeds and impact forces are greater. While no conclusive study has been done, birds seem to bounce off airframes at 250 knots or less while penetrating airframes above that speed. While there is an argument that high-speed flight at low altitude (below 10,000') may reduce some costs, those savings are so marginal that the damage from one significant strike at high speed will completely wipe out those savings (Sowden and Kelly 2002).

Pull up. Enroute, when suddenly confronted with birds, pull up, consistent with good piloting technique, to attempt to pass over the birds. Birds seem initially to attempt to manoeuvre away from conflicting aircraft (de Hoon and Buurma 2003; Kelly et al. 1999). In some cases they may dive. Basic aerodynamics dictates that birds will not have enough flight energy to attempt a sudden climb and they have not been observed doing so. However, commercial aircraft almost always have some ability to trade airspeed for altitude to pass over the hazard.

Report Hazards. Too many locations are susceptible to the "no report – no problem" syndrome. Write up the appropriate safety/captain report to document the problem and prevent a future occurrence. Airport wildlife control by airport operators is now an ICAO standard. Fill out the forms to let the airport operators know where the problem is and how their control program is working. Likewise USA and Canadian air traffic controllers are required to report to pilots known wildlife hazards and continue reporting until the hazard has departed. If you see a wildlife hazard, report it immediately to ATC. Use the word "PIREP" so that the controller will realize that the information must be passed to other flights. Ask ATC to forward your report to the airport operator so that mitigation action can be taken.

May 2004 – A CT155 Hawk *ingested a 280 gram gull during a closed pattern.*

Times change, aviation adapts. In the past flight crewmembers were passive participants in wildlife hazard mitigation. Aircraft and engine design/certification and bird populations were such there was little need for crew action. This situation is no longer acceptable. Data clearly validates the problem of wildlife strikes to aircraft. Viewed from a cost basis alone, the average damaging cost being $244,000, wildlife strikes are not only dangerous but also quite costly (Allan and Orosz 2001). In the USA, the courts have ruled that "…pilots must see what can be seen…" and react accordingly. Pilots are required to ensure the safety of their aircraft and their passengers (CFR). The use of the above procedures will aid flight crewmembers in mitigating the hazard to their aircraft by wildlife. ◆

The quoted article is reproduced with the permission of its authors. Their presentation and written paper is available online, along with the others from the 2006 conference, at www.birdstrike.org/meetings/2006scusaproram.htm.

Readers are strongly encouraged to visit the Bird Strike Committee Canada website located at www.birdstrikecanada.com/ *and the Bird Strike Committee USA website at* www.birdstrike.org, *where papers from other past conferences are also available.*

The Bird Strike Conference is located in Kingston this year, and will return to Canada in 2009 when it comes to Winnipeg. Attendance is encouraged.

DO NOT TOUCH!

By Sergeant Mike Brown, Directorate of Flight Safety 2-5-2-2 (Air AVN Tech), Ottawa

The dangers associated with handling and transporting unexploded or partially expended ordinance are extremely serious. A recent flight safety report recounted local law enforcement officers just off the BC mainland who had in their possession C2A1 Marker Location Marine (MLM) Smoke canister which they believed to be expended. A visiting CC115 Buffalo crew was preparing to return to the Wing when they were approached by the law enforcement personnel and asked if they could take care of the C2A1 Smoke they had. The crew agreed, and the flight engineer (FE) placed the smoke into one of the onboard plastic transport containers normally used to transport live C2A1 MLM Smokes.

Partially consumed C2A1 Marker Location Marine (MLM). This buoyant smoke and flame-producing device is used by ships and aircraft as a positional marker on the water surface. A small number of MLMs do not completely burn off and remain afloat.

Upon arrival at Wing, the crew informed the servicing personnel that they had an expended smoke onboard the aircraft. Servicing personnel checked the aircraft and, upon finding the C2A1 Smoke, immediately contacted the Wing Explosive Ordinance Disposal (EOD) personnel and quarantined the aircraft in accordance with Wing Armament Orders. The EOD technicians arrived, safely removed the C2A1 Smoke for disposal, and initiated a flight safety report. It was only then that the Buffalo crew realized they had contravened Wing Armament Orders as well as the A-GG-040-006/AG-001 Explosive Safety Policy and Program, and the C-09-008-003/FP-000 Ammunition and Explosives Procedural Manual.

Explosives are created to achieve destruction or some type of violent effect. Accidents or incidents involving explosives have the exceptionally high potential to inflict serious bodily harm or damage and loss of materiel and facilities. What is more, most of them need not happen: they are preventable. Hence, it is DND's policy to maintain a program of explosive safety that is consistent with the role and objectives of the department, and to require that all personnel participate in and support the program. Within this context, every member of DND is responsible for the following:

a. Complying with applicable explosive safety standards, regulations, directives, orders and procedures.

b. Correcting unsafe conditions, or reporting these conditions when they are beyond their capability to resolve.

c. Reporting all ammunition accidents and incidents that they personally witness or are involved in.

d. Warning others of known hazards or of their failure to observe safety measures.

e. Inspecting their task area for unsafe conditions and hazards prior to commencing assigned tasks.

Several of the above five responsibilities were NOT carried out by any of the DND members at the scene of the flight safety occurrence described earlier.

UXO Locations in Canada

In recent years, there have been several deaths and serious injuries in Canada caused by the detonation of unexploded explosive ordnance (UXO). As Canada's population increases and the urban sprawl continues, it is expected that people will come into more frequent contact with UXO on once-remote properties.

Many locations across Canada have

been used for military operations, training, and weapons testing over the years. Wartime action along Canada's coast and incidents involving ships, planes or vehicles carrying ammunition and explosives have also created legacy sites at which UXO may still remain.

Several hundred specific UXO legacy sites are known to exist at locations across Canada. There are 1100 known sites off Canada's east coast, with

CF18 releasing 10 Mark 82 bombs, Cold Lake / Prim Lake (1990s)

another 26 locations on the west coast. But the locations in which UXO and stray ammunition may be found are virtually limitless. However, experience has shown that stray ammunition and UXO are most often found in the following situations:

- In police stations, having been collected by Civil Police or handed in by members of the public.
- On private premises, having been improperly retained as souvenirs.
- On abandoned training areas previously used for live firing, particularly where such land is now used for agricultural or forestry purposes.
- In scrap metal yards, where explosive items have inadvertently been included in salvage material.
- In coastal areas, near waters where ammunition was previously dumped or used in surface firings, or near an active search and rescue training area where C2A1s are released almost daily. These areas are prone to having UXO wash up on the shore.
- On property previously owned or occupied by the Canadian Forces that is now undergoing redevelopment.
- Aggregate yards, where the raw aggregate has been suctioned or dredged from the seabed near coastal defence locations or sea ranges.
- On public or private land where UXO has been illegally or carelessly disposed of.
- On and around sites where accidents involving military vehicles, aircraft or ships have occurred.
- Museum and organizations such as Royal Canadian Legions where Military paraphernalia is displayed.

It is evident from the situations described that items found can vary from highly polished but lethal souvenirs, to those that have been buried in the ground or immersed in water for a considerable period of time and are consequently so corroded that positive identification may be very difficult or impossible. Be advised that the condition of stray ammunition can vary from that which is perfectly safe to that which is highly dangerous.

If you find something that could be UXO,

1. **Don't touch it!**
   If disturbed, UXO can explode, causing death or injury.
2. **Remember the location and leave the area**
   Remember where you saw the object. Go back the same way you came.

Dismantling/destruction of CF18 missile, Cold Lake (2003)

3. **Call 9-1-1 or local police**
   As soon as possible, report what you found by calling 9-1-1 or by contacting your local police.

Don't touch or disturb

In the last few years, the following armament stores have been lost, found missing, inadvertently released, or were duds, and were detailed in flight safety reports:

- **LUU 2Bs** – 50+ occurrences reported
- **MK82s** – 15+
- **C2A1's** – Numerous
- **Chaff/Flare** – Numerous
- **Ammo Belts** – Blank C6 (220-round belts) departed aircraft (3 occurrences)
- **Sonobuoy and CAD** – 6 occurrences
- **ARD 863 cart** – found on tarmac
- **ALE39 dispenser** – found missing after flight with chaff and flares loaded
- **MPB** (practice bombs) – found missing after flight
- **AIM 7** – fell off aircraft and landed on a golf course
- **C-8 Smoke** – no ignition
- **Trailer/CRV 7** – left outside overnight/unattended (rockets)
- **Trailer/MPBs** – left outside overnight and unattended

This article only scratches the surface of the dangers associated with UXO as well as the types of UXO that exist in Canada, not to mention the rest of the planet. If you ever have the opportunity to visit Europe, please remember the immense amount of ordnance dropped there during the two world wars. If you are interested, do a little research on the amount of UXO discovered every year in Europe and the number of injuries: you may be unpleasantly surprised. ◆

The DND Unexploded Explosive Ordnance (UXO) and Legacy Sites Program website provided valuable information and photos for this article. It is located at www.uxocanada.forces.gc.ca.

EPILOGUE

TYPE: ***Sperwer* CU161002**
LOCATION: **Kabul, Afghanistan**
DATE: **20 March 2004**

The Tactical Unmanned Aerial Vehicle (TUAV) troop was tasked with a routine mission near Kabul. After completing the pre-flight checks the crew launched the UAV. Shortly after take-off, the UAV began a shallow descent towards a populated suburb of Kabul. The UAV was unable to climb or maintain flight, so the Air Vehicle Commander ordered an emergency recovery. During the recovery, the UAV hit the ground with a vertical acceleration of 11g and sustained "B" Category damage.

The investigation found that the preset mixture adjustment screw, on the number one cylinder of the UAV's engine, was misadjusted, causing the number one cylinder to run too rich, degrading the overall engine power output. The reason for the misadjustment of the screw could not be determined.

The air vehicle was launched in challenging, but acceptable, meteorological conditions, using the approved checklists. The engine parameters observed by the launch crew, while lower than usual, were within the prescribed limits listed in their pre-takeoff ("C" check) checklist. The high density altitude, combined with the degraded engine performance, did not provide a sufficient power margin to maintain a positive climb rate after the launch. The crew reacted appropriately in commanding an emergency recovery; however, the altitude at the time of the recovery did not permit full deployment of the parachute system, resulting in a hard landing.

The *Sperwer* was introduced very quickly into the CF inventory in response to an urgent operational requirement and was being used in a high density altitude environment for which it had neither been specifically designed nor tested. Crews in theatre were often required to operate the air vehicle with very little performance margin. This accident was the result of a situation where the air vehicle's engine performance degraded, albeit within the limits approved at the time of the occurrence, such that it simply was not able to continue its mission safely.

A Service Bulletin adjusting the minimum engine parameters for take-off, for the Kabul area of operations, was promulgated following this accident. Other Service Bulletins, covering other areas of operation, are still under development by the manufacturer. ◆

EPILOGUE

TYPE: *Griffon* CH146489

LOCATION: Goose Bay, Newfoundland and Labrador

DATE: 12 June 2006

On 12 June 2006, a 444 Combat Support Squadron crew from 5 Wing Goose Bay was scheduled to fly a local familiarization/unit check out flight with a new flight engineer (FE). Engine #2 was started first (odd/even day rule) when the FE noticed a loud grinding sound coming from the engine. The shut down hand signal was given by the FE and acknowledged by the pilots. The engine was shut down very early in the start sequence as the engine just started to rotate. No abnormal indications, noise / engine instruments, were noticed by the pilots.

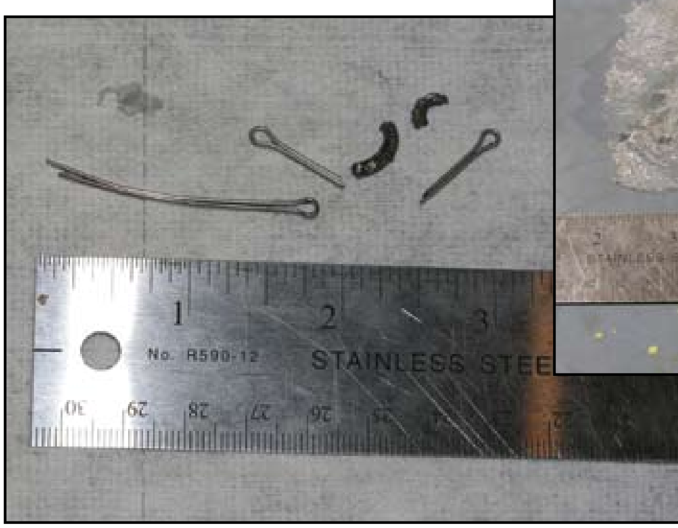
An initial visual inspection was performed in the engine compartment and the plenum area to ascertain the condition of the engine. Three new cotter pins and two small portions of a threaded screw were discovered in the plenum area. The engine protective mesh screen was then removed and a piece of what looked like a 4" by 9" plastic bag was discovered in front of the blades of the first stage. Inspection of the engine also revealed extensive blade damage to the first stage of the engine.

The type and nature of the evidence found (new cotter pins, remainder of a threaded/set screw, and remainder of a plastic bag) suggests that a parts bag, containing consumable items, was dropped and sucked into the engine. However, the investigation team was unable to link the objects found to a specific maintenance action.

Given the evidence, the most probable scenario for this occurrence is that a technician inadvertently dropped a parts bag through the engine intake, with the cowlings removed, while working on top of the helicopter. Suction and air recirculation created by the running engine stretched the plastic bag until it was ripped and allowed its content to escape.

This latest occurrence points to the requirement to stay vigilant but also the requirement to validate the effectiveness of the FOD programs at flying units.

Following this occurrence, the unit rejuvenated its FOD program. Further actions underway include the designation of a FOD Control Officer and the establishment of a Wing/Unit FOD committee. Also recommended are initiatives to render consumables more accessible to technicians so as to reduce the propensity of technicians to carry consumables in their pockets for maintenance actions. ◆



EPILOGUE

TYPE: ***Sperwer*** **CU161002**
LOCATION: **Kandahar, Afghanistan**
DATE: **6 July 2006**

The accident occurred during an Uninhabited Air Vehicle (UAV) mission in support of Op Athena. Immediately following launch, the UAV's airbags deployed, rendering it incapable of sustained flight. The UAV impacted the ground approximately 300 metres from the launcher and sustained "B" category damage. There were no injuries.

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

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

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

EPILOGUE

TYPE: ***Schweizer*** **2-33A C-FACY**
LOCATION: Valcartier, Quebec
DATE: 10 September 2006

The accident flight was an aero-tow flight to 2,000 feet above sea level. The glider release, upper air work and circuit work were uneventful. On final, a left crosswind was encountered that required the pilot to compensate by applying left wing down with the associated right rudder inputs. These control inputs were maintained until the glider descended below 40 feet above ground level, where trees lining the left side of the airfield blanked out the cross wind and caused a downdraft. The glider began to drift left with an increased rate of descent. The pilot was attempting to pull up and correct back to the right when the glider's left wing contacted a tree. The glider pivoted 90 degrees to the left then fell 20 feet to the ground.

The pilot received serious injuries and, after being attended to by Base medical personnel, was transported to a local civilian hospital.

The investigation revealed that Runway 04 was set up to use two lanes for glider operations. This allowed only 18 feet of clearance between the glider's wingtip and the trees that line the left side of Runway 04 during take-offs and landings. As well, the proximity of the trees, under certain wind conditions, cause a decreasing performance wind shear. It has been determined that the glider flew through this wind shear and the pilot was unable to react quickly enough to avoid striking the trees.

To mitigate this hazard, glider airfield obstacle clearance criteria are being developed. Airfields that do not meet the new criteria will be directed to modify their operations or conduct tree clearing so as to comply with the regulations. As well, the Eastern Region Flying Orders for Valcartier have been amended to include a warning on wind shear. Eastern Region Glider Operations at Valcartier have been amended so that the primary landing lane for Runway 04 is the lane furthest from the trees. ◆

EPILOGUE

TYPE: ***Hornets* CF188932 & CF188935**
LOCATION: **Cold Lake, Alberta**
DATE: **2 October 2006**

The mission involved two formations of two CF188 *Hornets* on a Combat Training (ACT) proficiency mission for 410 Tactical Fighter (Operational Training) Squadron (TF(OT)S) instructor pilots (IPs). The two incident aircraft were Bravo 61 and Bravo 62 (lead and number two) in the same formation, with each aircraft being flown solo by an IP. They were acting as a two-ship fighter element and employing Beyond Visual Range (BVR) weapons and tactics against a second pair of CF18 *Hornets* simulating a bandit threat.

Just prior to the incident, the non-manoeuvring bandit was killed out and the fighters were engaging the surviving bandit. The fighters were manoeuvring north in double attack (DA) formation with Bravo 62 flying to the east of and above Bravo 61. Bravo 62 targeted the surviving bandit and, while manoeuvring, briefly drifted away from lead further to the east, to approximately 3.6 nm separation. At this point, Bravo 62 momentarily lost visual on lead (Bravo 61), but regained it after he informed lead. Bravo 62 shot the surviving bandit, manoeuvred to the west, and, following a "62 out right" call from Bravo 61 about 25 seconds later, performed a left-hand descending hard turn towards Bravo 61. Simultaneously, Bravo 61 turned right to engage the surviving bandit. At the same time, Bravo 61 stopped monitoring Bravo 62's position and proceeded to work his RADAR, while Bravo 62 lost visual on Bravo 61. At less than 1 mile separation, and closing head on, both aircrews became aware of an impending conflict and attempted to avoid collision. The jets passed at an estimated 300 feet separation.

The occurrence resulted when Bravo 62, having lost visual contact, manoeuvred in a turn towards Bravo 61 while assuming that Bravo 61 was also in a left hand turn. Contributing to the occurrence was momentary poor radio reception in Bravo 62's cockpit that made it difficult to hear Bravo 61's direction to manoeuvre to the right.

Safe and effective air-to-air combat training requires that all pilots clear their intended flight paths before manoeuvring their aircraft. It is essential that pilots maintain visual with the other members of their formation, informing the other aircraft in the formation when they have lost visual, and maintaining lateral and/or vertical separation until visual is regained. Because of the speeds involved, clear and concise radio communications are essential to the passage of time critical information.

The preventive measures submitted include a recommendation to brief all CF18 pilots on this incident, highlighting the importance of clearing one's own flight path and maintaining vertical/lateral separation when not visual with the other aircraft, while simultaneously informing the other pilot of their lost visual status. ◆

FROM THE INVESTIGATOR

TYPE: ***Harvard II* CT156112**
LOCATION: **Moose Jaw, Saskatchewan**
DATE: **4 April 2007**

The incident involved a CT156 *Harvard II* training aircraft, crewed by an instructor pilot in the rear seat and a student pilot in the front seat. The student pilot had completed Phase I of the NATO Flying Training in Canada (NFTC) program at Portage-la-Prairie, Manitoba, in February 2007. He had recently begun the Phase II portion of the course in Moose Jaw, and on the day of the occurrence he was to conduct the Clearhood 1 mission, his first syllabus flight in the CT156 aircraft.

The mission had been briefed in detail the day before, however it was postponed by one day due to bad weather. After having reviewed the major briefing points in the early morning prior to the mission, both the instructor pilot and the student pilot walked to the aircraft together. The student pilot completed his strap-in procedure under the supervision of the instructor, who then strapped into the rear ejection seat. After the engine was started, as the crew was completing the pre-taxi checks and was about to request taxi clearance, the student pilot inadvertently ejected from the parked aircraft. The student pilot landed at the edge of the parking ramp, under a fully deployed parachute. He sustained minor injuries from the detonation of the canopy fracturing system and subsequently the parachute landing on the concrete ramp. The instructor pilot, who remained in the aircraft, sustained minor injuries from the detonation of the front canopy and the fireball produced by the front underseat rocket motor.

The aircraft sustained "D" category damage as a result of the ejection.

The investigation has not found any pertinent technical deficiencies with the ejection system, and has focused on what actions the student pilot may have taken which accidentally initiated the ejection sequence. Immediate preventive measures taken as a result of this incident include briefing all pilots on the requirement to meticulously adhere to the proper strap-in procedure. The investigation is on-going, however there are indications that a telecommunications cord may have been routed through the student pilot's ejection seat handle during the strap-in process. ◆

FROM THE INVESTIGATOR

TYPE: ***Schweizer* 2-33A C-GCLJ**

LOCATION: **North Battleford, Saskatchewan**

DATE: **5 May 2007**

The accident glider pilot was participating in the Spring Season familiarization flying at the North Battleford Gliding Centre (NBGC) in North Battleford, Saskatchewan. The purpose of familiarisation flying is to give the Cadets, in the Royal Canadian Air Cadet program, the opportunity to experience a flight in a glider. NBGC uses a winch to launch the glider. The winch is a trailer-mounted, large block engine from which 5500 feet of steel cable is extended and attached to the glider. The winch reels in the cable giving a method of thrust to launch the glider.

The glider was launched, but at approximately 150 feet above ground level the winch operator observed a partially failed splice in the cable and cut power to the winch. The pilot hesitated prior to initiating the recovery procedure. The glider stalled at this point.

The glider contacted the ground in a severe, nose-down, attitude 452 feet from the launch point. It then bounced and impacted again 501 feet from the launch point. The glider came to rest 538 feet from the launch point. The impact caused "B" category damage to the glider.

The accident was witnessed by several people who responded to the crash scene within seconds. Local emergency medical services were on scene in approximately 10 minutes. The pilot and passenger were taken to the local hospital and were released within two hours. The pilot and passenger suffered minor injuries.

The investigation is focusing on human factor, training issues and regulatory discrepancies. ◆

For Professionalism

For Commendable Performance in Flight Safety

MASTER CORPORAL MIKE BAKER

On 16 January 2007, Master Corporal Baker was tasked to conduct a pre-flight inspection on a CH146 *Griffon* helicopter. While carrying out this inspection, he was required to examine the combining gearbox (C-Box) oil gauge sight glass and the general security and condition of the component. It was during this process that he noticed a stud on the aft face of the C-Box was missing the connecting hardware. Deciding to investigate further, MCpl Baker discovered that an adjacent stud's hardware had backed off as well and was in danger of becoming fully separated from the mounting stud. He immediately brought this urgent situation to the attention of the servicing supervisor and the aircraft captain. A servicing technician was dispatched to inspect the C-Box, and the aircraft was declared unserviceable.

The area in which MCpl Baker discovered the fault is cramped, inaccessible and may only be illuminated with a flashlight. In such circumstances, any subtle anomaly may easily remain undiscovered. His outstanding attention to detail, professionalism, and perseverance ultimately resulted in the elimination of a highly hazardous condition.

MCpl Baker's actions prevented a potentially hazardous situation from persisting. His attention to detail, diligence and professionalism demonstrate a superior flight safety attitude and make him very deserving of this For Professionalism award. ◆

Master Corporal Mike Baker is serving with 403 Helicopter Operational Training Squadron, Canadian Forces Base Gagetown.

WARRANT OFFICER DARRYL BOYLING

While conducting a pre-flight inspection on a CP140 *Aurora* during a deployment to Kaneohe Bay, Hawaii, Warrant Officer Boyling, an airborne electronic sensor operator, discovered a fuel leak coming from the left hand main wheel well area. He immediately reported his finding to the flight engineer who determined that the leak originated from the up lock bolt and was outside of limits for an area that is not free venting.

The upper section of the wheel well area is located under the aircraft wet wing fuel tanks. Fuel fumes are not allowed to accumulate in these closed spaces as an ignition source could cause a devastating wing fire. This leak made the aircraft unserviceable and the remaining missions were cancelled. The technicians on the deployment carried out the necessary repairs prior to returning to 19 Wing Comox.

WO Boyling demonstrated a high level of professionalism by not limiting his pre flight inspection to the trade specific section of the aircraft. His inquisitive attitude led him to discover and report the fuel leak, which may have appeared to be benign when first detected. The fact that such a finding is well outside of his area of responsibility, demonstrates his keen and dedicated attention to safe flight operations.

WO Boyling's focused efforts, coupled with his safety of flight mentality eliminated the potential for a catastrophic accident. He is most deserving of this For Professionalism award. ◆

Warrant Officer Darryl Boyling is serving with 407 Maritime Patrol Squadron, 19 Wing Comox.

For Professionalism

For Commendable Performance in Flight Safety

CORPORAL RON CYR

On 1 December 2005, the intermediate gear box (IGB) on the *Sea King* helicopter CH124412 was installed in accordance with Canadian Forces Technical Orders (CFTOs). After 277.5 airframe hours, the tail gear box (TGB) input seal was found to be leaking and replaced. Eight days later, the output seal for the IGB was noted to be leaking and was also replaced.

Corporal Cyr, an aviation technician at 443 Maritime Helicopter Squadron, investigated to determine why these gearbox seals failed so soon after installation. While checking the alignment from the IGB to the TGB, he discovered that the gearboxes were misaligned by ¼ inch. He immediately informed his supervisor and continued his examination. Cpl Cyr's investigation revealed that when installing a new IGB, the CFTO installation instructions did not require a specific alignment check be carried out on the gearboxes.

He submitted an Unsatisfactory Condition Report (UCR) to include the requirement of an alignment check that would mitigate any future installation errors. As a result, NDHQ/DAEPM (M) approved the UCR and is initiating CFTO amendments. In addition, Cpl Cyr's efforts resulted in 12 Air Maintenance Squadron issuing an Air Maintenance Alert (SAMA 06-06).

Cpl Cyr demonstrated impressive initiative, professionalism, and technical skills in identifying this problem. His attention to detail greatly reduced the possibility of further TGB and IGB seal leaks as well as the potential of an in-flight tail rotor failure. He is very deserving of this For Professionalism award. ◆

Corporal Ron Cyr is serving with 413 Transport and Rescue Squadron, 14 Wing Greenwood.

CORPORAL KEVIN DYE AND CORPORAL CLAUDE MALBOEUF

On 27 January 2007, Corporal Dye and Corporal Malboeuf, aviation technicians posted to 8 Air Maintenance Squadron Trenton, were tasked to carry out a pressure relief valve replacement on *Hercules* aircraft CC130332. The relief valve was associated with a small fuel leak originating from the drain mast. There was considerable pressure to return the aircraft to a "Serviceable" status due to a priority tasking.

Despite the fact that there was no evidence of any other leak, Cpls Dye and Malboeuf noted the fuel transfer rate was slower than normal during the de-fuel operation. Upon carrying out a thorough inspection of the work area they discovered a very small amount of contamination on the bottom of the fuel tank and determined that the valve had failed due to a piece of foreign material (FOD) being ingested and lodged in the gate mechanism. Not satisfied with the slow fuel transfer rate, they investigated further on their own accord focusing their attention on the fuel pump and surge box area at the aft end of the fuel tank. Upon opening the number one fuel pump access panels they discovered the pump screens were completely clogged with debris. They then proceeded to check the remainder of the main fuel tanks and found all four-fuel pump screens were clogged with FOD. The aircraft was immediately quarantined pending investigation and extensive repairs.

Their initiative and attention to detail while inspecting this hidden area is commendable. Research revealed this aircraft had recently undergone extensive contractor fuel tank repairs during the past 18 months and had less than 10 flying hours since the last repair. The fuel pumps, filters and associated FOD were subsequently forwarded to the Quality Engineer Test Establishment (QETE) for further analysis.

Cpls Dye's and Malboeufs' professionalism averted a potentially catastrophic situation. This aircraft was scheduled for a trans Atlantic long-range training mission and had this fuel system contamination gone unheeded the resultant fuel starvation situation could have potentially resulted in a loss of both aircraft and aircrew. Their dedication to the task at hand clearly makes them deserving of this For Professionalism award. ◆

Corporal Kevin Dye is serving with 8 Air Maintenance Squadron, 8 Wing Trenton. Corporal Claude Malboeuf is deployed on Op Archer.

CORPORAL DAVE HANSON

Corporal Hanson applies a consistent safety-oriented work ethic, that when partnered with technical competence, has proven to be an effective incident mitigation tool.

On 25 May 2006, while conducting a "B" check on a CF188 *Hornet* aircraft, he noted that the roll/pitch/yaw (FCC) computer wire bundles were rubbing on the adjacent bulkhead routing hole. Further investigation revealed that the wire bundles had been clamped to the bulkhead contrary to applicable technical instructions. Being aware of the prevalence of Kapton wire in these bundles caused him concern knowing this type of wire's sensitivity to mishandling. On his own initiative, Cpl Hanson identified a number of other 4 Wing aircraft exhibiting similar incorrect clamping configurations. The issue prompted the 1 Air Maintenance Squadron AMCRO to submit a draft risk assessment and Special Inspection (SI) to NDHQ for formal action.

Then on 16 October 2006, he volunteered to provide support to another unit, whose personnel resource limitations were hindering its ability to complete a post incident snag rectification on the main landing gear (MLG) of a CF188 aircraft. Despite that much of the troubleshooting and subsequent work had been carried out, including reinstallation of the down lock actuators, he took it upon himself to survey the landing gear prior to commencing the remaining work. He discovered that both the left and right MLG assemblies were exhibiting excessive lateral movement. This discovery necessitated further disassembly of the landing gear whereupon he found both left and right upper side brace bearings worn well past useable limits. While in the process of rectifying the side brace defects, Cpl Hanson discovered additional anomalous issues with the down lock actuators that had previously gone undetected. This discovery resulted in immediate changes to the CF188 periodic inspection criteria for the MLG side braces.

Subsequently on 14 February 2007, while performing a daily inspection on a CF188 aircraft, he noted that there was something not quite right with the left MLG side brace upper attachment. Further scrutiny revealed that the attachment point bushings had been installed on the wrong sides of the side brace bearing. Further investigation showed that this configuration had gone unnoticed for a considerable period of time. This discovery prompted a decision to perform the recently released MLG SI for planing mechanism integrity.

Most recently on 12 March 2007, during the performance of a before flight check on a CF188 aircraft, Cpl Hanson's scrutiny of the MLG revealed that the left planing mechanism shrink link upper bearing was worn well beyond useable limits. The aircraft had recently been subjected to the requirements of the (SI) intended to confirm planing mechanism integrity. The shrink link forms part of the planing mechanism, however the SI did not provide any specific direction for this part and therefore its condition went unnoticed. This discovery has generated a NDHQ coordinated initiative to develop specific direction that will assist technicians in more precisely determining the condition of these critical MLG components during unscheduled inspections.

Cpl Hanson is well grounded in the Canadian Forces' flight safety ethos. These notable efforts are testimony to his dedication to safety of flight and make him a worthy recipient of this For Professionalism award. ◆

Master Corporal Dave Hanson is serving with the Aerospace Engineering Test Establishment (AETE), 4 Wing Cold Lake.

CORPORAL VICTOR KASSAY

Corporal Kassay, a flight engineer serving with 408 Squadron, was completing his pre-flight inspection on *Griffon* CH146414 in preparation for the return flight from an exercise. Aware that the aircraft had experienced an undiagnosed vibration during a previous flight, he decided to allow for extra time to complete a particularly thorough inspection.

During this extremely systematic inspection of the rotor head assembly, Cpl Kassay discovered that the elastomeric spindle bearing (P/N 412-010-187-101) had delaminated significantly at the blade root, allowing daylight to be seen through a hole that had developed. The delamination was located underneath the blade near the spindle, making the damage exceedingly difficult to detect.

A complete failure of the spindle bearing would have resulted in very serious controllability problems, likely resulting in the loss of the aircraft and crew.

Cpl Kassay's professionalism, perseverance and superior attention to detail are commendable. His efforts are noteworthy and make him well deserving of this For Professionalism award. ◆

Corporal Victor Kassay is serving with 408 Tactical Helicopter Squadron, Canadian Forces Base Edmonton.

For Professionalism

For Commendable Performance in Flight Safety

CORPORAL ROBERT HARPER

On the 17 November 2006, Corporal Harper was carrying out a Before-Flight Inspection ("B" check) on *Hornet* CF188749 when he noticed that the spacing between the main landing gear rigid connecting link and the planing link bell crank was marginal. Even though this portion of the aircraft is not part of the "B" check, Cpl Harper decided to investigate the problem further.

It was then that he discovered that the rigid connecting link pin was not the correct type. He immediately informed his supervisor and the aircraft was declared unserviceable. A squadron survey was carried out on all other aircraft that resulted in identifying two other aircraft with the same incorrect pin installation. Through further investigation it was determined that this type of pin would not pass load stress testing. This discovery led to the issuing of an amendment to an ongoing Special Inspection of the CF188 main landing gear.

Had this problem remained undetected, the reduced load stress properties of this incorrect pin could have led to a catastrophic failure of the main landing gear assembly resulting in severe damage to or loss of the aircraft and possible serious or fatal injury to the pilot. Cpl Harper is to be commended for his exceptional diligence in going beyond his normal inspection requirements in order to rectify this serious flight safety hazard. His attention to detail and professionalism make him very deserving of this For Professionalim award. ◆

Corporal Robert Harper is serving with 410 Tactical Fighter Operational Training Squadron, 4 Wing Cold Lake.

CORPORAL JOHN MAHER

On 9 December 2005, Corporal Maher was tasked with replacing the shielded mild detonating cord (SMDC) ejection-system explosives set in the cockpit of *Hornet* CF188926. After removing the rear ejection seat, he noticed that the small clevis pin securing the left-hand trombone tube on the ejection seat was protruding. Cpl Maher chose to investigate further and determined that a cotter pin was missing and the adjacent clevis pin was no longer secure. He immediately declared the ejection seat unserviceable and ensured the problem was rectified.

If an ejection had been initiated with the cotter pin missing it is very likely that the clevis pin would have fallen out. This, in turn, would have caused a breakdown in the ejection sequence with almost certain fatal results for the pilot or passenger occupying the seat.

As per the maintenance instructions, inspection of the ejection seat when it is removed for access to the cockpit is not required. This non mandatory maintenance action, coupled with the remote location of the cotter and clevis pins, led to a non-functionable state that could very easily have gone unobserved for a considerable period of time. Corporal Maher's alertness, professionalism and keen attention to detail averted a potentially catastrophic event. His refined skill level and determination to always do more than what is required "by the book" make him deserving of this For Professionalism award. ◆

Master Corporal John Maher is serving with 410 Tactical Fighter Operational Training Squadron, 4 Wing Cold Lake.

SERGEANT JAMES MACDOUGALL

On 22 March 2007, 417 Squadron was preparing to operate a mission with a CH146 *Griffon* that was borrowed from the Aerospace Engineering Test Establishment. During the required pre-flight inspection, Sgt MacDougall noticed that the tail rotor fixed link inboard bolts had been installed backwards. Upon further inspection, he detected that these bolts were contacting the tail rotor hub and had already scraped off adjacent paint.

The resultant flight safety investigation established that the bolts had been installed on 13 October 2006, and the aircraft had flown 99.6 hours prior to the incident. In spite of numerous tail rotor inspections by technicians and Flight Engineers that preceded this incident, the incorrect installation of the tail rotor fixed link inboard bolts had gone unnoticed.

Although the CH146 Flight Manual only provides direction for the Flight Engineer to inspect for the general condition of the tail rotor, Sgt MacDougall's professionalism, initiative and superb attention to detail led him to conduct a much more detailed inspection on this aircraft as it was unfamiliar to himself and 417 Sqn. Sgt MacDougall's actions prevented further damage to a critical flight control system on this CH-146 and a possible serious in-flight emergency and/or loss of aircraft and crew. His very impressive efforts make him deserving of this For Professionalism award. ◆

Sergant James MacDougall is serving with 417 Combat Support Squadron, 4 Wing Cold Lake.

CORPORAL DAVE TALBOT

Corporal Talbot is a trainee in the Non Destructive Testing (NDT) at 19 AMS Comox, and is not normally employed with the *Sea King* CH124 fleet.

On 15 December 2006, Cpl Talbot was tasked to carry out a liquid penetrant (LPI) examination of the main gearbox (MGB) mounts on *Sea King* helicopter CH124433. While waiting for the penetrant dwell time on the MGB mounts, he noticed a very slight linear discoloration of the metal in a separate area known as the "dog house". Although not in close proximity to the principle area of inspection, Cpl Talbot observed that this discoloration was unusual. Suspecting that this may be a crack, he sought the appropriate permission through 443 Maritime Helicopter Squadron maintenance organization to further investigate his visual observation. He proceeded to clean the suspect area, and found that there was no immediate evidence of damage.

Unsatisfied with these findings, he notified his supervisor and suggested that a NDT procedure be carried out to eliminate any chance of damage in this suspect area. A subsequent eddy current inspection was carried out and revealed multiple cracks totalling 14 inches in length on the frame. The "dog house" forms a critical part of the structure that maintains three hydraulic reservoirs. Numerous other technicians had frequented this area during the associated maintenance on the engine and main gearbox, but this defect had gone undetected.

It was a combination of Cpl Talbot's keen observation and attention to detail that drew him to this area and locate the defect. Had this fault gone undetected, the cracks would have progressed to the point of failure of the frame and loss of the reservoirs. The three hydraulic reservoirs are required to maintain controlled flight of the aircraft and their loss could have potentially lead to the catastrophic failure of flight components as well as the loss of both the aircraft and crew.

Corporal Talbot's notable efforts demonstrate a level of professionalism and caring that make him very deserving of this For Professionalism award. ◆

Corporal Dave Talbot is serving with 19 Air Maintenance Squadron, 19 Wing Comox.

For Professionalism

For Commendable Performance in Flight Safety

CORPORAL JOSEPH SHEA

On 5 March 2007, firefighter Corporal Joseph Shea was seated inside his fire truck, approximately 150 meters from *Hercules* CC130319, observing its start procedure. After a normal start, the aircraft got underway, but due to the aircraft's initial position on the ramp it had to perform a sharp left turn in order to avoid another stationary *Hercules* aircraft.

It was during this turn that Cpl Shea noted how close both wing tips seemed to have passed by one another. As the taxiing aircraft swung passed the parked CC130, he observed something fall from one of the wings onto the tarmac. He then drove the fire truck over to investigate and retrieved a piece of a navigational light deflector. Cpl Shea immediately brought the item to the attention of the start ground crew who instantly concluded that both aircraft wing tips must have scraped one another.

Without delay, Cpl Shea radioed Mirage tower to request that aircraft 319 return to the ramp for a closer inspection. Upon returning, it was discovered that the aircraft's right wing tip had in fact, contacted aircraft 333's right wing tip. Fortunately, no other damage was discovered but the potential for a major air disaster was very near at hand. Corporal Shea's alertness and quick action demonstrated a keen Flight Safety awareness that averted the accidental loss of both Air Crew and Air Force assets.

His professionalism and dedication to safe mission accomplishment were clearly demonstrated and make him deserving of this For Professionalism award. ◆

Corporal Joseph Shea is serving with the 14 Wing Greenwod fire department.

WARRANT OFFICER DALE STURGEON, SERGEANTS JERRY MARIN AND MITCH BRADLEY, AND MASTER CORPORAL JAMES SHEWAGA

During the conduct of instructional duties at 426 Training Squadron, Warrant Officer Sturgeon and Sergeant Marin attempted to demonstrate the capabilities of the on-board Sierra Quick-Donning Oxygen Mask. During this ground demonstration, both instructors identified that a significant amount of force, far more than normal, was required to deploy the oxygen mask from its hanger. Upon closer inspection, it was discovered that the oxygen mask hanger, originally manufactured with a semi-rigid friction-resistant plastic strap, was now replaced with a webbing cloth material. The end result was that the new cloth mask hanger strap prevented the oxygen mask from being deployable in an emergency situation within its design parameters.

WO Sturgeon and Sgt Marin inspected all remaining CC130 aircraft on the flight line at 8 Wing Trenton. They discovered that many oxygen positions in various aircraft were fitted with the cloth oxygen mask hanger straps, and were routed in a manner that would disable its quick-donning capability. After a more thorough investigation, it was discovered that the semi-rigid plastic and the cloth webbing hanger strap materials were inadvertently interchanged, holding the identical NATO stock number (NSN). After consulting Sergeant Bradley and Master Corporal Shewaga, both technical instructors at 426 Squadron, a Flight Safety Hazard Report and a Unsatisfactory Condition Report (UCR) were submitted.

Both Sgt Bradley and MCpl Shewaga continually monitored the processing of the FS UCR over the next several weeks. They opened a line of communication between themselves and the UCR Office of Primary Interest (OPI), personally explaining the nature of the situation and possible solutions to the issue. After making contact with the contractor and after concluding that significant delays were inevitable, both Sgt Bradley and MCpl Shewaga developed and forwarded a workable technical solution to aid the team in the processing of the FS UCR. In conjunction with a 435 Squadron flight safety investigation to resolve FS occurrence #129998, their proposal was approved by the life cycle materiel manager (LCMM) in Ottawa, and the appropriate Canadian Forces Technical Order (CFTO) was amended.

WO Sturgeon, Sgt Marin, Sgt Bradley, and MCpl Shewaga demonstrated a level of professionalism, initiative, and a dedication to the safety of flight beyond the requirements of their specific instructional duties.

These individuals demonstrated a superior professional attitude in rectifying a significant hazard to the safety of flight. They are very deserving of this For Professionalism award. ◆

Warrant Officer Dale Sturgeon and Sergeants Jerry Marin, Mitch Bradley, and James Shewaga are serving with 426 Training Squadron, 8 Wing Trenton.