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Flight Comment

ISSUE 2, 2016

CHECK SIX
Closing Action Report

VIEWS ON FLIGHT SAFETY
Commander 1 Canadian Air Division

DOSSIER
When Flight Safety meets the Chain of Command

Canada

Cover – One of Canada's newly acquired CH148 *Cyclone* helicopters practices landing procedures on Her Majesty's Canadian Ship *Halifax* off the coast of Nova Scotia.

Photo: OS Raymond Kwan

Flight Comment

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DIRECTORATE OF FLIGHT SAFETY

Director of Flight Safety
Colonel Steve Charpentier

Editor
Major Peter Butzphal

Imagery Technician
Corporal Daisy Hiebert

Graphics and design
d2k Graphic Design & Web

THE CANADIAN ARMED FORCES FLIGHT SAFETY MAGAZINE

Flight Comment is produced up to four times a year by the Directorate of Flight Safety. The contents do not necessarily reflect official policy and, unless otherwise stated, should not be construed as regulations, orders or directives. Contributions, comments and criticism are welcome. Contributions become the property of *Flight Comment* and may be edited for content, length or format.

Send submissions to:

National Defence Headquarters
Directorate of Flight Safety
Attn: Editor, Flight Comment (DFS 3-3)
101 Colonel By Drive
Ottawa, ON, Canada, K1A 0K2

Telephone: 613-992-0198
FAX: 613-992-5187
Email: dfs.dsv@forces.gc.ca

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ISSN 0015-3702 A-JS-000-006/JP-000

Views on Flight Safety

by Major-General Christian Drouin, Commander 1 Canadian Air Division

Throughout its 92 year history, the Royal Canadian Air Force (RCAF) has been a strong learning organisation that has learned from its mistakes and developed one of the strongest Flight Safety (FS) cultures in the world. The RCAF FS program is a key pillar in RCAF flying operations and it is crucial to our organizational success. The program was born out of the blood and sweat of our predecessors in both combat and in training. In essence, it is an optimized lessons learned system designed to enable the delivery of airpower.

We have heard much talk about the concept of *train as you fight* and the *warrior spirit*. I've always been a strong proponent of these notions; they have been present throughout my career. I look at the train as you fight concept as the means to maximize the delivery of air power and minimize the human and equipment cost to achieve our goals. It is all about efficiency and mission accomplishment at an acceptable level of risk.

Although I'm a strong proponent of the warrior spirit, through the lens of numerous operational tours and domestic operations, my personal observations and experience taught me that a freelance interpretation and execution of the warrior spirit can lead to an unnecessary breach of safety of flight for **perceived** operational gain. Be it during combat operations, aid to civil power, or search and rescue operations: the warrior spirit attitude and train as you fight concepts apply only as long as the *fight as you've trained* mantra is respected.

Application of air power in domestic or deployed operations shall be done in accordance with established flight rules, aircraft operating instructions (AOIs), tactics, techniques and procedures and using sound judgement and air sense while always keeping FS in mind. I strongly argue that FS does not preclude mission accomplishment but rather it complements it and enables its continued application. As such, the impetus to deliver air power in a tactically demanding environment is not a blank authorization to break rules and aircraft AOIs. The question you should ask yourself is how can I fully excel at doing my task and minimize the risk so all of the air resources are available for the next mission? For instance, flying operations in hot, dusty, high air density environments such as was in Kuwait and Afghanistan have proven that a combination of strict adherence to power performance limitations and mission management from both the aircrew and senior leadership allow for the continuous delivery of air power in a safe and effective manner.

In extremis, unpredictable and exceptional occurrences such as countering enemy action or handling an aircraft system malfunction during a critical phase of flight may require aircrew to react and take immediate actions leading to preservation of life and prevention of damage. As discussed previously, the train as you fight concept must always be supported by a robust fight as you've trained application to be safe and effective. In this regard, a robust mission management system provides a pre-flight decision process that assists aircrew, flight supervisors and senior leaders in assessing all pre-mission factors in establishing conditions for success.

> ***"Be it during combat operations, aid to civil power, or search and rescue operations: the warrior spirit attitude and train as you fight concepts apply only as long as the fight as you've trained mantra is respected."***

For instance, our air wing in Afghanistan refined, utilized and modified a risk and mission management system called MALA (Mission Acceptance and Launch Authority). The application of the MALA system proved effective and reliable during these combat operations to the point that it expanded from mission management system of tactical aviation assets to the other fleets operating in Afghanistan – the CC130 *Hercules* and *Heron* unmanned aerial vehicle fleets. The MALA provided standardization in tactical mission planning and enabled both aircrew and flight supervisors the opportunity to step back during mission planning and evaluate such criteria as: mission complexity, threat, aircraft and crew composition, qualifications, fatigue level, weather, illumination, etc. Thorough mission and pre-flight planning have always been an integral part of RCAF processes and is engrained in the RCAF standard operating procedures (SOPs) and flying culture. As well, MALA brings the added value of ensuring that the whole flying supervisory chain of command is involved in the mission decision process and that the tactical risk taken is in line with the strategic aim of the mission.

To be engrained with our combat operations, the MALA process was introduced and exercised during pre-deployment training. At its inception, MALA was perceived by aircrew as an added measure of control and micro-management from the chain of command. However, it rapidly proved to be an extremely valuable mission management tool and it was embraced by all crewmembers and became part of their SOPs. Aircrew quickly realized the advantages of having a means to systematically look at mission risk factors and having 'top cover' from the senior leaders, sometimes up to the Task Force Commander in high threat/risk environments. A second order effect was that it facilitated and enabled free flowing communication across the whole decision matrix. Finally, it ensured the engagement of senior leadership so that the acceptance and mission design were consistent with strategic objectives. Conversely, the dynamic free flow of information between aircrew and supervisors normalized a reach back consultation that was available and encouraged, as needed, during all the phases of flying operations.

Ultimately, the MALA process has been tested in combat operations and proved to be essential to maximize the success of our flying operations. I consider the MALA process as a mechanism applicable to all types of flying operations – not just combat operations.

"I strongly argue that FS does not preclude mission accomplishment but rather it complements it and enables its continued application. As such, the impetus to deliver air power in a tactically demanding environment is not a blank authorization to break rules and aircraft AOIs."

Acknowledging that MALA is not yet implemented across the entire RCAF, the MALA process translates well into the force generation phase and meshes perfectly with the concept of train as you fight. As stated by the Commander of the RCAF, "Flight Safety is everyone's responsibility but, first and foremost, it is a leadership responsibility". In that respect, the MALA process is an operationally proven tool that allows aircrew, flight supervisors and senior leaders alike to be part of a scalable decision process that maximizes the delivery of air power in a safe and efficient manner.

The Editor's Corner

It was 25 years ago this fall that a CC130 *Hercules*, call-sign Box Top 22, carried out controlled flight into terrain while on approach to the Canadian Forces Station Alert airport. The rescue effort, which persisted for more than 30 hours, involved 19 Canadian Armed Forces (CAF) aircraft along with three fixed-wing and two helicopter assets from the United States. Unfortunately, five members on that mission perished before they could be rescued.

While there will be more on this accident in the next issue, I wish to point out that while researching this accident in previous editions of *Flight Comment* magazine, I came across year-end summaries of aircraft losses and personnel killed. What I saw was shocking to say the least. In 1991, catastrophic accidents resulted in the loss of eight people and six aircraft. All eight lives were lost in the month of October alone. In the six month period preceding the Box Top accident, the CAF lost four aircraft. In the year prior to the Box Top 22 accident, five people died and seven aircraft were written-off. The year 1989 proved even worse –eight aircraft were destroyed and fourteen personnel lost their lives.

These figures were typical of the facts then published in *Flight Comment* – normally within the first edition of each new year. (fig.1) From today's perspective, it would seem somewhat morose to post such statistics, but back then this was the normal practice to convey the harsh realities of air operations.

Figure 1

Photo: DND

During the 70's and 80's, these year-end figures were not uncommon for the CAF. Let's take a moment and imagine if such figures were reported for 2015. How would the CAF or our government react? An operational pause on operations would probably be considered. There would certainly be great concern by the CAF leadership as to the negative trend in aircraft accidents and what can be done to address the situation. DFS would equally be concerned (and busy). What about the CAF members? The majority of them have never been exposed to such losses in their careers thus far.

For every year since the beginning of the Cold War there had been at least one instance of a loss of life, aircraft or a combination of both. It was only by the end of the 1990's that recorded aircraft losses headed towards zero and achieved zero on several occasions from then on. (fig. 2) Flying operations were equally being completed without any loss of life. Today, the running average on aircraft losses has been less than two per year since 2008. When we calculate the average rate of Category 'A' accidents, the general trend is definitely going down. (fig. 3) These statistics are significant, given our involvement in combat operations and the process of transitioning to new aircraft fleets in recent years.

The CAF Flight Safety (FS) statistics compare favourably with those allied nations having modern and proactive flight safety programs. The success of the CAF FS program is based on the involvement of all personnel of all ranks implicated in air operations. It is in our best interest to continue to foster the FS culture throughout the whole chain of command and reap its benefits lest our personnel and equipment become another *Flight Comment* centrefold statistic.

Volare tute

Major Peter Butzphal

Figure 2

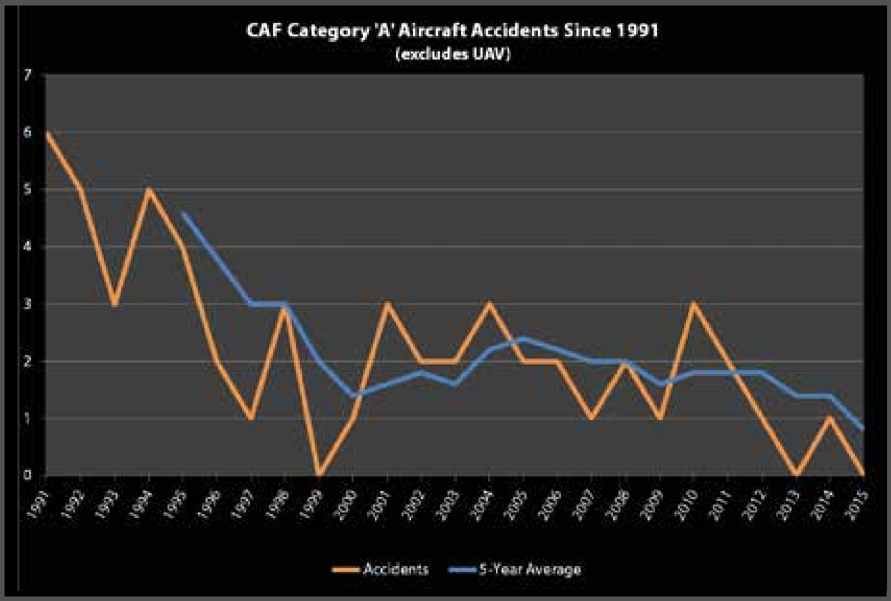


Photo: DND

Figure 3

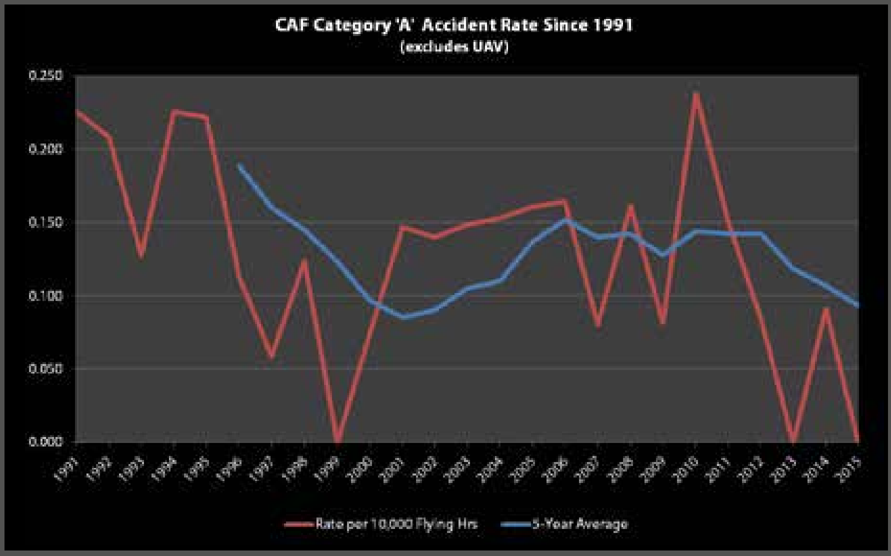


Photo: DND

For Professionalism

For commendable performance in flight safety

Captain Joseph Fowler

On 19 August 2014, while flying a CF188 *Hornet* on a local training mission with 425 Tactical Fighter Squadron, Capt Joseph Fowler experienced a critical inflight emergency where the flight control system reverted to a backup mechanical mode of operation, known as MECH ON.

Following a defensive manoeuver in a visual engagement with another CF188, Capt Fowler felt an abnormal response from the aircraft and control was momentarily lost. Being lower than the pre-briefed ejection altitude for this type of emergency, he quickly assessed the situation and found that he could still control the aircraft. Troubleshooting the problem, Capt Fowler realized that his aircraft was in a MECH ON condition, a critical emergency on the CF188. During a MECH ON emergency, the flight control computers no longer provide input to control the horizontal stabilators, leaving only a direct mechanical link from the control stick to provide pitch and roll inputs to these control surfaces. Without this electronic input, the aircraft becomes very unstable and difficult to fly. In this condition the pilot has to be very careful with the controls, using only the smoothest of movements to keep the aircraft within a safe flight regime and to avoid pilot induced oscillations. Despite these difficult circumstances, Capt Fowler was able to successfully recover his aircraft by using smooth control inputs, while carefully monitoring airspeed and angle of attack in order to achieve a successful landing.

Throughout this serious emergency situation, Capt Fowler stayed calm, using his thorough systems knowledge to analyze the situation and take corrective action. His use of superior flying skills and airmanship to prevent a potentially catastrophic accident, which would have resulted in the loss of an aviation resource, makes Capt Fowler most deserving of this For Professionalism award.

Photo: Cpl Jean-Roch Chabot

Captain Matthew Kutryk

On 20 August 2014, Capt Matthew Kutryk, a pilot with 425 Tactical Fighter Squadron, was flying a CF188 *Hornet* on a routine training mission. When faced with a very serious in-flight emergency, Capt Kutryk displayed superior judgment and flying skills in averting what could have been a disastrous incident.

Shortly after conducting air-to-air refueling, Capt Kutryk received multiple cautions indicating a possible problem with one of the hydraulic systems. He immediately initiated a return to base and began to troubleshoot the emergency. Following the checklist, Capt Kutryk shut down the left engine to minimize the risk of fire associated with a hydraulic pump operating without fluid. He then attempted to reduce the gross weight of the aircraft by dumping fuel. However, he was prevented from doing so by an unserviceable dump valve. Capt Kutryk now found himself in a very serious situation: with only one engine operating, reduced hydraulic capability, overweight landing configuration and with a "flaps-off" caution. To make matters worse, the calculated approach speed for a flapless landing was found to be too fast for the tires, thereby risking a blowout and loss of control on the runway. Having decided to use half-flaps, Capt Kutryk carefully configured his aircraft, used very gentle control inputs to minimize the demand on the remaining hydraulic system and conducted a controllability check. He then executed a single engine approach to a successful landing, at an above normal airspeed, with mismatched leading edge flaps.

Capt Kutryk remained calm throughout this dynamic emergency situation of multiple system failures, using sound airmanship and excellent flying skills. Capt Kutryk averted a situation that could very well have led to the loss of an aircraft and is thus truly deserving of this For Professionalism Award.

Photo: Cpl Jean-Roch Chabot

Captain Dennis Mann


Photo: DND

On 26 June 2013, Capt Dennis Mann, a flight instructor with 406 Maritime Operational Training Squadron, was conducting flight control functional checks on CH124 *Sea King* helicopter when he felt that something was slightly off in the pilot cyclic stick position.

After discussing his concerns with a technician, it was suspected that it was an anomaly in the roll channel of the Automatic Stabilization Equipment. An experienced maintenance test pilot, he elected to trouble shoot the issue further in the hover prior to continuing on with his scheduled training mission. Though unable to quantify the feeling, Capt Mann knew from muscle memory that the cyclic position was slightly right of normal. He taxied the aircraft back to the ramp to disengage the rotor and have a technician inspect the flight controls. He then confirmed that the pilot cyclic was positioned at a slightly different angle than the co-pilot's and elected to shut down the aircraft for maintenance action. Upon inspection, technicians discovered that the cyclic stick was improperly installed and that it was not attached to the cyclic mount in the floorboard. This condition had gone unnoticed for approximately 15 hours of flight time, including night deck evolutions the night prior.

Had the cyclic stick separated from the floor mount inflight or while conducting an autorotation, loss of control and a potentially catastrophic accident could have resulted. Capt Mann's superior airmanship and professional judgment allowed him to identify a major hazard based on a minor positional deviation and muscle memory alone. For averting a potentially disastrous situation, Capt Mann is clearly deserving of a For Professionalism Award.

Captain Chad Phipps

On 24 December 2014, while flying a CF188 *Hornet*, Capt Chad Phipps demonstrated superior situational awareness and outstanding airmanship when faced with a critical emergency.

Capt Phipps was flying as wingman in his first combat mission. With ten minutes remaining on his mission, , he noticed that his aircraft was beginning to decelerate contrary to the position of the throttles. Engine indications revealed that the left engine had rolled back to ground idle parameters despite the position of the left throttle. In order to return to base, Capt Phipps was required to on-load fuel, necessitating the conduct of Air-to-Air Refuelling (AAR).

Conducting AAR on a single engine is not a maneuver that is practiced by CF188 pilots. Capt Phipps demonstrated outstanding flying skill by successfully tanking. After departing the tanker, and with the assistance of the flight lead, Capt Phipps assessed the state of his engine and effected a successful recovery while continually updating plans for an emergency divert while enroute.

By using superior airmanship and flying skills to recover the aircraft, his actions averted the loss of a valuable asset. Capt Phipps is thus highly deserving of this For Professionalism Award.

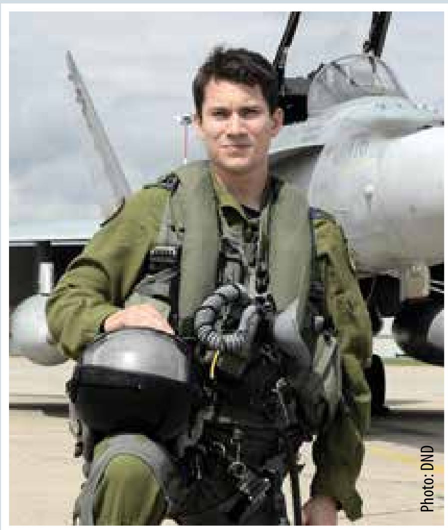


Photo: DND

For Professionalism

For commendable performance in flight safety

Sergeant Michael LeBrasceur

On 27 October 2014, while performing his duty as a start crew member for a CF188 *Hornet* detachment stop-over at Naval Air station Sigonella, Italy, Sgt LeBrasceur demonstrated exceptional situational awareness, decision making, and an extraordinary regard for safety by reacting to a situation that prevented possible damage to a CP140 *Aurora*.

Both the *Hornets* and an *Aurora* were preparing to depart and Sgt LeBrasceur had just completed a start-up sequence on his assigned *Hornet*. While waiting for his aircraft to taxi out, he observed the *Aurora* was performing its start-up approximately 200 ft. away. Sgt LeBrasceur immediately noticed a 50 lb wheeled fire extinguisher positioned very close to the nose landing gear of the *Aurora*. The aircraft had received permission and clearance from air traffic control to start without a ground crew member. By this time, it had started three of its engines and was in the process of starting its fourth.

The fire extinguisher had been positioned in the aircrew's blind spot and was not visible to them from the flight deck. Recognizing that the *Aurora* was going to taxi into the fire extinguisher, Sgt LeBrasceur ran from his position to the front of the *Aurora* and signaled to stop the start-up procedure. He then requested and received permission from the aircraft captain to approach the aircraft's nose landing gear area, where he retrieved the 50 lb wheel fire extinguisher and moved it to a safe location.

Sgt LeBrasceur's actions allowed the *Aurora* to finish its start-up procedure and depart without further incident. Sgt LeBrasceur's situational awareness, quick thinking and immediate reaction averted a potentially critical accident, for which he is extremely deserving of this For Professionalism Award.

Photo: DND

Sergeant Fabien Tremblay

During a routine helicopter towing operation on 7 January 2014, Sgt Fabien Tremblay, an Aviation Technician with 430 Tactical Helicopter Squadron in Valcartier, noticed that the tail rotor blades of a CH146 *Griffon* appeared to be slightly warped.

Sgt Tremblay was in the midst of directing a towing team. While the aircraft was being moved, he noticed one of the tail rotor blades appeared to have an irregularity. He interrupted the towing operation and personally examined the blade, which seemed to be seriously damaged. A comprehensive inspection showed that the other rotor blade was also damaged. Both blades were warped to the point of losing their functionality, mainly because of their uneven surfaces. The damage was serious enough to compromise the balance and aerodynamics of the blades. In fact, it might have led to the loss of the tail rotor.

The meticulousness, rigor and consummate professionalism showed by Sgt Tremblay made it possible to repair the hardly noticeable, but significant damage to the two blades that had escaped the notice of other personnel during previous inspections. Because of the keen powers of observation he demonstrated while performing a task other than maintenance, Sgt Tremblay is deserving of the For Professionalism Award.

Photo: Cpl François Charest

Master Corporal John Johnson

On 2 March 2015, MCpl Johnson, an Avionics Technician employed with 442 Transport and Rescue Squadron and a student in the practical phase of his training were carrying out system functional tests on a CC115 *Buffalo*. From his position in the aircraft, he observed another CC115 taxiing with engine plugs still installed in the upper intakes of both engine nacelles.

Engine plugs are installed into the upper cowling vents to prevent ingress of foreign matter into the nacelles when the aircraft is parked on the flight line. Failure to remove the covers before flight can result in engine overheats and become a foreign object hazard in flight.

Immediately recognizing a significant procedural oversight, MCpl Johnson quickly radioed squadron operations and the incident aircraft was directed to shut down, undoubtedly averting a much more grave flight safety incident.

Possessing superior situational awareness, coupled with his prompt and decisive action, MCpl Johnson is highly deserving of this For Professionalism Award.

Photo: MCpl Jeffrey Mason

Master Corporal Crystal Lyon

On 7 January 2015, MCpl Crystal Lyon, an aviation technician with 442 Transport and Rescue Squadron, while carrying out airframe corrosion control cleaning on a CC115 *Buffalo* aircraft identified damage to the right hand rear anti-torque strut mount. Upon closer inspection it was determined that the right hand engine nacelle bracket was completely broken off, and was no longer providing support to the right hand side of the engine Speed Decreaser Gearbox (SDG) assembly.

This strut is used to keep the engine aligned with the SDG and is critical during the application of torque when in flight. MCpl Lyon immediately brought her findings to the attention of her chain of command, raised a flight safety occurrence report and quarantined the affected aircraft. A fleet wide Special Inspection was ordered by the Aeronautical Engineering Office revealing potential issues on three more squadron aircraft.

MCpl Lyon's actions were exceptional and well outside the normal scope of her assigned task. She prevented the *Buffalo* fleet from operating with a serious unserviceability that had gone unnoticed for an unknown amount of time. Her diligence in the conduct of her duties and swift actions upon discovering the broken mount almost certainly prevented a major component failure or a loss of aircraft and/or life. Her exceptional diligence and decisive actions are commendable and fully deserving of this For Professionalism Award.


Photo: DND

For Professionalism

For commendable performance in flight safety

Corporals Berube and Hendsbee

Photo: DND

On 24 December 2014, while serving as the Arm/De-Arm crew in support of CF188 *Hornet* detachment, Cpls Berube and Hendsbee demonstrated first rate situational awareness and decision making when their immediate actions prevented a foreign object from entering into the engines of a CF188 aircraft.

Two CF188 *Hornets* were preparing to depart on a combat mission. They had completed their start-up sequence on the main ramp and had taxied to the Arm/De-Arm area where Cpls Berube and Hendsbee proceeded to arm both aircraft prior to takeoff.

The lead aircraft received clearance from the tower to proceed from the Arm/De-Arm area to the active runway for takeoff. The second *Hornet* proceeded to the hold short line to await take off clearance.

With only seconds remaining prior to the take-off of the lead aircraft, the corporals noticed a small flutter of a red flag on the aft upper portion of the aircraft. They quickly confirmed that it was a 'Remove Before Flight' flag from a dust plug that had been left on during the start up. With superior situational awareness and flawless team work they immediately contacted the tower to abort the takeoff. Their exceptional coordination and communications protected the safety of the aircraft and pilot, having averted a possible serious incident that enabled mission success with minimal delay.

In recognition of exemplary situational awareness and their immediate actions, Cpls Berube and Hendsbee are highly deserving of the For Professionalism Award.

Corporal Samuel Tremblay

On 24 October 2013, during a pre-flight inspection on a CF188 *Hornet*, Cpl Samuel Tremblay, an aviation technician with the Aerospace Engineering Test Establishment, noticed that the right hand trailing edge flap at the servo eye end attachment point was installed incorrectly.

Cpl Tremblay took the time to inspect two other aircraft and review the Canadian Armed Forces Technical Orders to confirm his findings and determined that a bushing was missing and that extra washers had been installed under the nut to take up the slack. After further research within the Maintenance Record Set, he discovered this flap had been installed for approximately one and a half years. As a result of the faulty installation with the extra washers, the flap attachment point was damaged causing a washer to be recessed into the flap hinge point.

His superior attention to detail, while inspecting an assembly that is normally only checked for general serviceability during the pre-flight inspection, clearly averted the potential for a catastrophic failure of the right hand trailing edge flap. Cpl Tremblay's professional efforts make him deserving of this For Professionalism Award.

Photo: Cpl J.W.S. Houck

Corporal Christopher Viveash


Photo: DND

Cpl Christopher Viveash, as a bowser operator during Devil's Deep Operations at the Canadian Forces Maritime Experimental and Test Ranges (CFMETR), went well beyond the normal duties to address and rectify procedural errors by aircrew during hot-refuelling of a CH124 *Sea King* helicopter. When pressurizing the fuel line for fuelling, he observed that the aircrew did not adhere to the correct valve-check procedures to ensure fuel overfill protection. He quickly provided on-scene coaching on the correct procedures, thereby averting a potentially serious incident. Following completion of fueling, Cpl Viveash also noticed that the aircrew had left the 'dead man' switch unattended on the tarmac. Given the associated significant safety hazard (the switch could easily have been caught in the rotor wash on take-off), he retrieved the switch and briefed operations staff to ensure the issue would be corrected for the future.

Following the departure of the CH124, Cpl Viveash provided constructive feedback to the CFMETR Detachment Supervisor, which led to a Flight Safety Occurrence Report. The ongoing investigation highlighted systemic aircrew training issues related to hot-refuelling. After a review of 12 Wing Flying Orders, new recommendations now state that all air combat systems operators and airborne electronic sensor operators be qualified to hot-refuel the *Sea King* before commencing flying duties. As a direct result of the incident, 443 Squadron recently implemented a new training and tracking program for hot refuelling procedures to ensure their aircrew receive training and maintain currency on this critical requirement.

Cpl Viveash's, singular efforts in stepping up to avert a potentially catastrophic incident and the constructive feedback he provided has served to significantly raise the bar with respect to aircrew training and proficiency in *Sea King* hot refuelling procedures. Cpl Viveash's actions reflect a superior flight safety attitude and he is well deserving of this For Professional Award.

Mr. Michael Gates

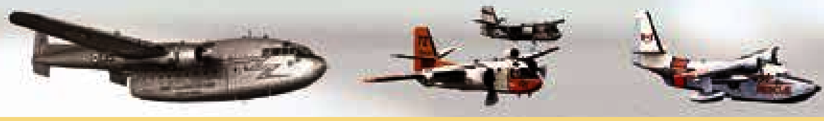
On 9 June 2015, while conducting a range of movement inspection on a CH149 *Cormorant* Helicopter, Mr. Michael Gates, a maintenance technician with IMP Aerospace at 103 Search and Rescue Squadron Gander, noticed that a bearing on the left-hand roto servo actuator had migrated from its seated position. Upon discovering this he immediately realized that it was incorrect and actively conducted a detailed inspection of the main rotor servo actuators installed on the aircraft and those installed on the other squadron aircraft. This inspection led to the discovery of one additional servo actuator on a second aircraft that had the same issue.

The servo actuator bearing migration from its seated position has the potential to cause the servo actuator input lever to become restricted in its movement, which could lead to catastrophic failure of the servo actuator, ultimately resulting in a 'frozen' flight control system on the aircraft.

As a result of Mr. Gates' discovery and his inspection of other local aircraft, a fleet-wide inspection was conducted to verify the integrity of the installed servo actuators. Since this discovery, another migrating servo actuator bearing was discovered on another aircraft a month later.

Mr. Gates is a highly motivated and professional technician who brings great credibility to the CH149 IMP Aerospace Maintenance Organization and the Canadian Armed Forces' Flight Safety Program. His attention to detail and thorough knowledge of the aircraft flight control systems and range of movement procedures ensured both the safety of squadron aircrew and aircraft and prevented a potentially deadly situation from occurring. Mr. Gates is highly deserving of this For Professionalism Award.


Photo: DND



CLOSING ACTION REPORT

'A' Category Aircraft Accident – CH12439 *Sea King*, Schenectady, New York , 4 August 1991

EDITOR'S NOTE: The following is a reprint of the Closing Action Report[1] then produced on the Category 'A' accident that occurred 25 years ago this August on a CH124 *Sea King* helicopter in Schenectady, New York. It bears a resemblance to an incident last year involving another *Sea King* helicopter making an unintended water landing off the coast of Victoria, British Columbia (*Flight Comment* 1-2015). The investigation, still underway, is focussing on human factors as well as supervision during deployment planning – similar to at least one of the causal factors that were assigned in this Closing Action Report. Nonetheless, both incidents continue to stress the importance of helicopter aircrews maintaining awareness on the dangers of vortex ring state.

Description of Occurrence

The crew of CH12439 were providing a static display at the Schenectady County Air Show. Concerned that their parking spot was too close to the taxiway which a C-5 *Galaxy* would be using, a decision was made to move the aircraft. The intent was to conduct a local familiarization flight while the C-5 was re-positioned. CH12439 was towed to the taxiway, started and took off at 1040 hours local and conducted a flight in the local area. The crew consisted of two pilots, a navigator, a flight engineer (FE) and a technician. There was a delay in receiving instructions as to where CH12439 was to park; therefore the aircraft captain (AC) established the aircraft in a high hover over the runway. While in the hover the aircraft entered an uncontrollable, rapid descent and struck the ground in an upright attitude. The aircraft came to rest on its left side, facing about 180 degrees from the initial impact heading. The AC, FE and technician suffered serious injuries, while the navigator and co-pilot suffered minor injuries. The aircraft sustained 'A' category damage.

Investigation Results

CH12439 was on an Operational Training Unit (OTU) syllabus IFR cross country trip with a secondary tasking of providing a static display at the Schenectady County Airshow. The mission departed Shearwater 1 August 1991, remained overnight at Hanscombe Air Force Base and proceeded to Schenectady the next day.

At the pre-airshow social events on 3 August 1991, the crew was requested on numerous occasions to participate in the flying display or in pre-show flying. All requests were refused. The possibility of jet blast damage to the *Sea King* from a departing C-5 was also raised by the air display director and the decision to move the helicopter was made that evening.

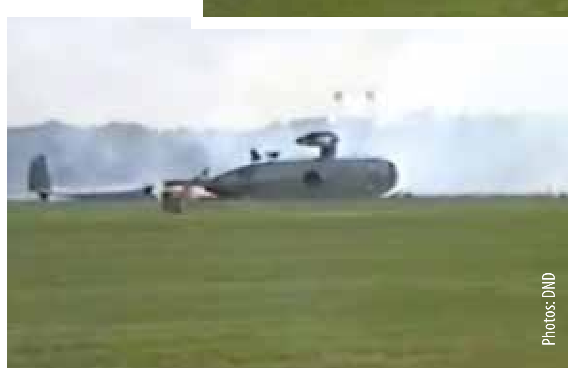
The AC planned to conduct a local flight as a means to move the aircraft, and he advised his crew of this decision. Following the flight, he planned to land at the military side of the airfield and refuel the aircraft while the C-5 departed.

Three crew members were sitting in the cargo door for the take-off which consisted of a vertical climb to approximately 100 feet prior to transitioning to forward flight. No post take-off check was completed.

Approximately 5 minutes after take- off, 439 was joined by a SH-60J *Seahawk* helicopter(call sign "Jolly 11") which formed up on the *Sea King* for the next 20 minutes while flying in the local area. The landing gear was raised during this period.

While the two helicopters were away from the airfield, the tower controller had handed over control of the airfield to the air display director. The air display director was situated in a portable tower with poor communication facilities. This led to some confusion on the return as to where to park and who would issue the clearance. At 1110 the air display director gave the helicopters a four minute window for the return and landing. The SH-60J broke off the formation in order to carry out a low pass and then land in the infield. The *Sea King* AC initially intended to carry out a circuit of the airfield and then land near the SH-60J. He subsequently decided to hover over the runway while waiting for the SH-60J to land and shut down.

The aircraft was established in a higher than normal hover, 80-100 feet above ground level (AGL), over the runway in front of the crowd. Numerous pedal turns were conducted and then the aircraft was climbed vertically to approximately 300 feet AGL. Two crew members were seated in the open cargo door throughout these maneuvers while the navigator stood behind the pilots ' seats. Pre-landing checks were not initiated. The aircraft was established in the hover using visual references only and a gentle uninitiated descent began shortly



Photos: DND

thereafter. The pilot attempted to correct with a collective input which was ineffective. The rate of descent increased rapidly to the point where the AC decided to turn away from the crowd and attempt to fly out of the situation. The turn to the right was just being completed as the aircraft struck the ground.

The aircraft struck the ground in an upright attitude. It immediately yawed right and rolled left causing the main rotor blades to strike the ground. The tail broke off simultaneously and swung towards the starboard side of the aircraft. The aircraft came to rest on its left side facing about 180 degrees from the initial impact heading. The FE and technician escaped through the cargo door, while the pilots escaped through the left windscreen which shattered on impact. The navigator, standing behind the pilot seats, was thrown part way out of the aircraft through the personnel door which had sprung open during the crash sequence. The aircraft motion stopped with the upper door sill resting on his chest. He was extricated by other crew members and the rapidly responding rescue personnel.

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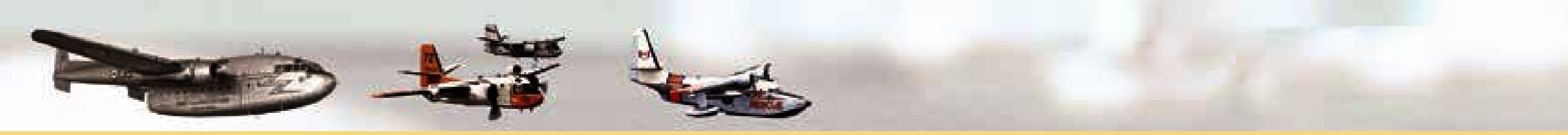

Examination of the wreckage, witness statements and videotaped evidence all indicate that the aircraft was serviceable prior to impact. The video tape of the accident was analyzed by the National Research Council who determined the rate of descent at impact to be approximately 2,000 feet per minute. The maximum rate of descent during the descent was 2,150 feet per minute.

The only phenomena which can explain the high rate of descent is a condition known as Vortex Ring State (VRS). VRS is caused by the recirculation of vortices about individual rotor blades. Conditions favorable to development of VRS are:

- high aircraft gross weight;
- high density altitude;
- light wind conditions;
- a steep or vertical descent; and
- an unwary helicopter pilot.

The condition is exacerbated by increasing collective pitch, in that the rate of descent will increase if collective pitch is increased. The recovery procedure to escape VRS is as follows:

1. reduce power (collective pitch);
2. increase forward speed (fly out of condition); or
3. use a combination of the above.

All of the conditions required for VRS were present during the accident flight. The aircraft weight at the time of the crash was approximately 19,000 pounds (maximum gross weight is 20,500). Airfield elevation at Schenectady is 378 feet above sea level, while the density altitude at the time of the crash was 1678 feet. The wind was light and variable and the aircraft had entered an uninitiated vertical descent. When fully developed VRS can generate rates of descent in excess of 3,000 feet per minute and recovery can well require in excess of 1,000 feet of altitude.

A small post-impact fire was quickly extinguished by the crash rescue personnel. The aircraft's crashworthy fuel system performed very well. Both pilots' injuries were accentuated by the thick foam seat cushions which allowed their bodies to continue descending at the original rate while the aircraft structure was decelerating. As their bodies struck the bottoms of the seat pans, the aircraft had stopped decelerating and the shock transmitted to their spines was much greater than that which would have been incurred had their bodies been allowed to take advantage of the deceleration provided by the crushing of the fuselage. This condition is known as dynamic overshoot. In addition, the AC's shoulder harness inertia reel would not unlock on the last few flights prior to the accident. To allow some freedom of movement during flight, he had loosened his shoulder straps. This allowed him to slump forward on impact causing further injury. There were numerous articles of cargo stored loosely in the cabin including luggage, maintenance equipment and the FE's tool kit. There was no means by which to secure these items and they became projectiles during the crash sequence causing numerous injuries to the crew.

"Conditions favorable to development of VRS are:

- ***high aircraft gross weight;***
- ***high density altitude;***
- ***light wind conditions;***
- ***a steep or vertical descent; and***
- ***an unwary helicopter pilot."***

The OTU had been heavily tasked over the previous twelve month period with a larger than normal load of pilot, navigator and airborne electronic systems operator courses as well as extra training requirements generated by the Gulf War. In addition, the squadron had also hosted its' Fiftieth Anniversary celebration in May. The AC's main secondary duty was Unit Flight Safety Officer, and as such he had previously raised concerns with his Commanding Officer (CO) about his perception that the workload on the squadron was causing stress and perhaps other problems. The CO and senior supervisors had been made aware of these problems by other instructional staff in the month prior to the accident and were initiating changes to alleviate the workload. Four of the eight pilot instructors (including the AC) on the squadron were being treated for stress related symptoms; however, all were considered fit to fly by competent medical and psychological professionals. Although stress may have been a possible contributing factor insofar as the AC's performance was concerned, it was not deemed causal in this accident.

Director Flight Safety (DFS) Comments[2]

The problem of heavy OTU workloads is not a new one and requires constant monitoring. Stress problems, whether real or perceived, are very real to the individual concerned and must always be dealt with in a timely and appropriate manner. This preventable accident was preceded by an extensive chain of errors of commission and omission. Sequentially, they began with the decision to conduct a flight

which was neither authorized nor required. The initial intent of the flight was to refuel and reposition the aircraft. The fueling was completed prior to the flight the aircraft was towed prior to start; therefore there was no requirement to fly. Thereafter, the pre-flight documentation was not completed and the crew was not thoroughly briefed, nor did they question the rationale behind the flight. The flight included un-briefed, dissimilar type formation flight. No one challenged the AC's actions even when they realized things were not correct. Finally, the pilot's complacent attitude and careless actions/maneuvers in the final phase of the flight sealed the fate of both the crew and the aircraft.

Final Cause Factor Assignment

The following cause factors are assigned:

- Personnel-Flight Crew/Pilot-Carelessness: In that the AC conducted the flight in such a manner as to endanger his crew and aircraft by placing his aircraft in a 300 foot AGL hover in conditions conducive to Vortex Ring State.
- Personnel-Flight Crew/Pilot-Complacency: In that when he was established in a high hover, the aircraft captain allowed the aircraft to descend and enter Vortex Ring State/power settling.

Problem Areas Identified and Corrected

- Pilot student course loading was at or exceeded the maximum for 32 of the 46 weeks preceding the accident which, combined with Gulf War taskings and the squadron 50th anniversary, contributed to a high stress environment. This stress was not directly causal but had a deleterious effect on the pilot's performance. The Wing Commander in Shearwater directed an immediate assessment of all flight instructors by the Wing Surgeon. All pilot instructors were found fit to continue their duties.
- The squadron has initiated an Establishment Change Proposal to increase staffing, and in conjunction with National Defence Headquarters, Air Command and Maritime Air Group, has re-examined course loading to prevent overtasking of the OTU.
- *Sea King* Aircraft Operating Instructions has been amended to include specific reference to the increased danger of vortex ring state in a high, out of ground effect hover.

"[...] pre-flight documentation was not completed and the crew was not thoroughly briefed, nor did they question the rationale behind the flight. The flight included un-briefed, dissimilar type formation flight. No one challenged the AC's actions even when they realized things were not correct."

DFS' Closing Remarks[3]

This accident was the result of an unbroken chain of both minor and major deviations from authorized procedures, as well as extremely poor airmanship. Injuries to personnel and the loss of an aircraft were the direct consequences. Cockpit Resource Management training presently being conducted and expanded within Air Command will help address many of the shortfalls in airmanship highlighted by this accident. The tragic circumstances of carelessness and complacency must be constantly stressed at all levels and such acts and attitudes never tolerated.

References

1. Closing Action Reports (CARs) at that time were derived from Flight Safety Board of Inquiry reports. In brief, they covered a synopsis of the accident and indicated cause factors from which preventive measures were then raised. It was prepared for the chain of command and used to document the actions taken by the units or groups responsible for the implementation of those preventive measures (PM). They are no longer in use today and have since been replaced by the Epilogue which essentially contains the same information as a CAR minus the list of actions taken in response to the PMs. These are now located in a separate document called an Action Directive, which is sent out by the Airworthiness Authority and gives direction to various Action Organizations to implement the PMs assigned.

2. Then Colonel L.G. Pestell, Director of Flight Safety from 1992-1994.

3. Ibid.

ON TRACK

Can We Descend below Minimum Safe Altitude on Vectors?

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

This article will address some questions that came up on a recent Instrument Rating Test in Comox, BC. The answer comes from Captain Quinton Trites, ICP Instructor.

Have you ever been flying into an airport, especially an unfamiliar airport, been picked up on vectors then cleared to a lower altitude than you expected? Was it lower than a published minimum safe altitude (MSA)? Were you comfortable with that cleared altitude or did it give you a moment of pause? Maybe a crewmember spoke up and questioned the clearance. Maybe you recalled for a second a commercial ATR that flew into a mountain while on vectors and cleared below MSA in Kosovo in 1999. Or maybe you understand Minimum Radar Vectoring Altitudes (MRVA) and know the air traffic control (ATC) responsibilities for obstacle clearance when you are on vectors.

There are dangers and exceptions to every rule, notably with respect to the Kosovo incident; we'll come back to that later.

First, let's review what MRVAs are. Here's what the Department of National Defence Information Publication – GPH 204 tells us with a bit of my own emphasis:

> *MVRAs are the lowest altitude, at which an aircraft may be vectored and still meet obstruction clearance criteria. MRVA is an altitude which may be lower than minimum altitudes shown on navigation and approach charts. MRVA's have been established at a number of locations to facilitate transitions to instrument approach aids.*

But am I safe to do this?

> More from the GPH 204: *"When an IFR flight is cleared to descend to the lower altitude, ATC will provide terrain and obstacle clearance until the aircraft is in a position from which an approved instrument approach or a visual approach can be commenced."*

The Transport Canada Aeronautical Information Manual (TC AIM) states "... when the aircraft is being radar-vectored, ATC will ensure that the appropriate obstacle clearance is being provided".

Quick recap in pilot-speak: MRVA is an altitude that you may be vectored to; it may be lower than a published altitude; they do not exist everywhere; where they do exist they are designed to aid your transition for the approach; and if you are assigned this altitude by ATC while on vectors they are taking responsibility for keeping you safe from obstacles.

So ATC has us on vectors, they tell us we are safe to descend, and our procedures tell us we can trust them. In the interest of keeping the entire crew informed, most pilots like to brief safe altitudes when preparing for their approach. Unfortunately, there can be a disconnect between ATC and aircrew in this matter because we [aircrew] cannot see where the MRVA divisions are and we do not have pubs in the aircraft to check these altitudes. So if ATC clears us lower than what we expected or briefed, this may cause some consternation in the cockpit. This does not mean that we necessarily need to go out and query ATC as to what the MRVA is every time they ask us to descend. Similar to our approach plates, ATC has a charting system which allows them to know when an aircraft is safe to descend below MSA. A given area is broken down into sectors. When the aircraft enters that sector, a procedure has been established to enable ATC to vector them as low as the MRVA. These altitudes have been calculated to provide obstacle clearance with the same care and precision as MSA, approach procedures, etc. (i.e. they have been assessed for obstacle clearance).

Does ATC temp correct the MRVA?
Yes.

What if I get a vector in the climb on departure?
You are responsible for meeting your required climb gradients.

What if I have a communication failure?
Good question: Climb immediately to appropriate published minimum altitude or continue VFR.

Do MRVA's work the same in International or US controlled airspace?
Yes.

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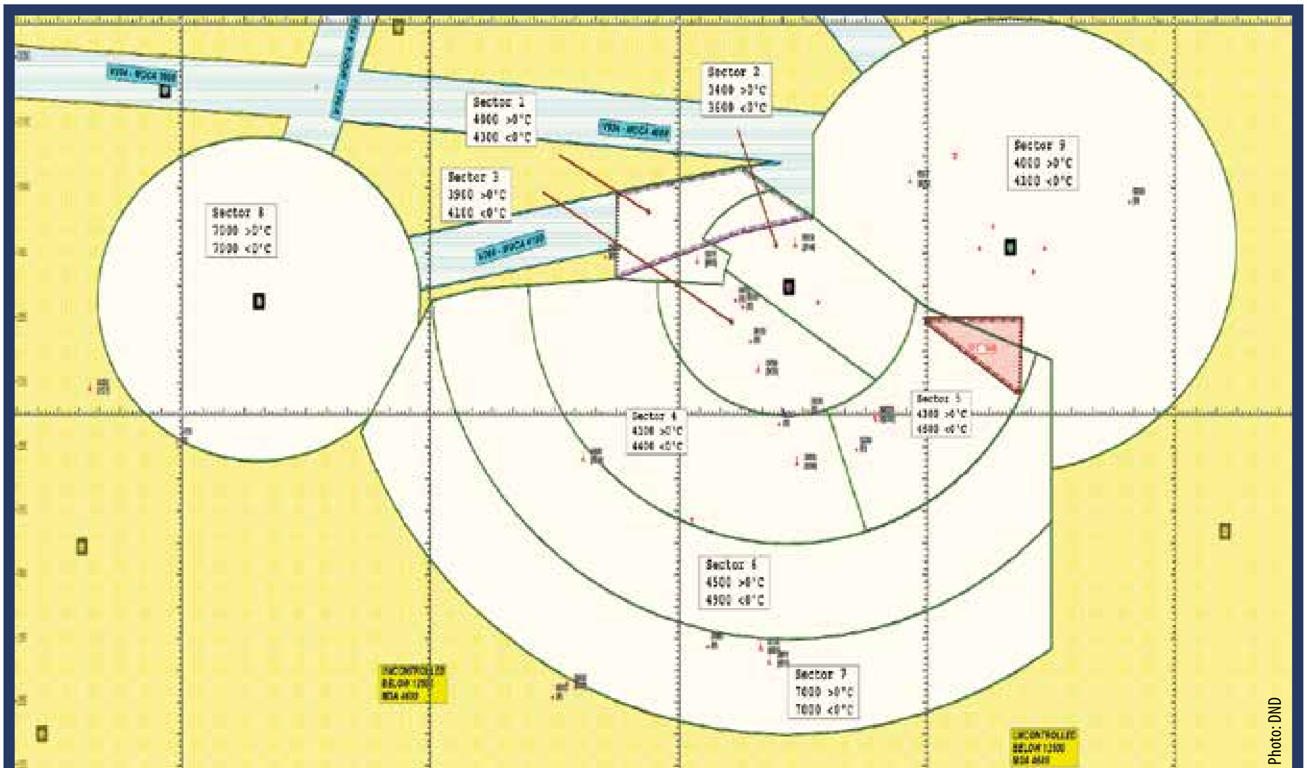

Figure 1. Snapshot of an MVRA overlay used by ATC.

Should I trust every controller world-wide? Of course not.

Let's go back to the Kosovo incident for a moment. There is the luxury of reading a Flight Safety report[1] to glean information in this case, but I would like to point out a few things. The airport in question had been heavily bombarded in previous months so radar control had switched between several nations in a matter of months. There were up to six different sources providing flight operation information (much of it contradictory), and regulatory information had been put in place without any detailed checks as to their conformity to international civil norms and practises. We can all agree that this place was not your standard, well-run airport with an effectively functioning ATC. It was an exception to the rule.

The crew in this case were instructed to comply with a special announcement issued by their airline that MSA altitudes were to be "rigidly adhered to" due to a Notice to Airmen indicating that there were ongoing problems with the radar service. Unfortunately for the crew, they did not follow this instruction and when ATC cleared them down to MRVA while on vectors, they descended. Another problem lay with ATC: after the aircraft had been cleared down to a legitimate MRVA (4600 ft. in this case) the controller focused his attention on vectoring and clearing a separate aircraft for an approach – effectively forgetting about the accident aircraft. (There is some indication that the controller confused his radar returns and did not know which aircraft on his scope he was vectoring). After several minutes, the crew of the accident aircraft queried the controller who again turned his attention to them, but by this time they had entered a sector where the MRVA was 7000 ft. and terrain penetrated up to the altitude they were level at: 4600 ft. Subsequently they impacted terrain resulting in the loss of 24 souls on board.

We can recognize two things right away with the above incident: first the crew did not follow company procedures which were clearly issued to prevent this exact incident. Second, the crew had no way of knowing what the MRVA altitudes were or where the sector dividers lay. ATC was supposed to ensure obstacle clearance while they were on vectors.

"Quick recap in pilot-speak: MRVA is an altitude that you may be vectored to; it may be lower than a published altitude; they do not exist everywhere; where they do exist they are designed to aid your transition for the approach; and if you are assigned this altitude by ATC while on vectors they are taking responsibility for keeping you safe from obstacles."

Clearly, not all controlling agencies provide the same level or quality of service. You are never going to be encouraged to blindly follow all descent clearances or ATC instructions especially when there is a concern. When we are flying in Canada, the US, or in most of Europe for that matter, we know that we have a tried and tested ATC system with excellent training, quality control and a very good track record. That being said if you have a concern, query the controller however; if Vancouver Arrival starts vectoring you below MSA as you descend for the approach, have confidence!

If there is a known problem (with radar services for instance) or if you are flying to a nation with questionable ATC, what can you do to protect yourself? Quite simply, tell ATC what you want, and stay at MSA. If MSA's are extremely high around your arrival airport, usually there is a published shuttle procedure for descent. Opt for that. If you have an Air Combat Systems Operator [navigator] as a crewmember, have them on the topographical charts and use him/her to ensure that you will be safe as you descend.

Keep in mind that IFR flying is a dynamic, often changing realm. Rules and procedures change occasionally, people learn things that they never knew before, or they find themselves in situations where they are unsure of the correct answer. Do not waste your training opportunities! They are all around you. Discuss MRVA's with your crew on your next flight. Look up the answer to questions that you or your co-pilot may have had. Attend briefings or presentations when your training shop or unit ICP hosts them, or present something that you have learned during a morning brief. For many readers, MRVA's are old news, you didn't learn much here. For some, you kind of knew the rule but never really thought about how it applied. And for some, you either have been totally confused before or would have been if put in the situations that MRVA can apply to. The intent of this article is to remind pilots that Minimum Radar Vectoring Altitudes exist, that ATC is responsible to ensure you will not hit anything, and to prepare you to have an appropriate response if the use of MRVA is uncommon to you or your community.

Reference

1. See http://flightsafety.org/ap/ap_oct00.pdf for a comprehensive summary on subject accident.

DOSSIER

Flying Helicopters with 'ATTITUDE'

Photo: Sgt Matthew McGregor

By Major Brad Steeles, Commanding Officer, 417 Combat Support Squadron

When I first began flying the CH146 *Griffon* in 1999, I was a new wings graduate at my first operational flying squadron, 444 Combat Support Squadron (Sqn) in Goose Bay. At the time the *Griffon* had a cyclic Force Trim (FT) release button that took about 1000psi to press and hold – only the long-in-the-tooth *Griffon* drivers will remember what I'm talking about – the good old days before the mod to the new cyclic grip took place. As a result of compensating for the lousy FT button, I routinely flew the aircraft in Stability Augmentation System (SAS) mode with the FT off, since my right thumb hurt a lot less that way. It wasn't until later in my career, flying the CH149 *Cormorant* that I realized the full value of Attitude Hold mode (ATT) and was forced to adapt my flight control strategy to make best use of it.

Most experienced CH146 pilots, if not all, will already recognize the benefits to flying in ATT mode, and this is being stressed to new CH146 pilots on the type conversion course. However, to reinforce what you already know about the benefits of flying in ATT mode I want to share some of what I've learned while working at the Aerospace Engineering Test Establishment for several years, particularly while involved with the Degraded Visual Environment Solution for TACHEL (DVEST) project. Until I worked in flight test, I didn't fully understand why ATT was better in a Degraded Visual Environment (DVE) such as night, IMC, or whiteout/brownout.

In SAS mode the Automated Flight Control System (AFCS) response of the CH146 to pilot cyclic inputs gives a rate-type response (also called Rate Command), which means that a given rate of pitch or roll in degrees per second is generated corresponding to a given cyclic input (Fig. 1). The larger the input, the larger the rate of pitch or roll that is generated, and the pitch or roll rate is maintained until the stick input is removed by the pilot. In ATT mode, the aircraft also exhibits a rate-type response whenever the

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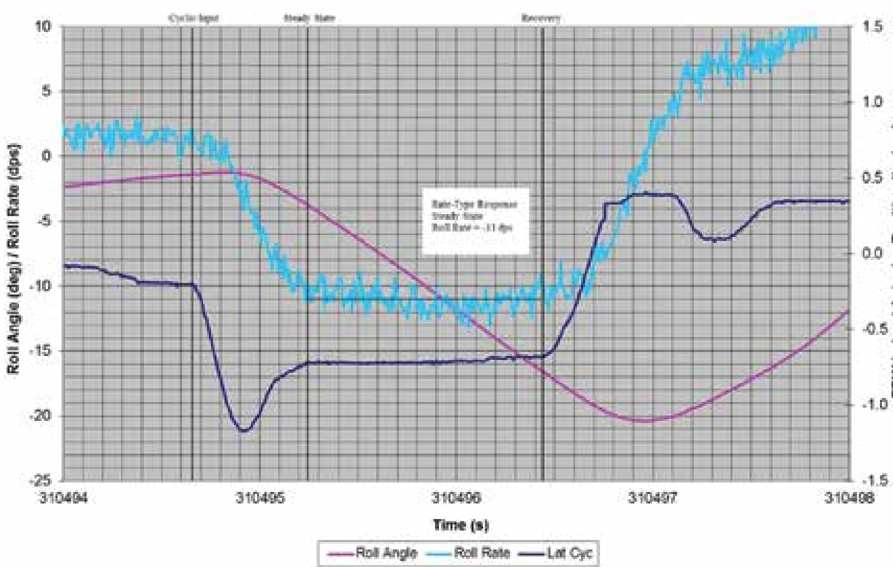

Figure 1. Lateral cyclic response of a Bell 412HP in SAS mode, showing rate-type response.

FT button is depressed, though the AFCS will try to maintain the aircraft attitude when the FT button is released. A rate-type response is good for aggressive maneuvering in a Good Visual Environment (GVE) but what if the pilot has poor cues and cannot perceive residual pitch or roll rates? And without good cues when the FT button is depressed where should the pilot place the cyclic for a wings level aircraft attitude? Recently in the CH146 simulator I got complacent doing multiple circuits and emergencies – when glare from a fire light obscured the runway lights on my night vision goggles (NVG). I held the FT button down and rolled into a final turn expecting to see the runway lights but didn't cross-check my attitude as I continued searching for those runway lights – they were there moments ago! Within only a few seconds the simulator impacted the ground at about 90 deg AOB before I realized my error. This example not only highlights the value of simulator training, but serves to reiterate the danger of a rate-type response in a Degraded Visual Environment. (Glad I got that out of my system in the simulator!)

In ATT mode the CH146 AFCS gives an attitude-type response (also called Attitude Command), which means that a given change in aircraft attitude in degrees (pitch and/or roll) is generated corresponding to a given cyclic input (Fig. 2) against the force trim. The larger the input, the larger the amount of pitch or roll that is generated, and the pitch or roll attitude is maintained until the stick input is removed by the pilot. What's important to note here is that the CH146 exhibits this response type in ATT mode only when the pilot makes a cyclic input against the force trim. This can be demonstrated while in forward flight by applying a lateral cyclic input against the springs – the corresponding roll response will stabilize at a fixed angle of bank proportional to the cyclic input, which is very convenient during IFR flight for example, as the pilot workload to maintain a desired bank angle is significantly reduced as compared with a rate-type response. The attitude-type response occurs as a result of the AFCS trying to counteract the pilot's input to maintain the trimmed aircraft attitude, which coincidentally results in an attitude-type response. (ATT mode provides an attitude-type response using the attitude beep trim switch also, but I have assumed that is obvious.)

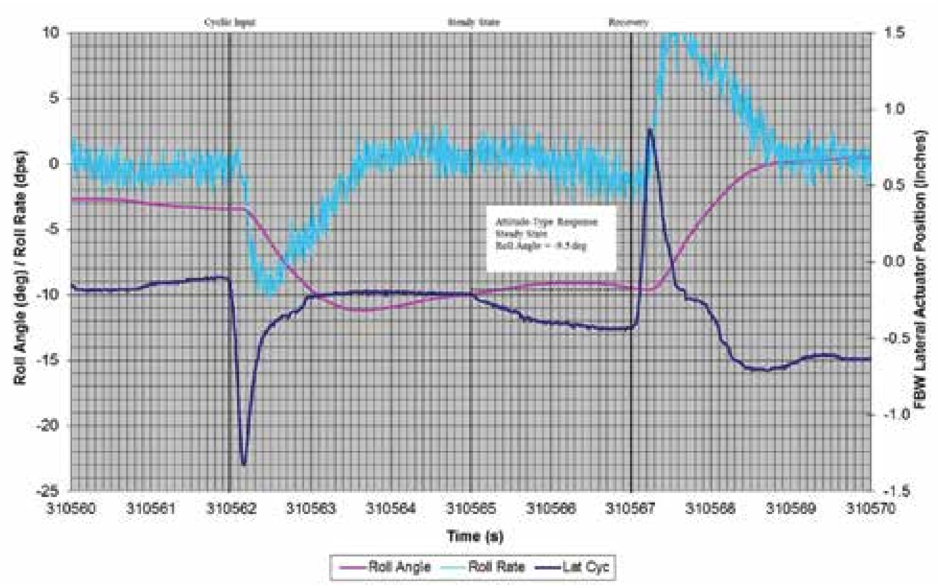

Figure 2. Lateral cyclic response of B412HP in ATT mode FT on, showing attitude-type response.

> ***"However, the key takeaway here is for pilots to recognize that every time the FT button is pressed the aircraft has reverted to a rate-type response."***

An attitude-type response is more desirable in DVE compared to a rate-type response since the pilot workload is generally lower and the aircraft will return to a trimmed attitude when the cyclic is released. It then follows that the best CH146 control strategy would be to always fly the CH146 with cyclic against the force gradient springs, or use the attitude beep trim switch. Unfortunately there are some system deficiencies that don't always allow these strategies to be employed. For example, attitude beep trim rates are low and there is some lag with the net result that it is difficult to adequately control aircraft attitude in forward flight using attitude trim, and next to impossible in the hover. In addition the aircraft was not designed with a 'transparent' ATT mode, since it clearly states in the Aircraft Flight Manual (AFM) that this is a 'hands-off' mode. This is further described in the Force Trim section of the AFM below which states:

"Failure to press and hold [FT] button while manually flying in ATT mode will result in AFCS counteracting control inputs from pilot in an effort to maintain helicopter at reference attitude. Although pilot can override AFCS, control response will be sharply reduced. Likewise, upon releasing FORCE TRIM release button, the pilot should release the cyclic to prevent interference with AFCS operation."

Because the AFCS counteracts the pilot inputs, it is frequent to get 'AUTOTRIM' cautions as the AFCS linear actuators sense they are reaching saturation since pilot inputs on the cyclic disable the autotrim system by design. It's a shame really that the CH146 ATT mode, which is able to provide an attitude-type response, is not meant to be used in that fashion. In my experience it is difficult hovering the CH146 against the cyclic springs since the high force gradients are difficult to comfortably 'fly through', and there is a strong tendency for stick jump if the FT release button is pressed with pressure against the springs. The AFM warns against this when it states,

"If the pilot is holding control pressure when a force trim release switch is depressed, the helicopter may yaw, pitch, or roll slightly due to the sudden release of pressure. It is recommended that the force trim release switch be depressed prior to making control movements and then released after the control movement is complete."

It should now be apparent that the CH146 FT release button will be required much of the time in ATT mode to make pilot inputs. However, the key takeaway here is for pilots to recognize that every time the FT button is pressed the aircraft has reverted to a rate-type response. This discussion links back directly to the Royal Canadian Air Force (RCAF) Automation Philosophy outlined in the RCAF Flight Operations Manual in which a fundamental principle is AFCS mode awareness. It is extremely important for helicopter pilots to limit use of a FT release button in DVE since every time they do so it effectively lowers the level of AFCS augmentation. Over two weeks in the simulator during the DVEST project I was able to watch pilots flying with developmental brownout symbology under DVE – a general observation was that pilots who used ATT mode while minimizing use of the FT button had the best aircraft control. By comparison pilots that held the FT button down for long periods often failed to interpret residual pitch or roll rates (or vertical velocities) due to the reduced cues and aircraft control suffered resulting in ineffective approaches or in the worst case ground impact. Although the CH146 has been the main example thus far, the ideas presented are common across all fleets as there will be analogous AFCS modes providing rate-or attitude-type control responses. It will be extremely important for legacy CH124 *Sea King* pilots to firmly grasp the automation principles that come with a state-of-the-art CH148 *Cyclone* and avoid the tendency to kick off the AFCS modes and 'hand fly it' (or even press the FT release at times).

"I was able to watch pilots flying with developmental brownout symbology under DVE – a general observation was that pilots who used ATT mode while minimizing use of the FT button had the best aircraft control. By comparison pilots that held the FT button down for long periods often failed to interpret residual pitch or roll rates (or vertical velocities) due to the reduced cues and aircraft control suffered resulting in ineffective approaches or in the worst case ground impact."

During my tour at 442 Transport and Rescue Sqn flying the CH149, I learned to appreciate an ATT mode that provides a good attitude-type response: We got the call to launch a *Cormorant* one night for a Search and Rescue (SAR) mission. The weather was horrible with a ragged 2-300 ft. ceiling and less than a mile visibility as I recall. We filed an instrument flight plan and took off towards the west coast of Vancouver Island where a tug boat had run aground and sunk in a storm. Several Coast Guard boats were searching for the tug driver who was missing and presumed to be in the water. On completion of a radar-guided over-water transition, we were only able to continue due to the lights of the boats providing some visual references as the rain in the NVGs looked like golf balls falling around us. As we leveled off at 100 ft., we hovered over the water toward the search area where the mast of the tug was still just showing above the water. During that search I greatly appreciated the capability of the CH149 AFCS with a good attitude-type response model – coupled to radar altitude hold (RAD Alt) hold, I was able to drive the aircraft around in the hover over the water at night in terrible weather simply using small cyclic pressures. If I released my hold on the cyclic I knew the aircraft would return to a level hover attitude and we would be safe. Sadly we didn't locate the missing tug driver that night and later departed the area after scouring the shoreline near the sunken vessel. Since that experience, I have always understood the benefits of a good AFCS with ATT hold. In contrast to the *Griffon*, the *Cormorant* is designed for over-water operations; it is designed for the pilot to fly against the cyclic force gradients and has an attitude beep trim system that can be used to easily adjust attitude or trim stick forces to neutral in the hover. It's worth noting, however, that the CH149 is just as susceptible to pilots pushing the FT release button and reverting to a rate-type response, which can be treacherous in DVE.

Modern military rotorcraft design standards help to shed some light on the limitations of the CH146 AFCS, especially with respect to flight in DVE. The United States Aeronautical Design Standard Performance Specification Handling Qualities Requirements for Military Rotorcraft (ADS-33E) provides comprehensive guidance for design of helicopter flight control

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systems. ADS-33E outlines AFCS stabilization requirements to achieve desired aircraft Handling Qualities (HQ) while conducting well-defined mission task elements (MTE) (i.e. hover, landing, lateral reposition, etc.) under various types of Usable Cue Environment (UCE). The UCE is defined by the quality of the pilot's attitude cues and horizontal and vertical translational rate cues, where simplifying slightly, UCE1 means good cues (i.e. day VMC), UCE2 fair cues (i.e. NVGs over land), and UCE3 poor cues (i.e. NVGs over water, snowball/dust ball). MTE definitions contain detailed maneuver descriptions and provide 'desired' and 'adequate' levels of performance (or precision). Aircraft HQs are defined by the Cooper-Harper Handling Qualities rating scale, where the definition of Level 1 HQ says that the pilot is able to carry out the MTE within desired performance parameters (as defined by ADS-33E), and in the worst case there may be "mildly unpleasant deficiencies" or "minimal pilot compensation required". By comparison, Level 2 HQ means that in the best case the pilot can carry out the MTE within desired parameters but there are "minor but annoying deficiencies" or "moderate pilot compensation required". The worst case of Level 2 HQ means the pilot can carry out the MTE within only adequate performance parameters (less precision) and there are "very objectionable but tolerable deficiencies" or "extensive pilot compensation required".

MTE	UCE = 1		UCE = 2		UCE = 3	
	Level 1	Level 2	Level 1	Level 2	Level 1	Level 2
Required Response-Type for all MTEs. Additional requirements for specific MTEs are given below.	**RATE**	**RATE**	**ACAH**	**RATE + RCDH**	**TRC + RCDH + RCHH + PH**	**ACAH**
Hover			RCDH + RCHH			RCDH + RCHH
Landing			RCDH			RCDH
Slope Landing			RCDH			RCDH
Hovering Turn			RCHH			RCHH
Pirouette			RCHH			RCHH
Vertical Maneuver			RCDH			RCDH
Depart/Abort			RCDH + RCHH			RCDH + RCHH
Lateral Reposition			RCDH + RCHH			RCDH + RCHH
Slalom	NA	NA	RCHH			RCHH
Vertical Remask			RCDH			RCDH
Acceleration and Deceleration			RCDH + RCHH			RCDH + RCHH
Sidestep			RCDH + RCHH			RCDH + RCHH
Turn to Target			RCDH + RCHH			RCDH + RCHH
Divided Attention Required	RCDH+ RCHH+ PH		RCDH + RCHH			RCDH + RCHH

Figure 3. ADS-33E Table IV defining rotorcraft flight control system Required Response-Type to achieve Level 1 or Level 2 handling qualities based on UCE 1 to 3. (Note: ACAH-Attitude Command Attitude Hold, RCDH-Rate Command Direction Hold, RCHH-Rate Command Height Hold, TRC-Translational Rate Command, PH-Position Hold)

Figure 3 shows the ADS-33E Table IV, which provides the recommended flight control system response-types to conduct various MTEs while achieving Level 1 or Level 2 HQ, with pilot's visual references corresponding to a defined UCE from 1 to 3. If we consider NVG hover operations over land as a reasonable example of UCE2, Figure 3 states that the minimum flight control system to achieve Level 1 hover HQ is Attitude Command Attitude Hold (ACAH) plus Rate Command Direction Hold (RCDH) (i.e. yaw-axis heading hold), plus Rate Command Height Hold (RCHH) (i.e. collective-axis height hold). The CH146 AFCS does not meet the ADS-33E minimum requirement for Level 1 hover HQ under UCE2. This means that in practice pilots must work harder to compensate for the aircraft in order to achieve desired parameters during flight operations, or in some cases may only meet adequate performance parameters. (Technically the CH146 does not even meet the Level 2 HQ requirements under UCE 2 due to lack of RCDH.) The direct benefits of reduced pilot workload and compensation are difficult to quantify, just like the effectiveness of a good Flight Safety or Human Performance in Military Aviation program. However, we know there is a real world benefit in terms of increased operational effectiveness and increased safety margin when pilot workload and compensation is reduced by an AFCS.

If we consider NVG operations over water as a reasonable example of UCE3 (vertical and horizontal translational rate cues are very poor!), Figure 3 states that the minimum flight control system response-type to achieve Level 1 hover HQ is Translational Rate Command (TRC) plus RCDH, plus RCHH, plus Position Hold (PH). While the CH146 AFCS has none of these capabilities, it is my understanding that the CH147 *Chinook*, CH148 *Cyclone* and CH149 *Cormorant* all have the required AFCS modes to meet the ADS-33E requirements for Level 1 hover HQ in UCE3 – very cool! Since the CH146 does not meet Level 1 requirements, let's consider Level 2 HQ - The minimum AFCS capabilities from Figure 3 for Level 2 hover HQ over water are ACAH with RCDH and RCHH, and again the CH146 AFCS does not meet the ADS-33E requirements. It is, therefore, reasonable to deduce that during CH146 operations over water at night there will be times that pilots are able to only achieve Level 3 HQ. This is supported by the fact that there is a RARM in place for CH146 over-water operations that imposes additional requirements for specific weather minima and pilot references, which is based on several flight safety occurrences. Level 3 HQ means that in the best case "there are major deficiencies in the aircraft" or "the aircraft is controllable, but adequate performance is not attainable with maximum tolerable pilot workload" – at best the MTE cannot be flown with sufficient precision to be acceptable for the mission. And the worst case definition of Level 3 HQ means that "considerable pilot compensation is required just to maintain aircraft control". Tragically the RCAF knows all too well what the outcome of Level 3 HQ can be when UCE3 is represented by a dustball in which pilots have insufficient visual cues to compensate for the limited CH146 AFCS in proximity to obstacles.

CH146 pilots are amazing at compensating for their aircraft. The myriad of missions that are executed each year is a testament to this, ranging from domestic SAR cases in extreme weather to tactical missions in hostile theatres – we get the job done! However, ADS-33E provides an excellent benchmark for the CH146 AFCS and shows that it falls below the min spec for Level 2 HQ in UCE2 and 3. It is very important to note that ADS-33E does not just contain recommendations based on control system theory – the minimum specified AFCS response types in Figure 3 have been the subject of extensive validation though real-world handling qualities tests on numerous types of rotorcraft using mission representative tasks (MTEs). Arguably, the ADS-33E prediction for CH146 HQ below Level 2 under UCE 2 or 3 is further substantiated by historical CH146 flight safety incidents and accidents. A key point to observe in Figure 3 is that the CH146 could achieve Level 2 HQ in UCE2 and 3 by only adding a yaw-axis heading hold (RCDH) and collective-axis height hold (RCHH). However, modification of an operational aircraft's AFCS is not a cheap or trivial task.

As professional aviators, understanding your AFCS and employing the best flight control strategy for the conditions is imperative to conducting safe operations. This is especially important as we move forward to newer fleets with advanced flight control models. And understanding the limitations of the AFCS on legacy fleets such as the CH146 helps us be prepared to avoid situations that might exceed the pilot's ability to compensate for the aircraft. In addition if an opportunity to update legacy AFCS should present itself (i.e. *Griffon* Mid-life Update?), the ADS-33E provides a proven road map for success based on operational mission tasks.

No matter what fleet you currently belong to, I hope this discussion has proven interesting and provided you food for thought in order to better fly your helicopter with 'attitude'!

DOSSIER


Photo: MCpl Johanie Maheu

EMBEDDED TROUBLE

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While transiting in Australia from Canberra to Richmond the aircraft encountered moderate to severe turbulence and as a consequence deviated from the assigned level without air traffic control (ATC) clearance. Once clear of the weather the crew continued to Richmond terminating the task upon landing.

The crew had been tasked to fly from Canberra to Puckapunyal to Canberra to Townsville. But a late deviation to the task dictated an aircraft change during the transit through Canberra and a requirement to transport a passenger to Richmond. The meteorology forecast for the leg between Canberra and Richmond indicated a line of weather with embedded thunderstorms.

The aircraft departed Canberra for a turnaround in Richmond before continuing to Townsville. The crew leveled at the assigned altitude of flight level 170 and conducted the cruise checklist. The weather radar identified a number of weather cells further on track. At approximately 100 nautical miles (NM) to the cells the co-pilot asked the aircraft captain (AC) if a deviation left of track was required.

The AC responded that the decision would be deferred until closer to the weather. At approximately 50 NM the co-pilot asked if the AC would like a clearance for 20 NM left of route. The AC responded that he would like a closer look to see if there was a suitable gap between the cells prior to deviating left around the weather.

The weather radar was indicating two cells to the right of track and the co-pilot recommended 20 NM left of route. Approaching the cells, a path approximately 10-15 NM wide was identified between the two cells and the AC made the decision to track through this gap towards Richmond.

After entering cloud the aircraft began to experience light to moderate turbulence; however, after 10-20 seconds the turbulence increased and the aircraft experienced a significant jolt. The co-pilot recommended that if that happened again the AC should disengage the autopilot, with which the AC concurred. The aircraft experienced significant altitude (300 ft.) and pitch (10 degree)

changes. The co-pilot noted a10 degree nose down attitude and called to disengage the autopilot, to which the AC responded by disengaging the autopilot and proceeded to hand fly, wings level.

The aircraft flew into a break in the cloud, the AC elected to conduct a turn to avoid re-entering cloud. During the turn the aircraft deviated from assigned [altitude] level by up to plus and minus 400 ft.

At this time ATC questions the crew about the altitude deviations and the co-pilot responds informing ATC of the turbulence and manoeuvering to clear the weather. The AC noted a gap in the cloud and commenced to track for the gap. The co-pilot noted the airspeed at 220 knots (kt) and thinking that was too fast began to reset the airspeed bug to 170 kt. While adjusting the airspeed bug the co-pilot noticed and called that the left hand engine inter-turbine temperature (ITT) indication was red, indicating it had exceeded ITT. The co-pilot took control of the power levers and reduced the ITT to within normal operating limits.

The aircraft flew clear of the weather, at which point the co-pilot stated that the left engine had exceeded ITT limitations. The aircraft was flown to the west and north around the weather and conducted a visual approach into Richmond. The aircraft was landed at Richmond and maintenance was informed of the ITT exceedance.

Task influences

The crew had been tasked for airshow support during the week before the incident and were programmed to depart on another one-week-away task after returning to Townsville. The crew had one day to complete post-task administration and subsequent planning for a detailed digital-imagery-acquisition task.

The changing requirements of the tasking on the incident day, involving an aircraft change and extra turn around in Richmond, had increased the planned length of the crew day. The AC later noted his awareness of the crew day and was planning to minimise the timings where possible. He wished to be as efficient as possible with the Richmond turn around and planned for an engines-running passenger offload and subsequent departure.

"The AC said that when flying with the co-pilot it didn't feel like he was the AC, as all decisions and directions were challenged and debated. He had become highly frustrated with the co-pilot and the perception that the co-pilot would manipulate the management of the task in order to have the flight proceed in the way that the co-pilot would like it conducted."

Crew Resource Management

The AC said that when flying with the co-pilot it didn't feel like he was the AC, as all decisions and directions were challenged and debated. He had become highly frustrated with the co-pilot and the perception that the co-pilot would manipulate the management of the task in order to have the flight proceed in the way that the co-pilot would like it conducted. The AC noted that the co-pilot would change the AC's screen displays without consultation. However, the AC had not discussed these frustrations with the co-pilot, as he was not prepared to confront the co-pilot with the issue, preferring to accept the frustration and limit the occasions where they would fly as a crew.

The co-pilot, a Category C Captain, acknowledged that there was a difference in operating styles and preferred to conduct tasking in a specific manner; however he said that there was no awareness of any crew resource management (CRM) conflict or issue with the AC at the time.

Tracking decision

Approaching the weather cells the crew discussed options for weather avoidance. The co-pilot suggested continuing further left of the planned route and fly around the weather cells. The AC noted the suggestion however wanted to delay the decision until he could have a closer look at the positioning of the specific weather cells. The AC felt that there could be additional cells behind those appearing on the radar display which would create further track miles and create further delay.

The AC noted a gap between the cells and decided to track through this gap. The co-pilot stated that she didn't think the gap was large enough and that flying through the gap would be turbulent.

The AC later noted that while he was aware of the published guidance regarding weather avoidance he had flown through similar weather conditions previously without any issue. The AC did not believe that there was any increased risk to the safety of the aircraft.

The AC noted that while not the key factor in this decision, he was conscious of the impact of going around the weather may potentially significantly increase the crew duty day.

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The AC also acknowledged that once he had made his decision, his frustration with perceived ongoing attempts by the co-pilot to influence the task may have reinforced that decision to fly through the gap between the cells. The AC later stated that at this point his frustration had peaked and he wanted to make a decision and not have it further debated.

Aircraft control technique

The AC stated that after the autopilot had been disconnected he continued to hand fly the aircraft, initially wings level and then once into the cloud break, in a turn to remain clear of the cloud.

The AC noted that throughout this sequence he had one hand on the control yolk and the other hand on the engine power levers. During the turn the AC was looking out of the cockpit with minimal reference to the aircraft instruments. Without a visible horizon the AC was unable to maintain a steady attitude which has caused significant attitude, and consequently altitude and airspeed excursions. The co-pilot was actively monitoring the attitude indicator and was providing timely attitude callouts to inform the AC of the deviations.

The AC stated that while he had one hand on the power levers, he made no conscious decision to increase power, however believes that he has instinctively pushed the levers forward. Without a conscious decision to increase power or awareness that the power had been applied, neither pilot was monitoring the engine instruments until the co-pilot recognised that the engine ITT was indicating an over-temperature condition.

Wing damage

While conducting maintenance action associated with the engine ITT exceedance the maintenance engineers identified a number of creases across the upper wings, predominately on the left-hand wing. Initial damage was found adjacent to the upper wing attachment point, spreading out towards the tip of the wing and appeared to be consistent with the aircraft having been exposed to aerodynamic stress consistent with inflight turbulence.

A detailed visual and empirical examination of the airframe was carried out and multiple damage sites identified on both wing upper surfaces, with some lesser damage on the wing lower surface. Damage was also found on the left-hand nacelle and the rubber vibration components of the engine mounts.

Level 1 and 2 inspections were subsequently carried out. No further sub-structure damage was identified. There were no indications of fuel or oil leaks that would have identified ruptured fuel tanks/tank bags, fuel or oil pipework.

The damage found on the wing skins and nacelle, while out of published limits, showed no indication of cracking of the skin or pulled rivets, although the left-hand wing had a panel adjacent to the outboard-inboard wing split that was torn at the free edge. Typically, the depth of the creasing ranged between five and ten thousandths of an inch.

A risk assessment was conducted for a flight from Richmond to the Hawker Pacific Bankstown facility, which assessed as an acceptable risk and an operational endorsement was sought and approved.

Aircrew comments

This Aviation Safety Occurrence Report has some very important learning points for all aircrew. Firstly entry into cloud with weather which is painting on the radar is to be approached with a level of caution. Weather avoidance and or mitigation is a central tenet to getting the mission done safely. Acknowledging the AC's concerns, hindsight has proved that a more cautious route would have saved more time in the long run.

Secondly and significantly the CRM used in this situation could have been better. The co-pilot suggested a different route to the AC. The AC was concerned with timeliness and not knowing how far the weather went. My appreciation is that the AC did not fully bring along the co-pilot in this decision making process and/or minimised the co-pilot's input.

Thirdly and following on from the second point is one of backing up each other in a pressure situation and acting as a crew. The application of power in a descending aircraft in moderate to severe turbulence allowed the ITT to overtemp and this is a direct result of the AC setting a high power setting and not checking the power/temperature ratio. The main job of the co-pilot in this situation is to back up the AC when setting powers and this has not occurred.

The result from this lack of appreciable CRM is an aircraft that is now going through significant (structural) maintenance to return to flying and an engine which has been removed and sent for overhaul.

Decision making and CRM remain a core captaincy skill, which aircrew need to continue to develop.

DOSSIER

Photo: Sgt Pascal Quille

When FLIGHT SAFETY meets the CHAIN OF COMMAND

By Lieutenant-Colonel Martin Leblanc, Chief Investigator, Directorate of Flight Safety, Ottawa

I often get questions from the Wing Flight Safety Officer (WFSO)/ Unit Flight Safety Officer (UFSO) asking what is allowed as far as the interaction between a flight safety investigation and the chain of command. The purpose of this article is to clarify the situation, and therefore would behoove all WFSOs/UFSOs and the chain of command to read and understand.

Flight safety (FS) investigations are actually Airworthiness investigations that are conducted under authorities listed in the *Aeronautics Act*[1]. The Act requires the Minister of National Defence (MND) to designate a member of the Canadian Armed Forces (CAF) or an employee of the Department of National Defence (DND) to be the Airworthiness Investigative Authority (AIA). On 26 Jan 2015 the MND designated the officer holding the position of Director Flight Safety (DFS) as the AIA, Colonel Steve Charpentier. Furthermore, the Act stipulates that the AIA may designate investigators to investigate any FS occurrence on the AIA's behalf and those investigators shall report to the Authority (AIA) with respect to the investigation. These legal terms, in practice, specify that when a WFSO/UFSO is conducting an investigation he/she works for and on behalf of the AIA. This is a critical element in keeping FS investigations independent and impartial, thus free from any outside influences.

"These legal terms, in practice, specify that when a WFSO/UFSO is conducting an investigation he/she works for and on behalf of the AIA. This is a critical element in keeping FS investigations independent and impartial, thus free from any outside influences."

Now what is the relationship between the WFSO/UFSO and their Commander? Just like Director Flight Safety being double-hatted as both DFS and the AIA, a WFSO/ UFSO is also required to work on two fronts. The first is the conduct of flight safety investigations on

Continued on next page

behalf of the AIA. The second is to act as adviser to their respective Commander in terms of running/ managing the FS Program and providing expert advice as to how to mitigate safety risks. We often refer to this second task as advising and managing the safe behaviour program. In essence, the chain of command has a responsibility to the FS Program and the WFSO or the UFSO is managing the program on behalf of the Commander.

> ***"So, what can a Commander do and not do? In short, the Commander is allowed to read or be briefed on an investigation report before it is made public (i.e. releasing a Supplementary Report)."***

Now back to the original question: what is allowed as far as the interaction between the FS investigation and the chain of command? As stated above, FS investigations shall be conducted independently and free from outside influences. That does not preclude a WFSO/UFSO from providing some information to their Commander but there is some information that shall not be communicated by law. For example, factual information can be communicated (see the Airworthiness Investigation Manual for a complete list of delegated authorities[2]). But the Act also clearly states that some information is privileged and shall not be shared. Examples of privileged information are the statements and the identities of the persons who made the statement, on-board recordings (e.g. cockpit voice recorders) and representations made by Parties of Direct Interest to the AIA or designated investigators on draft reports.

So, what can a Commander do and not do? In short, the Commander is allowed to read or be briefed on an investigation report before it is made public (i.e. releasing a Supplementary Report). Simply put, our goal is to enhance safety - not to keep our respective Commander in the dark. Upon his/ her review of the report, a Commander might ask the WFSO/UFSO to further explore an area that requires more investigative work. He/she might also ask for a new line of investigation to be examined if not yet covered in the investigation report. Some minor wordsmithing/editing is permitted, as long as it is not done with the intent to make the report less critical of the unit or the CAF at large. These would be in the form of suggestions for consideration by the WFSO/UFSO in the final report. Ultimately the WFSO/UFSO decides if the investigation reports should be amended. When investigations are conducted thoroughly followed up by well-written reports, at that point, there should remain little doubt as to the validity of the Cause Factors and Preventive Measures. A Commander shall never ask for a Cause Factor and/or Preventive Measure to be altered or removed from the report. This would be considered interference with the investigation.

In conclusion, FS and the chain of command have to work in conjunction. Our common goal is to accomplish the mission at an accepted level of risk. Often the chain of command may be perceived as focussing solely on mission accomplishment while the FS Program may be perceived as wanting to eliminate all risks. In the end, everyone has a role to play in the prevention of accidents but it is first and foremost a leadership responsibility. In a nutshell, prevention is a chain of command responsibility while investigation is an AIA responsibility. Both help optimize the CAF FS Program and therefore cannot work in isolation from one another. Lastly, when in doubt, whether you are a WFSO/UFSO or a Commander, do not hesitate to call anyone at DFS. It will be our pleasure to guide you through any issues that may arise.

References

1. The *Aeronautics Act* is available on the Internet at: http://laws-lois.justice.gc.ca/PDF/A-2.pdf

2. A-GA-135-003/AG-001 – available on the DFS DWAN site at: http://airforce.mil.ca/caf/vital/fltsafety/pubs/aga135003-eng-v1-30dec2014.pdf

FIFTY YEARS of towing and still learning!

By Captain Renaud Durand, Canadian Forces School of Aerospace Technology and Engineering, Borden

I was appointed to be the next Flight Safety Officer (FSO) at Canadian Forces School of Aerospace Technology and Engineering in Borden Ontario. Like most people, I wondered what I would be doing as the FSO in a training environment with no flying. Then the day came when the outgoing FSO told me an investigation was underway!

Apparently, a left-hand CT114 *Tutor* nose gear door panel was damaged following a tow job. I was shocked. I had worked with the CT114 in Moose Jaw for three years and I could not figure out how this could happen. Even trying to attach the bar to the aircraft blind folded would not do the trick; the doors are simply too high above the bar to make contact. I got frustrated. How is it that after 50 plus years of towing CT114s, do we still find ways to damage the aircraft during this elementary task? I regained my senses. After all, this was a training environment and certainly a tired or distracted pilot would be for the most part at fault for this mishap. I was really interested in finding out what on earth had happened.

Apparently there is a small extension built into the tow bar that prevents technicians from removing the landing gear safety pin. It appears that this extension got close to the nose gear door when the bar was moved almost parallel to the wings. During the incident, the pilot moved the tow bar almost parallel to the wings and when he let go of it, the bar stayed up floating in the air like magic! Unbeknownst to him, the extension was actually sitting on the nose gear door which had prevented the bar from falling. Like any keen individual, the pilot proceeded to push down the bar down to make sure it lay [normally] on the tarmac. In doing so, it damaged the nose gear door panel. "But how did the extension make contact with the door in the first place?" I calmly asked. "Certainly this is not the first time we moved the bar parallel to the wings". As it turns out, it was one of the rare times the bar was moved in this position whilst [another] pilot was sitting in the cockpit. His weight was sufficient enough to lower the aircraft nose bringing the door closer to the extension and allowing contact with the tow bar.

The mystery was solved. It was then that I realized two mistakes I had made. First, I thought we knew everything there was to know about the CT114 but apparently, even after more than 50 years of towing it we still have not fully explored all the risks. Second, I immediately thought a pilot was the sole cause of the incident. Even the most experienced technician could have made this mistake which could have resulted in the same type of damage. Although I wasn't fully immersed in Flight Safety at the time, I realized afterwards that it was the unit's professionalism and positive attitude towards Flight Safety that made it possible for us to determine what had happened which in turn, allowed our section to inform other CT114 users to ensure this particular incident didn't get repeated… at least throughout the next 50 years!

Photo: MCpl Robert Bottrill

BURIED BY A CHINOOK

By Captain Blair Wilhelm, Royal Canadian Dragoons, Petawawa

As members of the Canadian Armed Forces, we often employ hasty Helicopter Landing Sites (HLS) for *Chinook* and *Griffon* helicopters on exercise and on operations. Challenges arise when there are individuals who are not completely familiar or comfortable with working in or around aircraft, which can lead to potentially unsafe situations.

While on exercise in the fall of 2014, as a member of B Squadron of The Royal Canadian Dragoons, I was to be inserted into to the training area by a *Chinook* in order to conduct dismounted reconnaissance on several objectives which were to be assaulted by infantry companies. We had trained with 450 Tactical Helicopter Squadron in order to familiarize ourselves with the embarking and disembarking procedures (combined with enough kit for a three day task). As the platoon commander, it was my responsibility to ensure that all of my troops understood the procedures and behaved in a safe manner while in or around the aircraft. As much of the platoon, including myself, had never worked with *Chinooks* before, I led several practices up to the morning of the flight to ensure the smooth and safe execution of the task.

The squadron was divided into three separate chalks, with each chalk getting dropped in separate locations in the training area. Also present was a media crew taking photos and video for recruiting and the unit padre who were to accompany the second chalk, as they had trucks waiting at the drop off locations to pick them up after the flight. While waiting to depart, I was casually chatting with the padre when we both realized that his chalk had left to make the 300 metre trek up to the HLS for pick up. When we realized his group was gone, slight panic set in as the padre realized he was about to miss his flight. I advised him to run and catch up. He made it about 75 or so metres from the helicopter, somehow getting past the ground crew, running directly towards the *Chinook*, which started to take off. All I could do was yell to get down as the aircraft, with rotors tilted toward the helpless chaplain, flew towards him. He dropped to his chest, and was buried by snow as the propellers kicked up a huge drift of snow in his direction. Luckily no one was hurt; however, it became very clear to me how important it is to respect ground crews and safety procedures when dealing with these very large and potentially very dangerous aircraft.

Because of this close call, I was even more vigilant when it came time for my platoon to leave. In stressful situations, training can sometimes be forgotten or ignored. It becomes even more important as leaders and mentors to ensure that we prepare our subordinates, and ourselves, to ensure that we do our jobs safely and properly.

Photo: DND

WHEN IN DOUBT, SPEAK UP!

Photo: MCpl Robert Bottrill

Photo: MCpl Robert Bottrill

By Master Corporal Justin Hill, 431 Air Demonstration Squadron, Moose Jaw

Being a member of the Canadian Armed Forces Snowbirds Air Demonstration Team since January of 2010, this past summer I saw myself deployed as the detachment Aircraft Structures/Aircraft Life Support Equipment technician. This story will draw on experience from that deployment.

Being part of the coordinator team for this kind of an operation is quite dynamic, the kind of job where nothing remains constant and change happens at the blink of an eye. Anything can happen to break your routine, which can cause for some things being missed or unnoticed if you don't pay attention to detail, or speak up when you think something isn't right.

After a mid-week show, we were departing as a 2-ship formation, two hours ahead of the team to make it to our next destination in Ontario. The weather wasn't great: cold wind and rain with low ceilings – the kind of environment that can lead to distractions. As we taxied to the runway, a small cockpit snag came up, so the pilot asked the tower if we could hold at the button of the runway to troubleshoot it. We would ask for clearance to takeoff once it was cleared. Through discussion with the pilot in the other aircraft, we were able to troubleshoot the snag and deem the aircraft serviceable, allowing us to depart without any further incident.

As the pilots spoke to one another and prepared to takeoff, it occurred to me that we had not been granted clearance for takeoff, but I didn't speak up, assuring myself that the pilots knew what they were doing. I had not considered that being so busy dealing with the snag that they may have forgotten to ask for clearance. Perhaps they had thought we already had it. I mean, I'm just a technician after all; the pilots know what they're doing. Silly me. Once we departed and made our heading towards the next destination, I queried the pilot if he had received a clearance. At that moment he realized that he indeed did not ask for it and that we had taken off without it. The Flight Safety paperwork had been raised and was waiting for us when we landed.

I learned then as a relatively junior Corporal to never assume that people have all the information or that they have everything 'covered' because of their position, role or rank. Sometimes people just need a reminder, especially in the case when distractions from outside sources can lead to mistakes.

Checklist Discipline

By Major Brian Perigo, Directorate of Flight Safety 2-3, Ottawa

I was a young second tour CC130 *Hercules* crew commander during a late night summer callout to search for an Emergency Locator Transmitter somewhere near the mid-Atlantic. The distance from the coast and night conditions necessitated maximum fuel and a full load of illumination flares to maintain any significant on-scene loiter time.

When I arrived at the hangar, the Air Combat Systems Officer had flight planned and the First Officer (FO) and Flight Engineer (FE) were now at the aircraft. The FO was a newly minted junior pilot, so I was elated to see that the most experienced FE on squadron was part of the crew. I settled in the left seat to conduct pre-flight checks. Shortly before starting the engines, a young unqualified observer Search and Rescue Technician (SAR Tech) came on the flight deck and asked me if he could sit up front to observe our takeoff. I immediately agreed but made a point of discussing sterile cockpit procedures on the intercom during the takeoff.

After an uneventful max-weight takeoff, we picked up a vector towards our flight-planned routing. Shortly thereafter, the FE advised that the aircraft would not pressurize. After the requisite bleed air checks and an unsuccessful analysis, we decided the only course of action was to abort the mission as we didn't have adequate fuel reserves to maintain 10000 ft. or below. The rescue center was informed, and a new clearance was obtained as we setup for a 12500 kg fuel dump in order to land at maximum landing weight.

Just as we were setting up for the dump, a tranquil edgy voice came on the intercom. It was the observer SAR Tech who had since been sitting on the bunk. "Sir" he said, "I really don't mean to interrupt, and this may sound silly, but does that big hole in the ceiling have anything to do with our problem?" All heads turned at once to the rear of the flight deck to see the gaping hole where the overhead hatch cover should be. It was sitting on the floor beside the FE at the wall of the cockpit.

Without a word, the FE got out of his seat, wrestled the hatch in place and advised me the aircraft was pressurizing. His face was beet red.

During the ensuing debrief, we all agreed that the checklist had been followed, the challenge and response to "exits" had been heard, but that he didn't physically look up and confirm the hatch. Complacency had reared its ugly head, and four qualified members on the flight deck had not noticed. The extra noise had been muffled by the quality headsets we were all wearing.

Missing the hatch presented no danger, but the message I want to convey is that of checklist discipline, crew cooperation and focus during operations. The missing of critical checklist items due to 'lip service' has been responsible for many documented catastrophic events in the past. In addition, the possible return to base, unnecessary fuel dump and the ensuing delay attending a distress call could have been very embarrassing or worse. As well, don't forget that all members of the crew have a voice, and that empowering your crew to stay involved is a key characteristic of a great crew commander.

Photo: MCpl Roy MacLellan


Photo: Air Task Force, DND

Safe Habits

By Warrant Officer René Perron, 438 Tactical Helicopter Squadron, Montreal

Where do we learn good work habits? Unfortunately, we still learn them from our mistakes or the mistakes of others. We learn our trades from lesson plans that are carefully crafted and revised to perfection. Our instructors study the tiniest gesture in the task to be evaluated. But who has the time to teach all the little gestures that form work habits? More often than not, no one.

About twenty-five years ago, on a morning like any other at 409 Tactical Fighter Squadron in Baden, while starting up a CF188 *Hornet*, an utterly routine task I had been doing for some time, I was assigned the duties of technician number two. My task involved checking certain components and pressures around the right side of the main landing gear. Then I was to do the same task on the left side. Obviously I always had to pass in front of the front landing gear and remain at a safe distance from the engine air intakes. I no longer remember the name of the technician who had been assigned to work as technician number one, the man who stood in front of the aircraft in constant visual contact with the pilot, but I will remember the expression on his face for the rest of my life.

While I was crossing from the right side to the left side, I noticed that the CF188 was making a lot more noise than usual. I suspected that something was wrong so I looked towards the front and it was then that I saw my number one with an expression on his face that I will never forget. I realized that I was between the central pylon and the front landing gear, much too close to the running engines. Being highly aware of the danger, I put my hands on my hearing protectors so they wouldn't get swallowed up and crossed over as quickly as possible.

We were the only two witnesses of the scene. No breakage, no flight safety report was opened. Since I had had a terrible scare, I wanted to make sure I never made that mistake again. From that time forward, when moving from one side to the other, I would always follow the same path. Whether it was for a maintenance job or an engine start-up, and whether or not the engines were running, I would only pass in front of the landing gear. I was lucky. I learned from that experience.

I've never hesitated to talk about that experience with my work colleagues, especially new arrivals. And anyone who has experience shouldn't hesitate to give advice, especially on the little things that aren't taught and that may make all the difference.

DFS' COMMENTS:

This article is analogous to circumstances surrounding an unfortunate accident back in 1986 whereby a fuel bowser technician was killed after being ingested into an idling CF188 engine. At the time, the pilot and a servicing technician were focused on the left side of the aircraft, trying to solve an unserviceability issue and were unaware of the bowser technician who had approached from the right side of the aircraft towards the engine intake. He was attempting to ground the aircraft prior to commencing a hot-refuel when he was sucked in the engine. (FSOMS #33533) Recent incidences involving technicians approaching the CF188 in Trenton (Sept '15) and Greenwood (Jan '16) had the potential of repeating the same fatal error. It is imperative that, prior to engaging in operations with unfamiliar aircraft, all ground crew become thoroughly acquainted with the danger areas. Further, aircrew must equally be vigilant and monitor for non-standard or unsafe practices of ground personnel around their aircraft during ground operations.

Photo: MCpl Pierre Thériault

To report or not to report

By Captain Phil Tate, 405 Long Range Patrol Squadron, Greenwood

I was a student in Moose Jaw getting my first taste of jet flying in the CT155 *Hawk* and was still in the early stages of the syllabus where everything was still very new and exciting. It was still winter in the Saskatchewan prairies and so full 'bunny suit' winter-wear was required for one of my early clearhood sorties. This made the normally tight fit of the *Hawk* even tighter especially for taller people like me. As a result it was a little more difficult to visually determine if the ejection seat harness was secured properly during strap-in. Everything felt like it was good to go and I had heard the definite "click" of the harness locking into place. Off we went completing the necessary syllabus maneuvers in the air. At some point during the flight I felt like the left side of my harness was looser than it had felt earlier but I didn't think much of it. It wasn't until after shut down when I went to unstrap that I noticed that my left shoulder belt was no longer locked into the quick release buckle (QRB) and was floating freely on my lap, being held in place only by the leg strap and my winter clothing. I could not believe that I had just flown in an ejection seat airplane and never realized that I was un-buckled – a fatal result if ejection had been necessary. The worst part was that I was certain I had buckled in properly but now I was a little unsure as to how the restraint had become unlocked other than by neglect on my part.

As a student I decided not to tell my instructor for fear that it would result in a bad grade or other disciplinary measures. I did talk to my peers and the idea of writing up a flight safety incident report was floated but under the demands of course it quickly drifted to the back of priorities. I did change my strap-in procedure to ensure the belts were locked by giving them a hard tug prior to tightening.

Fast forward 2-3 weeks later: During one of the morning briefs there was a flight safety presentation about another instance of a harness unlocking and how the current QRB has the ability to give a 'false lock' indication by making a discernable click without actually locking into place. I couldn't believe that what I had experienced was the exact situation that was now being described in the brief. I learned two very important lessons that day: The first lesson was that if you experience something that causes you to think about a flight safety related item, chances are someone else has experienced it as well or will in the near future. The second is that if your immediate thought is that a flight safety incident should be reported to help others learn from the experience it is best to see it through. Pass the information along so that all members get the necessary information to do their job safely and effectively.

From the Investigator

TYPE: **CH12419 *Sea King***
LOCATION: **RAF Odiham, England**
DATE: **13 October 2015**

While at RAF Odiham, The main landing gear tires were found to be low. A dual-pressure inflation kit was used, the low side reported to be set for 60 psi. The high pressure side was reported to be around 500 psi. Normal tire pressure is 105 psi.

During inflation, the left hand inboard tire ruptured. Rim fragments caused damage to the left hand and right hand landing gear as well as the fuselage.

The investigation is focussing on human factors procedures for the use of unfamiliar equipment.

From the Investigator

TYPE: CT155219 *Hawk*
LOCATION: 4 Wing Cold Lake, Alberta
DATE: 28 January 2016

In the late afternoon, 28 Jan 2016, the pilot of a Canadian Hawk Mk 115 was performing a Cuban 8 manoeuvre. During the inverted 45 degree portion following the first loop the pilot's unrestrained publications bag drifted upwards (relative to the cockpit) and aft. The pilot then rolled upright and pulled 5g to complete the Cuban 8. During the 5g pull, the bag dropped down towards the aft portion of the right console and struck the Miniature Detonation Cord (MDC) firing unit (red circle in the photos) with enough force to activate it, fragmenting the canopy. The pilot ceased manoeuvring, slowed the aircraft and RTB without further incident.

The pilot received minor injuries from the MDC combustion products and canopy fragments and there was significant damage to cockpit equipment and external airframe structures. The engine ingested some of the canopy fragments but only received minor damage.

The investigation so far has not identified any technical issues with the airworthiness of the aircraft or the fleet. The investigation is focusing on operational and human factors, primarily the procedures and requirement to carry and store a publications bag in the cockpit. The investigation is also looking at possible ways to protect the MDC firing unit from being inadvertently activated.

This photo is of a serviceable MDC firing unit in the front cockpit of a different aircraft.

From the Investigator

TYPE: **CT156115 *Harvard II***
LOCATION: **Hillsboro, Oregon**
DATE: **12 February 2016**

Two Harvard II Instructor Pilots (IP) from 15 Wing Moose Jaw were conducting a night cross country flight to Hillsboro Airport Oregon, USA. (IP1 – front seat and Aircraft Commander, IP2 – rear seat).

On final approach to Hillsboro airport, IP2 selected the landing gear down and noted the Nose Gear (NG) and Right Gear (RG) indicated down and locked, but the Left Gear (LG) indicated an "unsafe" condition, in this case indicating that the LG was not down and locked.

The Landing Gear Malfunction procedure was completed as per the Checklist. At no time during the procedure did the LG indicate down and locked. When the landing gear was cycled up as per this procedure, all gear indicated up and locked. In accordance with the checklist, a gear up landing was conducted.

IP1 flew a full flap, gear up landing. During the flare, the Power Control Lever was selected off to prevent engine damage. The landing was completed successfully on a bare and wet runway at Hillsboro airport.

The investigation is focussing on the technical functionality of the landing gear system. To date it has been determined that the LG up lock switch failed internally, preventing completion of the electrical circuit to ground. A failure of this type will not allow a down and locked indication in the cockpit even if the gear is physically down and locked.

Photo: DND

Photo: DND

Epilogue

TYPE: CC130342 *Hercules*

LOCATION: Naval Air Station Key West, Florida

DATE: 21 February 2012

During a touch and go at Naval Air Station Key West just prior to the aircraft becoming airborne, the Loadmaster, who was seated in the rear of the cargo compartment, heard an electrical buzzing sound and observed an orange jet-like flame shoot across the cargo ramp floor. He unbuckled his harness and was reaching for the fire extinguisher when an expansive orange fireball erupted, causing him to protect his head with his jacket. Once the fireball receded, he alerted the crew to the fire and moved forward to escape the heat and smoke.

Concurrent with the fire alert, the aircraft became airborne and reached 10 feet in altitude above the runway. With sufficient runway remaining, the Flying Pilot landed straight ahead and aggressively stopped the aircraft while the Non-Flying Pilot notified Air Traffic Control. Once the aircraft came to rest and the engines were shut down, all nine crewmembers quickly egressed and moved upwind of the aircraft. Crash Fire and Rescue services responded and expeditiously extinguished the fire. The aircraft was extensively damaged and one crewmember received a minor injury.

The investigation determined that routing and clamping deficiencies in a modification to install ground test connections to the auxiliary hydraulic system, resulted in chafing between the hydraulic pump motor power wire and a pressurized hydraulic flexible hose. Electrical arcing between the wire and the hose resulted in a pin-hole breach of the flexible hose, release of hydraulic fluid under high pressure, and initiation of the fire.

Preventive measures included redesign of the modification, as well as changes to the modification process to include specialist review of wiring and hydraulic lines to ensure proper routing, support and protection from chafing, abrasion, harsh environments and damage from anticipated hazards. Preventive measures also included measures to educate and create awareness of the hazards associated with chafing.

A number of collateral observations were made and preventive measures recommended, including use of the dual layer principle for aircrew fire protection, policy for maintenance technicians flying as crew members, and improving communication between airworthiness authorities when imposing and lifting operational restrictions.


Photo: DND


Photo: DND

Ukrainian officers receive Flight Safety training in Winnipeg under Operation UNIFIER

Operation UNIFIER is Canada's contribution in support of Ukrainian forces through capacity building, in coordination with the United States and other countries that provide similar training assistance. The provision of basic flight safety training to some Ukrainian officers is one of the seven lines of activity for Op UNIFIER. The selected officers attend English language training in Saint-Jean-sur-Richelieu before proceeding onto the Flight Safety Course (FSC) in Winnipeg. Captain Anton Genov and Captain Vitalii Fedoryshyn from the Ukraine Air Force were the first two officers to conclude this training when they attended the FSC from January 19 to 28, 2016.

Ukrainian Air Force Officers, Captain Vitalii Fedoryshyn (front left) and Captain Anton Genov (middle second row) are absorbed in class amidst Canadian Armed Forces personnel during a Flight Safety Course in Winnipeg, Manitoba from 19 to 28 January 2016.

Captain Anton Genov (centre left) and Captain Vitalii Fedoryshyn (far right) flanked by Colonel Steve Charpentier, Director Flight Safety (far left) and Lieutenant-General Michael Hood (centre right), Commander Royal Canadian Air Force during their visit to Ottawa on 1 February 2016.

Chief Pilot of Winnipeg Police Services certified on Canadian Armed Forces Flight Safety Course

On 5 December 2013, Mr. Malcom Murray, Chief Pilot for the Winnipeg Police Service (WPS) Flight Operations Unit became the first pilot of any Canadian police aviation unit to be qualified on the Canadian Armed Forces (CAF) Flight Safety Course (FSC).

On 19 October 2015, Major Chuck Halikas, 17 Wing Flight Safety Officer, had the honor of presenting Chief Pilot Murray with the Winnipeg Police Service Flight Safety Badge at 17 Wing Winnipeg.

The Winnipeg Police Service recently developed their own model of the Flight Safety (FS) badge, closely based upon the original CAF version. With their new black FS badge, Chief Pilot Murray and any future flight safety specialists are easily identifiable.

The WPS and 17 Wing have an agreement in place allowing the WPS helicopter to operate from the 17 Wing flight line. It was a natural next step to share the strong FS culture of the CAF with their partners and tenants at the WPS by opening the FSC to WPS candidates. The WPS expects to have another member certified in the next few months.

Photo: DND