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AVIATION SAFETY LETTER

IN THIS ISSUE...

- Risks and Danger for Helicopter Pilots
- Powering Your Ultralight: A New Engine Case Study
- How NAV CANADA Communicates Impact to System Capacity
- Mental Health and Crew Resource Management
- Threshold Concepts
- Common Problems and Essential Questions for Automation in Aviation

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Cover photo submitted by Craig Walker, 1978 Grumman Tiger

Canada

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Table of Contents

Page

Risks and Danger for Helicopter Pilots 3
Powering Your Ultralight: A New Engine Case Study 7
How NAV CANADA Communicates Impacts to System Capacity 9
Submission of *Aviation Safety Letter* (ASL) articles 13
Mental Health and Crew Resource Management 14
Threshold Concepts 15
Submission of Instructor's Corner Articles 18
Common Problems and Essential Questions for Automation in Aviation 19
Civil Aviation Documents Issued Recently 22
TSB Report A23P0091—Collision with Terrain 24
TSB Report A24O0048—Tail Rotor Strike During Ground Handling 29

TIPS AND TOOLS

Risks and Danger for Helicopter Pilots

by Manfred Harder, Royal Canadian Air Force (RCAF) (retired)

This is the second of a series of articles on the typical dangers for helicopter pilots. In this series, we will explore the risks involved with takeoff and landing, weather, approaches and night flying.

Mast Bumping

This is one of those topics that causes student pilots or long-seasoned bush operators to start wondering if their wills are up to date: another one of the many misunderstood things in aviation that we need to understand to fly safely but should not be afraid of.

Mast bumping is a concern to those of you flying a teetering rotor head: those that are supported under an articulated, rigid or some other design rotor head read along anyway. Teetering rotor hubs vary amongst differing ships, in size or design. All have a teetering hinge. Robinson adds a coning hinge, whereas Bell achieves coning solely through bending of the blades. The odds of being under a teetering head are very good, since the Robinson R22, 44 and 66 are all included, as well as what may be the most recognized light helicopter—the Bell 206—in its various iterations, and now followed by its offspring, the 505. For those with bigger blades, there is the venerable Huey/Iroquois, and its lethal cousin, the Cobra. So as not to leave out the senior crowd, there is the Bell 47, and there may be others as well. That is a lot of helicopters; you have probably flown one or might fly one in the future.

Figure 1:"NTSB" shows the failure mode of the mast just below where the static stop would be touching. The mast bumping occurred with this Bell 206 rotor from the NTSB WPR19FA109 report aircraft

Figure 2: "B206 head" is the underside of a normal Bell 206 rotor head. Finger at the bolted static stop and next to the interference area between the stop and the mast

How did we learn of this unique problem? Well, time to put on your jungle fatigues and OD green flight helmet. The Vietnam War was well underway, and the multitude of aircraft types engaged was staggering, but what does everyone associate with that conflict, the workhorse UH-1/Huey? Every GI's favourite sound was that thumping rotor whop to take them away from the hell of war. Things, at first, seemed to be going well in using this new form of troop and supply transport, MEDEVAC and even in attack roles. Unfortunately, losses began increasing and not always to the usual and expected enemy action, but from unexplained rotor system failures! Crash investigations found the rotor head was often some distance from the airframe; the mast had been sheared off! Was there a design failure, or did the 20ish-year-old pilots find a new way to overstress the machine and kill everyone in the process? With the US Army being the size it is and having the resources and expertise to carefully investigate accidents, yet there were some 7,000+ UH1s that flew over 10 million hours in Vietnam, and almost half of them were destroyed—a daunting task for sure!

So, what did the US Army with the help of Bell, the helicopter manufacturer, discover? The aircraft had an unloaded rotor system in several scenarios: 1) an attempt to maintain nap of the earth (NOE) during low G pushovers, 2) poorly coordinated wingovers and 3) turbulence.

The reason this situation becomes dangerous is that the tail rotor thrust, which is above the center of gravity, causes a roll to the right in the low G condition. Left cyclic input does not yield much roll correction, because the main rotor system is producing little thrust. The pilot applies increasing amounts of cyclic to right their ship, only to have the main rotor hub static stop, violently contact the mast first on one side and then 180 degrees later on the other side of the mast, usually causing a failure of the mast and separation of the hub from the aircraft (the bumping you

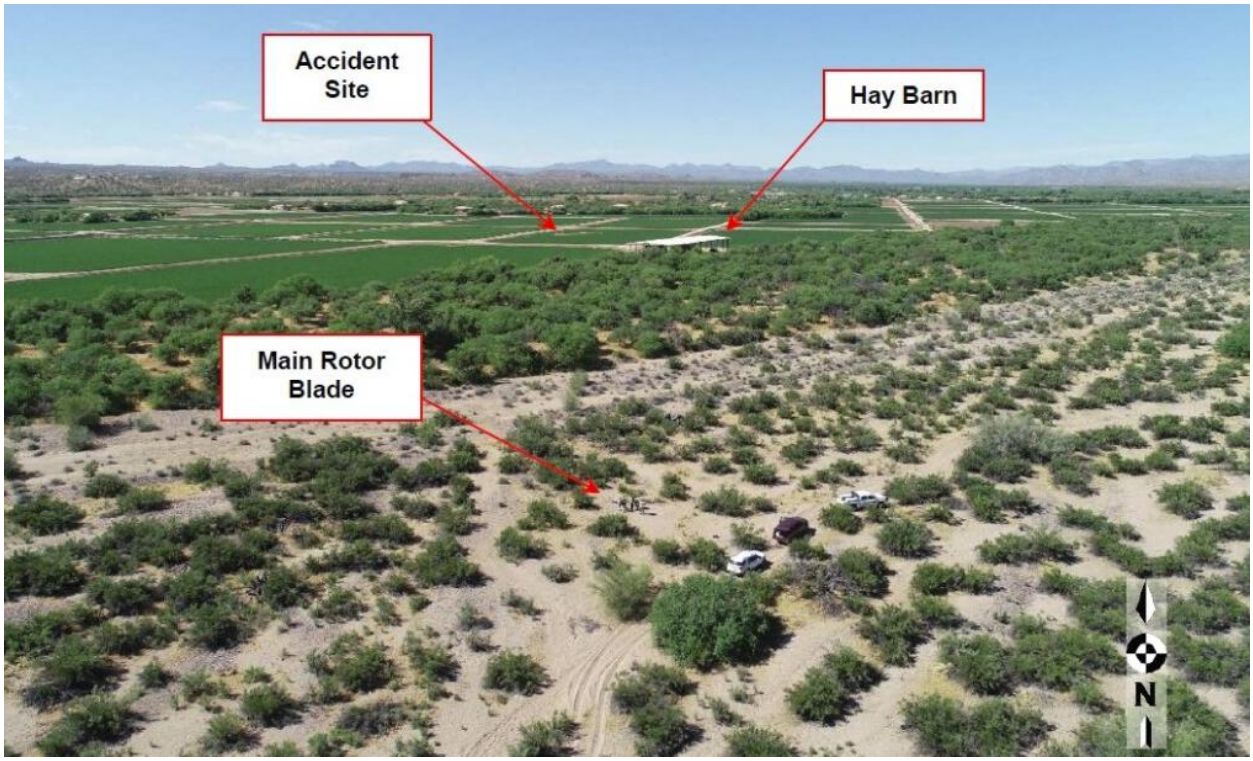

Figure 3: "Debris field" shows that the main rotor blade has separated from the NTSB WPR19FA109 Bell 206 and is some distance from the crash site. The aircraft was not complete upon impact. This was similar to the UH1 crashes in Vietnam that alerted the US Army to the mast bumping problem.

may feel during sloped landings is a mild cousin to the low G scenario, but any contact of the stop to the mast is undesirable). Helicopters are especially dangerous to transitioning airplane pilots that use the stick instead of the collective to change vertical direction.

The correct technique to recover from this low G right roll is to reload the disk with some gentle aft cyclic. Then, when roll control is established through positive rotor system lift and hence positive G, apply gentle left cyclic. Of course, the real lesson to be learned is to avoid situations that cause low G (no cyclic pushovers, if entering areas of turbulence slow down, and finally, leave wingovers to the military). It is worth noting that since the onset of the awareness and training of mast bumping, Bell has not seen this failure in the recallable past.

Robinson helicopters had some similar mishaps and commissioned a study to see if their rotor system was inherently at risk to mast bumping. The studies showed that it is equally as safe as other teetering designs, if flown correctly. The Federal Aviation Administration (FAA), however, mandated some updated training syllabuses under SFAR 73 to make pilots more aware of dangers of low-G flight, amongst other topics. It did stress to never use a cyclic pushover, to use collective to initiate descents and to slow in turbulent conditions.

An interesting difference to the Bell situation is that the tail rotor on the Robinson is not as displaced from the center of gravity; therefore, it does not cause as much right roll as on the tall UH1 tail during low G. The Robinson models however have a single sided horizontal stabilizer on the right side of the tail boom opposite the tail rotor. This stabilizer with its downward force causes a similar rolling moment in low-G flight to the UH1 situation. The similar recovery technique will mitigate this problem: gentle aft cyclic to load the disk then correct the roll with left cyclic.

Robinson went a step further in its goal of continued safety improvement, including that outside of the normal flight envelope, all new Robinson helicopters have a double-sided horizontal stabilizer mounted on the tail boom forward of the tail rotor, which reduces the rolling effect in low G. Robinson has made this design available as a retrofit to earlier aircraft.

If you fly an aircraft with a teetering head, or even if you don't, reacquaint yourself regularly with your AFM. Discuss various situations with an instructor or check pilot, and fly with them. They often have safe and appropriate techniques to stimulate the learning process. △

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Take Five… for Safety—Passenger Safety Briefings: Why, When and How

Review what to include in passenger safety briefings and how to address common issues than can arise

Powering Your Ultralight: A New Engine Case Study

by Gord Dyck, Director of UPAC and member of the Ultralight Working Group

Basic ultralight aircraft (BULA), with their low gross weight of 1200 lbs, have primarily used non-certified engines as powerplants. The majority of certified engines are too heavy for the ultralight aircraft, cost too much and burn expensive aviation gas (100 low lead). Ultralight aircraft builders have, until recently, been reliant on two-stroke engines, predominantly from Hirth and Rotax. These engines offered high thrust to weight; albeit,at the expense of fuel consumption (a typical Rotax 503 or 582 burns four gallons an hour of automotive fuel at cruise power), and they offer less reliability than four-stroke engines. A Rotax 582 at 65hp and just over 100 lbs provides excellent power to weight. However, all two strokes are very sensitive to air/fuel/oil mixture and require constant carburetor maintenance and attention to their exhaust gas temperatures if they are to be flown safely. Having flown many hours behind a Rotax, my new ultralight project required a powerplant. With the announcement that both Hirth and Rotax were no longer manufacturing two-stroke engines, my latest BULA build needed a new powerplant. Ideally, I was looking for a four stroke to reduce fuel consumption, enhance safety and eliminate carburetor maintenance.

Original engine bracket

I found a new engine that seemed to fit the bill: a two-cylinder V-twin 800cc, 60hp, four-stroke fuel injected engine with electronic ignition that weighed within a few pounds of a Rotax 582. The engine is an all-terrain vehicle (ATV) engine that has been in production for years, with the manufacturer making thousands of engines a month for the recreational vehicle market. As the US distributor LSA Aeromarine said, their engine was "red neck proven." So, I proceeded to purchase the engine and install it into the airframe. The distributor was in the process of installing the new engine on his personal sport aircraft Merlin concurrently with us installing the engine on my build. Much to our chagrin, we were leading the distributor in developing the installation procedure. People in the ultralight community are much more pilot/builder types, unlike the majority of the general aviation pilot community, who are limited by regulations with their certified aircraft. Assisting with the installation was an Argo design engineer, who routinely works with these engines and their wiring harnesses. Together, we decoded the Delphi computer harness, determined the fuel pressure the engine was happy with and installed the Ace aviation belt reduction drive that replaced the continuously variable transmission (CVT) the engine normally was attached to.

The engine started with the turn of a key, just like your ATV. The initial engine run ups indicated that the engine mount as designed for the ATV/Merlin wasn't fit for purpose on my application. There was too much vibration in the mount. The diagonal upper engine mount was replaced with a pair of diagonal mounts, one on each side of the engine. These shock mounts provided the rigidity necessary. The Merlin exhaust system wouldn't work with my cowl configuration, so I elected for a pair of straight pipes. The Mk1 stacks sounded like an angry Harley-Davidson, so these were modified to a single pipe feeding a cylinder with baffles and three stacks which made the sound acceptable. With these fixes in place, the first test flight was flown. The engine ran fine but required a pitch adjustment to reduce engine rpm and maximize thrust. With propeller pitch adjusted, subsequent flights demonstrated good performance from the propellor/ re-drive/engine combination. A stabilizing bracket was added to each muffler stack, as it was found that the two attachment bolts were loosening after each flight.

Re-designed bracket incorporating a bearing

After five hours of orbits around the field, the aircraft was performing well. During a slow flight practice, the engine hesitated on being asked for power, and a precautionary landing was undertaken. Inspection revealed a ring of oil inside the cowl in line with the redrive. Further investigation then discovered that the engine crank seal was leaking oil. The spinner, prop, cowl and redrive were removed. The front crank cover was removed where it was confirmed that the crank oil seal had failed. The failed oil seal was a symptom of a bigger problem: the design of the crank case cover. Instead of having a sealed bearing, this design used a bushing that supported the crankshaft. This bushing was in the process of failing. Investigation with LSA Aeromarine engineer, our own engine chap and our Argo guru indicated that the bushing was not designed to take a lateral load that the belt drive had imposed, as opposed to the ATV CVT. Clearly, this was a major engineering problem that required a fix.

A two-stage fix was developed by LSA Aeromarine. First, working with LSA Aeromarine engineer, Ben Bosma, the Ace Aviation redrive was redesigned to incorporate a bearing to take the side load from the belt drive without touching the existing engine design. A mounting bracket holds the upper pulley. This bracket was modified to incorporate a bearing that sleeved onto the engine's crankshaft. This would eliminate the side load on the engine's original bushing. A new bracket was manufactured and incorporated into their aircraft and my aircraft. This modification has entered production for the companies Merlin aircraft. The proposed long-term fix was to get Gaokin, the engine manufacturer, to change the crank cover and incorporate a proper bearing for future engines being used in this application.

With the new redrive tower in place, I flew the a/c for another two hours before the new oil seal began leaking again. The engine was removed and returned to the distributor. The distributor has gone into production with their

new redrive variant. The redrive manufacturer continues to do product improvements to their design and continued to reach out to our builders' group.

So, what did I learn going through this process? Firstly, folks in the industry are solid and want to solve problems. Although not required in basic ultralight aircraft, keeping a detailed log for airframe/engine was very useful in both discussion with the distributor and tracking development, and I would consider it a best practice. Secondly, one must be prepared to work constructively with the distributor and the design engineer to solve problems. It was essential to communicate what we discovered and what they had discovered to work towards a common goal, whether it was puzzling through the wiring harness, working on the ATV engine manual or brainstorming a fix for the crank seal and bearing. The ultralight community is one of companies, builders and flyers who combine non-certified equipment with best practice build techniques to meet ultralight aircraft requirements. Innovation has always been part of the community. It is enhanced by the sharing of information to improve the best practices, whether this is better build techniques or a more reliable engine.

From my experience, one of the roles of Transport Canada and the Ultralight Safety Working Group is to promote communications on technical best practices as the ultralight community continues to innovate, whether that is because of the retirement of a range of engines or the arrival of new technology, such as electric power. △

How NAV CANADA Communicates Impacts to System Capacity

by Stephen Little, Manager, ATS Standards Compliance, NAV CANADA

Ensuring Canada's air traffic control towers and flight service stations are appropriately staffed is a highly important, shared responsibility throughout NAV CANADA. However, in the event a situation occurs which may impact system capacity, such as the unplanned absence of an air traffic controller or flight service specialist, NAV CANADA has procedures in place to safely manage the impact and to ensure critical information is shared, within the established communication channels, with all impacted users.

Understanding those procedures; what information to expect, and within which channels this is communicated, will assist you in preparing should this occur when airspace you plan to operate in, is under the jurisdiction of an air traffic control tower or flight service station.

Reduced system capacity

When an impact to system capacity is identified at an air traffic services (ATS) unit, the NAV CANADA operations manager may, as a first step, implement procedures to reduce capacity at the impacted facility.

Notification of the reduced system capacity of an ATS facility would be communicated in a NOTAM, with specific details of any limitations detailed within it.

The following are examples of NOTAM which could be issued if a control tower within a Class C or D control zone has reduced system capacity:

Example 1: HXXXX/20

NOTAMN Q) CZUL/QACCH/IV/NBO/AE/000/030/4517N07317W006 A) CYJN
B) AAMMJJHHMM C) AAMMJJHHMMEST E) DUE TO REDUCED SYSTEM
CAPACITY: LIMITATIONS IN EFFECT WITHIN THE ST-JEAN (CYJN) CTL ZONE:
VFR TRAINING CAN EXPECT DELAYS UP TO 30MIN.

Example 2: HXXXX/20

NOTAMN Q) CZUL/QACCH/IV/NBO/AE/000/020/4531N07325W006 A) CYHU
B) AAMMJJHHMM C) AAMMJJHHMMEST E) DUE TO REDUCED SYSTEM
CAPACITY: LIMITATIONS IN EFFECT WITHIN THE MONTREAL/ST-HUBERT

(CYHU) CTL ZONE: VFR ACFT REQUESTED TO REMAIN CLEAR OF THE CTL
ZONE EXCEPT DEP/ARR

Temporary closure of air traffic control tower or flight service station outside of published hours

In rare situations, personnel absences or shortages may also lead to temporary closures of an ATS unit outside published hours.

To determine the safest course of action, the decision as to the time and the duration of the closure will be made by NAV CANADA operations, with careful consideration of the unique circumstances of each facility (e.g. MEDEVAC or other high priority flights, commercial operations, flight school activity, or anticipated weather).

Closure of an air traffic control tower or flight service station does not mean that the airport is closed, as that remains the responsibility of the airport authority.

For air traffic control towers, the airspace classification of the control zone changes to Class E, and both VFR and IFR users may operate within it. Also, where a published mandatory frequency (MF) is established, MF procedures will apply.

Notification of a closure

The following channels may be used to notify a closure to impacted users.

- NOTAM
- Broadcasts on published ATS frequency
- ATIS

NOTAM

A NOTAM may be published as soon as it is known that a closure will be occurring. At air traffic control towers, when a control zone is designated Class C or D, a statement regarding the designation of airspace will be included.

Example of an air traffic control tower NOTAM

(NXXXX/23 NOTAMN
Q) CZUL/QSTLC/IV/NBO/AE/000/040/4831N07103W005
A) CYRC B) AAMMJJHHMM C) AAMMJJHHMM EST
E) DUE TO <raison> [optional]
ST-HONORE (CYRC) TWR CLSD. MF PROC APPLY ON 118.4MHZ.
THE CTL ZONE SURROUNDING CYRC IS DESIGNATED CLASS E AIRSPACE.
IFR AND VFR ARE USING AIRSPACE.
IFR DEP CLEARANCE ARE CANCELLED.
IFR DEP CLEARANCE CTC BAGOTVILLE TERMINAL 1-888-813-8508.
FREQ UNMONITORED: 118.4MHZ, 121.9MHZ AND 121.5MHZ.
FOR INFO ATIS 124.95MHZ OR 134.8MHZ.

Examples of flight service station closure NOTAM

Example 1: N1009/19 NOTAMN
Q) CZQM/QSSLC/IV/NBO/AE/000/030/4726N06147W025
A) CYGR B) AAMMJJHHMM C) AAMMJJHHMMEST
E) ILES-DE-LA-MADELEINE (CYGR) FSS CLSD.
AD LGT AVBL WITH ACFT RDO CTL AD LGT (ARCAL).
PRE-TAXI CLEARANCE (PTC) NOT AVBL, IFR DEP CLEARANCE CTC MONCTON ACC 134.35MHZ.
FREQ UNMONITORED: 123.15MHZ, 121.5MHZ AND 243.0MHZ.
METAR AND RVR NOT AVBL.

Example 2: N1005/19 NOTAMN
Q) CZUL/QSSLC/IV/NBO/AE/000/032/4837N06812W005 A) CYYY
B) AAMMJJHHMM C) AAMMJJHHMMEST E) MONT-JOLI (CYYY) FSS CLSD. ALL AD LGT ON CONTINUOUSLY INTST 3. APPLY PROC FOR HIGH INTST APCH LGT INOPERATIVE (AIP AD 2.22.4). PRE-TAXI CLEARANCE (PTC) NOT AVBL, IFR CLEARANCE CTC MONTREAL ACC 134.65MHZ OR 1-800-633-1353. FREQ UNMONITORED: 122.1MHZ AND 121.5MHZ. METAR AND RVR 06 NOT AVBL. BAIE-COMEAU RVR 10 NOT AVBL. REMOTE AD ADVISORY SVC (RAAS) AND PRE-TAXI CLEARANCE (PTC) NOT AVBL: BAIE-COMEAU (CYBC) 118.3MHZ, GASPE (MICHEL-POULIOT) (CYGP) 122.3MHZ REMOTE AD ADVISORY SVC (RAAS) NOT AVBL: LOURDES-DE-BLANC-SABLON (CYBX) 122.0MHZ.

Broadcasts on published ATS frequency

The air traffic controller or flight service specialist will make a broadcast advising of the closure.

Air traffic control tower broadcasts

> "(unit id) TOWER IS CLOSED. THE (unit id) TOWER CONTROL ZONE IS NOW CLASS E AIRSPACE. ALL AIRCRAFT AND VEHICLES BROADCAST INTENTIONS ON FREQUENCY (XXX.X (MF)). SURVEILLANCE SERVICE TERMINATED."
>
> When the unit is opening again you can expect to hear the following:
>
> "THIS IS (unit id), (unit id) IS OPEN. THE (unit id) CONTROL ZONE IS NOW CLASS (CLASS OF AIRSPACE). ALL AIRCRAFT ON THE GROUND AND VEHICLE OPERATORS CONTACT (unit id) ON (ground frequency). ALL AIRCRAFT IN THE AIR CONTACT (unit id) ON (tower frequency)."

Flight service station broadcasts

> "THIS IS (unit id), (unit id) IS CLOSING UNTIL (time-4 digits) ZULU. [REMAIN ON THIS FREQUENCY FOR (name of service) FROM (unit id)]"
>
> When the unit is reopening, you can expect to hear the following:
>
> "THIS IS (unit id), (unit id) IS RESUMING NORMAL OPERATION"

ATIS broadcast

Both air traffic control towers and flight service stations will update ATIS to broadcast details of the closure.

Example of an air traffic control tower ATIS broadcast

> " (unit ID) TOWER IS CLOSED; CLASS ECHO AIRSPACE IN EFFECT.
> MANDATORY FREQUENCY PROCEDURES APPLY, BROADCAST INTENTIONS ON (XXX.X (MF)) CONTACT LONDON FIC FOR NOTAM AND WEATHER INFORMATION ON 123.15. ALL IFR CLEARANCES ARE CANCELLED. PILOTS MUST OBTAIN IFR CLEARANCES WITH unit ID) ON (freq). (unit) ID TOWER WILL REOPEN AT
> XX:XX"

Further reading

Understanding the procedures in place—what information to expect, and within which channels this is communicated—will greatly assist you in preparing. However, it is also important you know your responsibilities within CARs.

CARs–'Part VI: General Operating and Flight Rules–Subpart 2: Operating and Flight Rules–Division V: Operations at or in the Vicinity of an Aerodrome' contains the following:

- 602.96 Operations at or in the Vicinity of an Aerodrome
- 602.97 VFR and IFR Aircraft Operations at Uncontrolled Aerodromes within an MF Area
- 602.98 General MF Reporting Procedures
- 602.99 MF Reporting Procedures before Entering Manoeuvring Area
- 602.100 MF Reporting Procedures on Departure
- 602.101 MF Reporting Procedures on Arrival
- 602.102 MF Reporting Procedures When Flying Continuous Circuits
- 602.103 Reporting Procedures When Flying through an MF Area
- 602.104 Reporting Procedures for IFR Aircraft When Approaching or Landing at an Uncontrolled Aerodrome

Also, TC AIM '*RAC–Rules of the Air and Air Traffic Services'* provides flight crews with an additional single source of information on rules and procedures and contains the following

- 4.5 Aircraft Operations–Uncontrolled Aerodromes △

Submission of *Aviation Safety Letter* (ASL) articles

Do you have an aviation safety topic you are passionate about? Do you want to share your expert knowledge with others? If so, we would love to hear from you!

General information and guidance

The ASL's primary objective is to promote aviation safety. It includes articles that address aviation safety from all perspectives, such as safety insight derived from accidents and incidents, as well as safety information tailored to the needs of all holders of a valid Canadian pilot licence or permit, to all holders of a valid Canadian aircraft maintenance engineer (AME) licence and to other interested individuals within the aviation community.

If you are interested in writing an article, please send it by e-mail to TC.ASL-SAN.TC@tc.gc.ca in your preferred language. Please note that all articles will be edited and translated by the Transport Canada Civil Aviation (TCCA) Aviation Terminology Standardization Division and will be coordinated by the ASL team.

Photos

In order to captivate our readers' interest, we recommend that you include one or two photos (i.e., photo, illustration, chart or graphic) for each article, if possible. Please send us your photos as an e-mail attachment (preferably as a jpeg).

We look forward to receiving your articles. △

Mental Health and Crew Resource Management

by Mathieu Meunier, Manager, Ground training for an airline, and human factors graduate

Mental health week in Canada was held from May 5 to 11. For several years now, these awareness days have reminded me of a tragic event that radically changed the world of aviation. In 2015, while alone in the cockpit, a Germanwings co-pilot deliberately steered the Airbus he was piloting into a mountain in the French Alps. The investigation concluded that the co-pilot [translation] "was experiencing mental disorders with psychotic symptoms" (Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile, 2016). Since that fateful day, considerable attention has been paid to mental health issues and their impact on air transportation safety.

Credit: iStock

Despite much progress, the subject is still taboo 10 years after the Germanwings accident. Everyone agrees that certain mental disorders are not compatible with the profession of pilot, and that optimal mental health enhances flight safety. The issue becomes complex, however, when a pilot suffers in silence and needs help, particularly in the aviation industry, where there are many obstacles to consulting a medical professional.

Some aviation professionals claim that stigmatization, fear of losing their job and status, and lack of resources are reasons that prevent them from getting the support they need. Many hesitate to talk to a doctor about their situation, for fear of "losing" their medical certificate. A study of healthcare avoidance among Canadian pilots (Patel et al., 2023) found that for 72% of respondents, consulting a doctor was a source of concern, which could result in a postponement of medical visits or simply a decision not to consult professionals. In other words, asking for help when your livelihood depends on a medical certificate is easier said than done. In the context of a safety management system, this point needs to be raised, and team resource management courses would, in my opinion, be an excellent forum for tackling the subject.

Over the years, these courses (mandatory since 2020 for commercial air operators covered by subparts 702, 703, 704 and 705) have been adapted to reflect technological advances and recommendations published during accident investigations. By the same token, I believe that mental health issues should also be given a prominent place. A number of reports echo this and recommend the integration of mental health education programs for aviation personnel.

Many of the topics covered in these courses are already directly or indirectly related to mental health: stress, pressure, fatigue, etc. Examining best practices and, above all, dispelling the myths surrounding mental health in relation to aviation, in an open and relaxed atmosphere, could make a significant difference in terms of destigmatization and awareness raising.

The Flight Safety Foundation's Aviation Professional's Guide to Wellbeing, published in the wake of the COVID-19 pandemic, is an excellent starting point for tackling the subject. Available in several languages, it presents simple, concrete tools that set a framework for "managing" one's mental health.

At the same time, the industry is launching numerous initiatives through peer support programs. Coupled with effective awareness-raising, these initiatives will inevitably result in a safer environment and a better understanding of mental health in the aviation context. △

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Threshold Concepts

by Daniel Gustin, Chief Instructor at www.flighttrainers.ca, a modern online ground school dedicated to providing positive learning experiences and solutions for flight schools, private pilots, commercial pilots and flight instructors. Daniel is also a scholar of aviation education with experience as an aerobatic instructor, airline pilot and simulator instructor.

In aviation, threshold concepts are fundamental ideas that, once understood, transform a student's perspective and approach to learning. It can also be a way of looking at something that allows deep understanding of something in the world (Mossley, 2017). A widely accepted way of understanding threshold concepts is to envision our students crossing an irreversible line (i.e., a "threshold"), which, once crossed, allows them to approach knowledge in a more advanced way. Crossing this line is transformative; it changes the way we think, perceive or experience phenomena (Meyer & Land, 2003). However, such thresholds come with challenges. Transformations can be so drastic and frightening that students may resist learning them. Nevertheless, once a concept is accepted and internalized, students can then progress with their learning. In aviation education, these concepts play a crucial role in shaping the mindset and skills not only of student pilots but also of active aviation professionals. Threshold concepts "bind a subject together, being fundamental to ways of thinking and practicing" (Land et al, 2005, p. 54).

When creating an aviation curriculum, whether it be preparatory ground instruction material for student pilots or a course on oceanic airspace, instructors must identify and address threshold concepts. Let's consider two examples: one of an ab-initio student learning about stalls, and another of a two-crew environment in a 705 operation. For student pilots, once it is fundamentally understood that an airfoil stalls due to its angle of attack, the student may, from that point forward, begin to learn the correct and proper techniques for stall prevention and recovery. By mastering this ab-initio concept relating to stalls, students will be better prepared for any subsequent transition to higher performance aircraft, where stall recoveries may be more dangerous and difficult. As for the example of a

Credit: Daniel Gustin
Image is from a video of an Aerobat exiting a ½ Cuban 8 maneuver with the stall horn audible in the background. This relates to the threshold concept that aircraft can stall at any attitude.

two-crew 705 operation, this requires transitioning pilots to understand how best to make a two-crew scenario work. Once a pilot can transition their mindset away from single-pilot operations and embrace the skills necessary to work as a crew, they will be able to tackle complex problems that require task sharing, workload management, leadership or other crew resource management related proficiencies. Transitioning into a two-crew environment for the first time may be difficult and troublesome for some pilots, as it requires a fundamental change in how they approach flying. No longer are they an individual decision-maker; instead, they are now a part of a coordinated team effort. Once this threshold in mindset is crossed, skills flourish and become irreversibly ingrained.

In aviation training, it is important to emphasize that our teachings must be correct and inclusive of threshold concepts. They must also incorporate the accurate language and phraseology used within the Canadian aviation environment. Terms such as "Certified Flight Instructor - CFI" (a term found in American aviation) must be replaced by the correct Canadian equivalent (in this case, "Flight Instructor"). Similarly, the term "class of medical" should be correctly referred to as a "Category" of a medical. Using correct verbiage is not a matter of semantics; it embodies a comprehensive understanding of the *Canadian Aviation Regulations* (CARs), which fosters the professional mindset we seek in our students. Using correct and standardized language when discussing a topic represents the cognitive and procedural shift that define a threshold concept, thus reshaping how the individual engages with aviation. With this greater engagement comes a reduction in misunderstandings, in errors, in misinterpretations and in unsafe practices in the cockpit.

Credit: Daniel Gustin
Photo is from a crew on final at Rome's Fiumicino Airport.
CRM skills are necessary to work in a two-crew airline environment

Using the correct language is a crucial threshold concept to grasp; the next step is applying it effectively in real-world scenarios. A look at aviation medicals will demonstrate the importance of a language threshold concept. CAR 404.04(6) defines the validity periods of medicals, while the relevant standards in Part 4 of the CARs define which medicals will validate a licence. The basic premise of CAR 404.04(6) is that the validity period of a medical is based on the license held, **not on the category of medical held**. This means that any medical that validates a private pilot licence (PPL) for anyone less than 40 years of age is 60 months. Standard 421.26(2) outlines that a PPL is maintained by a valid Category 1 or 3 medical. Therefore, if a 23-year-old private pilot held a Category 1 medical, their medical would be valid for 60 months. Some pilots may argue that section 404.04(6.1) states that the validity period in such a case would be reduced to 12 months; however, this only applies to someone who holds a CPL, MPL or ATPL, and **not to** our 23-year-old with a **PPL**. The misinterpretation of these regulations may lead to confusion and to students unnecessarily renewing their medicals early, which will increase training costs and put more strain on the Civil Aviation medical processing system.

Such misinterpretation, resulting from the misapplication of regulations, can be the result of oversimplification, curriculum gaps or a lack of instructor knowledge. In the case of aviation medicals, instructors may feel that it is easier to teach students that the categories of medicals change after a year instead of properly explaining the regulations. Examples such as this are found at all levels of aviation in Canada, from a flight instructor poorly explaining how a wing makes lift to an airline Captain asserting that their own personal flying techniques are their employer's Standard Operating Procedures when they are not. We must ensure that our own interpretations and assumptions do not replace reality; instead, we should rely on the literature provided by the companies for which we work, by Transport Canada and by our application of accepted principles extracted from evidence-based aviation research.

It is also imperative that we do not impede on a student's ability to learn necessary threshold concepts, as this may result in students taking unnecessary or unsafe actions when flying aircraft. If instructors focus too much on surface level facts or memorization, they may fail to encourage the deeper learning necessary to grasp a threshold concept. If we use incorrect terminology, neglect context in our teachings or teach something incorrectly, students will struggle to grasp the threshold concepts that are necessary for their growth as aviators. Paradoxically, a strict teaching style may discourage critical thinking to a point where students are prevented from navigating the difficult aspects of a threshold concept. For students learning to be effective, instructors must be mindful of these potential consequences and must create learning environments where students can actively engage, experiment and explore foundational threshold concepts in aviation.

To better apply threshold concepts to your own aviation journey, I encourage you to think about points:

- What role does feedback play in helping students navigate a threshold concept?
- In a transition from single pilot to multi-crew operations, what behavioural changes are necessary for pilots to properly integrate crew resource management (CRM) into their flying?
- What is the key threshold concept that someone must fully understand to effectively perform their role in aviation? What about your role in aviation?
- How does the mastery of a threshold concept, like angle of attack, transform pilot's approach to decision-making and risk management during a flight? △

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Submission of Instructor's Corner Articles

The purpose of the ASL instructor's corner is for instructors to share past instructing/teaching experience with the ASL readership.

Submitted articles can be addressed to a variety of readers, instructors, student pilots, private pilots, and glider, ultralight or commercial pilots. In fact, this issues's article is for any type of student that an instructor may encounter in the course of their career, whether it be for a licence or a rating. The most important thing is that, at the end of the article, a lesson has been learned.

Your submissions can be as basic as attitude and movement for private pilot training, to night rating, multi-IFR or seaplane rating, teaching tips for instructors. It can also be tips to increase aviation safety or to be better prepared for a flight.

It's up to you, as long as you have your instructor's hat when you're writing your piece.

If you would like to submit an article or would like more information, please send an email to the following address: aviationsafetyletter-securiteaeriennenouvelles@tc.gc.ca △

Common Problems and Essential Questions for Automation in Aviation

by Jeremy C.-H. Wang, Chief Operating Officer, Ribbit

When Lawrence Sperry invented the first autopilot in 1912, it was a gyroscopic stabilizer designed to hold heading and altitude. More than a century later, today's autopilots and autothrottles are complex systems that can follow three-dimensional paths, manage power during takeoffs and go-arounds, and land airplanes. In the years ahead, automation—and, indeed, autonomy—will continue to enhance crew resource management, precision navigation and efficient performance, especially in long-duration flights. However, when these systems fail, are designed poorly or are operated incorrectly, the results can be disastrous. As autopilots continue to become more pervasive and capable, it's helpful for pilots and manufacturers alike to consider the most common problems for automation-related accidents.

Wiener and Curry's NASA report[1] offers an excellent review of typical automation issues where the human pilot may function as or switch between being a passive monitor (supervising automated activities) and being an active controller (assuming manual control). Although authored in 1980, the report presents timeless guiding questions for automation development and operation.

Credit: Jeremy Wang
Canada's first autonomous fixed-wing airplane demonstrator, which completed the first hands-free gate-to-gate flight in Canada in 2023 while under contract to the Transport Canada Innovation Centre

[1] Wiener, E. L. & Curry, R. E. (1980): NASA-TM-81206 Flight-deck automation: promises and problems, Moffett Field, CA: NASA Ames Research Center

Based on Ribbit's experience developing highly automated and autonomous autopilot systems, a modified and expanded list of guiding questions is offered below for both builders and operators of modern aircraft. Manufacturers may use these questions to guide autopilot development, ergonomics analysis, flight deck design and certification. Operators and instructors may use these questions to assist the development of ab initio, line indoctrination and recurrent training programs. A contemporary review of automation-related aviation accidents is available from Gawron[1].

Division and transition of control

1. **Failure detection**: For which failures and under what conditions does the pilot detect failures more reliably as the passive monitor? As the active controller?
2. **Context switching**: How long should/does it take for the pilot to "warm up" when they transition from passive monitor to active controller? How fast should/does the pilot "relax" after automation is turned on?
3. **Setting changes**: Should/does the automated system inform the pilot after making a change, or only make changes after the pilot has approved? Should/does the automated system disclose the reason for the change?
4. **Override vs disengage**: Is it safer for the pilot to assume active control by overriding the automation system while it's still engaged, or by disengaging the automation system?
5. **Reliability**: How do different levels of equipment reliability affect the pilot's ability to detect, diagnose and treat failures? Is the perception of high reliability leading to complacency or low reliability helping to maintain vigilance?

Acquisition and retention of skills

6. **Deterioration**: How quickly do manual skills deteriorate? What factors affect the rate of loss?
7. **Practice frequency**: Can periodic practice prevent deterioration? If so, what frequency is required?
8. **Types of practice**: Are there alternatives for practice with the actual system, such as simulators?
9. **Quality control**: What quality control techniques or programs are needed to ensure skills are maintained?
10. **Overall capability**: Does the automation system in question enhance the pilot's overall capabilities, especially with complex tasks, by having some of the subtasks automated?

Monitoring

11. **Performance degradation**: Does complex monitoring performance degrade with time on watch?
12. **Rare situations**: What are the means for maintaining alertness for rare occurrences?
13. **State awareness**: Is the pilot's understanding of the automation system's different states and behaviour in each state consistent with reality?
14. **Interpretability**: What makes the automation system interpretable? How are the different possible malfunctions communicated or made noticeable?

[1] Gawron, V. (2019): MTR190013 Automation in aviation—accident analyses, McLean, VA: MITRE Corp.

Alerting and warning

15. **Design & gaps**: What are the characteristics of an ideal alerting system? What is missing, and how are those gaps being filled?
16. **False alarms**: What would be an unacceptable false alarm rate? What are the causes and effects of a high false alarm rate?
17. **Missed alarms**: Why are alarms going unnoticed?
18. **Primary vs backup**: When should/does the pilot rely on alerting and warning systems as primary versus backup devices?
19. **Alarm validity**: When should/does the pilot choose to check the validity of an alarm?
20. **Preview**: Should/do alarms accompany a preview of a corrective action or subsequent escalation if no action is taken?
21. **Complexity**: Is the logic for alerting and warning systems too complex for the pilot to verify or trust all alarms that could be issued?

Psychosocial aspects of automation

22. **Perception**: How does the automation system influence job satisfaction, prestige and self-esteem?
23. **Mitigations**: What precautions and/or remedies should be taken to counter the negative effects?
24. **Job requirements**: How does the use of the automation system affect pilot recruitment, hiring and selection processes?
25. **Training:** How should training programs be designed to manage psychosocial effects? △

Credit: Jeremy Wang
Canada's first autonomous fixed-wing airplane demonstrator, which completed the first hands-free gate-to-gate flight in Canada in 2023 while under contract to the Transport Canada Innovation Centre

Civil Aviation Documents Issued Recently

Civil Aviation Safety Alerts (CASAs)

Document number (R-Revised)	Issue number (Date issued)	Subject
CASA 2025-09	Issue 01 2025-07-09	Pilot cyclic stick tube cracking
CASA 2025-08	Issue 01 2025-06-16	Low Torque on Transmission Mounted Bellcranks
CASA 2025-07	Issue 01 2025-05-15	PY Lines and fuel control unit (FCU) contamination
CASA 2025-06	Issue 01 2025-05-15	Closely Spaced Parallel Operations (CSPO) Standards and Procedures at Toronto/Lester B. Pearson International Airport (CYYZ)
CASA 2025-05	Issue 01 2025-04-08	Potential Risk of Interference of 5G Signals on Radio Altimeter - Clarification on RadAlt Retrofit Mandate
CASA 2025-04	Issue 01 2025-04-14	Teledyne Continental engine through bolt replacement
CASA 2025-03	Issue 01 2025-04-04	Flight controls – unannunciated loss of ground lift dump spoilers due to faulty throttle quadrant assembly (TQA)

Advisory Circulars (ACs)

Document number (R-Revised)	Issue number (Date issued)	Subject
AC 571-026	Issue 01 2025-07-09	Parts Removed from an Aircraft No Longer in Service and Disposal of Scrapped Parts
AC 705-002	Issue 02 2025-06-23	Approval Process of Initial Flight Attendant Training Programs for Use by Multiple Air Operators
AC 301-001	Issue 06 2025-06-20	Procedure to be followed in order to support Instrument Procedures (IP) at a non-certified aerodrome
AC 500-030	Issue 02 2025-06-18	Alternative Agents for Aircraft Fire Extinguisher System
AC 107-003	Issue 01 2025-06-06	Runway Safety Program
AC 922-001	Issue 02 2025-04-01	Remotely Piloted Aircraft Systems Safety Assurance
AC 901-001	Issue 01 2025-04-01	Remotely Piloted Aircraft Systems Safety Assurance Declaration and Pre-Validated Declaration Processes
AC 901-002	Issue 01 2025-04-01	Guidance on Manual Development for Remotely Piloted Aircraft System Operator Certificate (RPOC) Holders

RECENTLY RELEASED TSB REPORTS

TSB Report A23P0091—Collision with Terrain

History of the flight

On July 28, 2023, the De Havilland DHC-2 Mk. I (Beaver) aircraft was conducting a visual flight rules repositioning flight from Louie Bay on Nootka Island, British Columbia (BC) to Gold River Water Aerodrome, BC (CAU6) with only the pilot on board. On arrival at CAU6, the pilot noted a rough sea state in the company's primary landing area and elected to land in the secondary area, a tree-lined river to the east of the base. The aircraft was observed overflying the company dock to the north and then turning right, aligning with the southwest direction of the river. When descending on the alignment turn to final approach, the aircraft experienced an uncommanded yaw and roll. It abruptly turned further right, heading west, and continued to descend toward the trees. It was reported that opposite aileron input, to try and arrest the uncommanded yaw and roll, increased the roll rate. At approximately 1720, the aircraft struck the forested area on the west side of the river, coming to rest approximately 75 ft from the river (Figure 1). The pilot received serious injuries, was extracted by local firefighting personnel and attended to by local paramedics. He was then airlifted to hospital by a search and rescue helicopter.

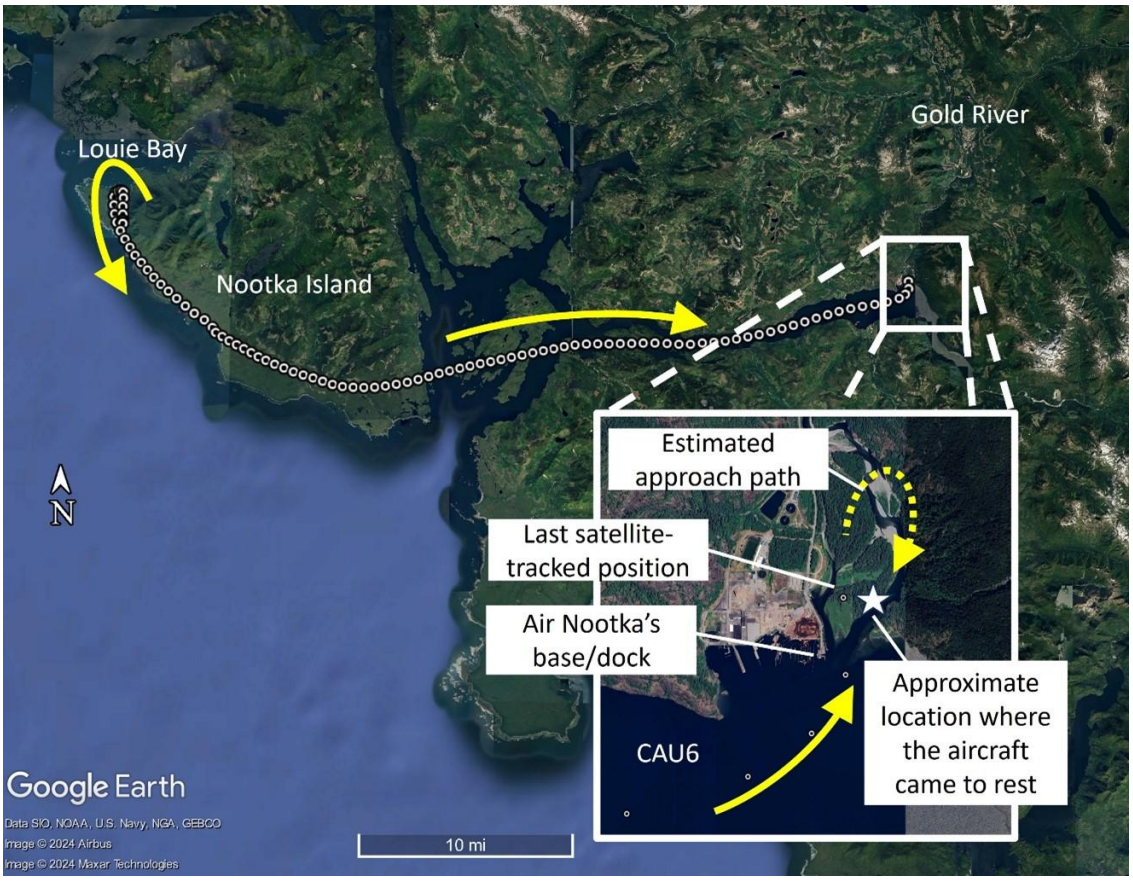

Figure 1: Recorded and estimated flight track of the occurrence aircraft (Source: Google Earth and Spidertracks data, with TSB annotations)

Pilot information

The pilot, the licence and the ratings were appropriate for the flight in accordance with existing regulations.

Weather information

The nearest aviation weather reporting stations are located at the Campbell River Airport, BC (CYBL), 38 nautical miles (NM) northeast of CAU6; the Tofino/Long Beach Airport, BC (CYAZ), 32 NM south-southeast; the Comox Airport, BC (CYQQ), 48 NM east; and the Nanaimo Airport, BC (CYCD), 92 NM east-southeast. The aerodrome routine meteorological reports (METARs), valid at 1700 on July 28, 2023 (approximately 20 minutes before the occurrence), indicated favourable conditions for the flight and landing.

In addition to the METARs, an automated marine weather observation was taken at 1700 on July 28 at Estevan Point weather station, BC (CWEB), approximately 25 NM southwest of the occurrence location. It also indicated general conditions to be favourable.

The coastal geography and features can complicate coastal weather forecasting. The location of the occurrence is situated on an inlet that can, for example, funnel the prevailing winds, increasing their speed well above the surrounding areas.

Aerodrome information

CAU6 is a registered water aerodrome located at Muchalat Inlet, BC, on the Pacific Ocean, approximately 7 NM south-southwest of the town of Gold River, BC. It is situated at the mouth of the Gold River, surrounded by heavily forested areas and rising terrain, and oriented on an east-west axis. The bay is more than 10 000 ft long and over 5 000 ft wide at its midpoint.

Prevailing winds are from the west or southwest in the summer. The operator reported that the preferred takeoffs and landings are typically conducted in the primary area, toward the west. The *Canada Water Aerodrome Supplement* notes that at CAU6, “water can be extremely rough in a strong inflow wind condition.”

When the sea state is undesirable, the operator's recommendation for takeoff and landing is to use the southwest portion of the Gold River mouth (marked as the secondary area in Figure 2), which provides approximately 1 700 ft of surface. This secondary area may be shielded from the winds affecting the inlet, but the winds aloft in this area, as noted by the operator, have been observed to be unpredictable (Figure 2).

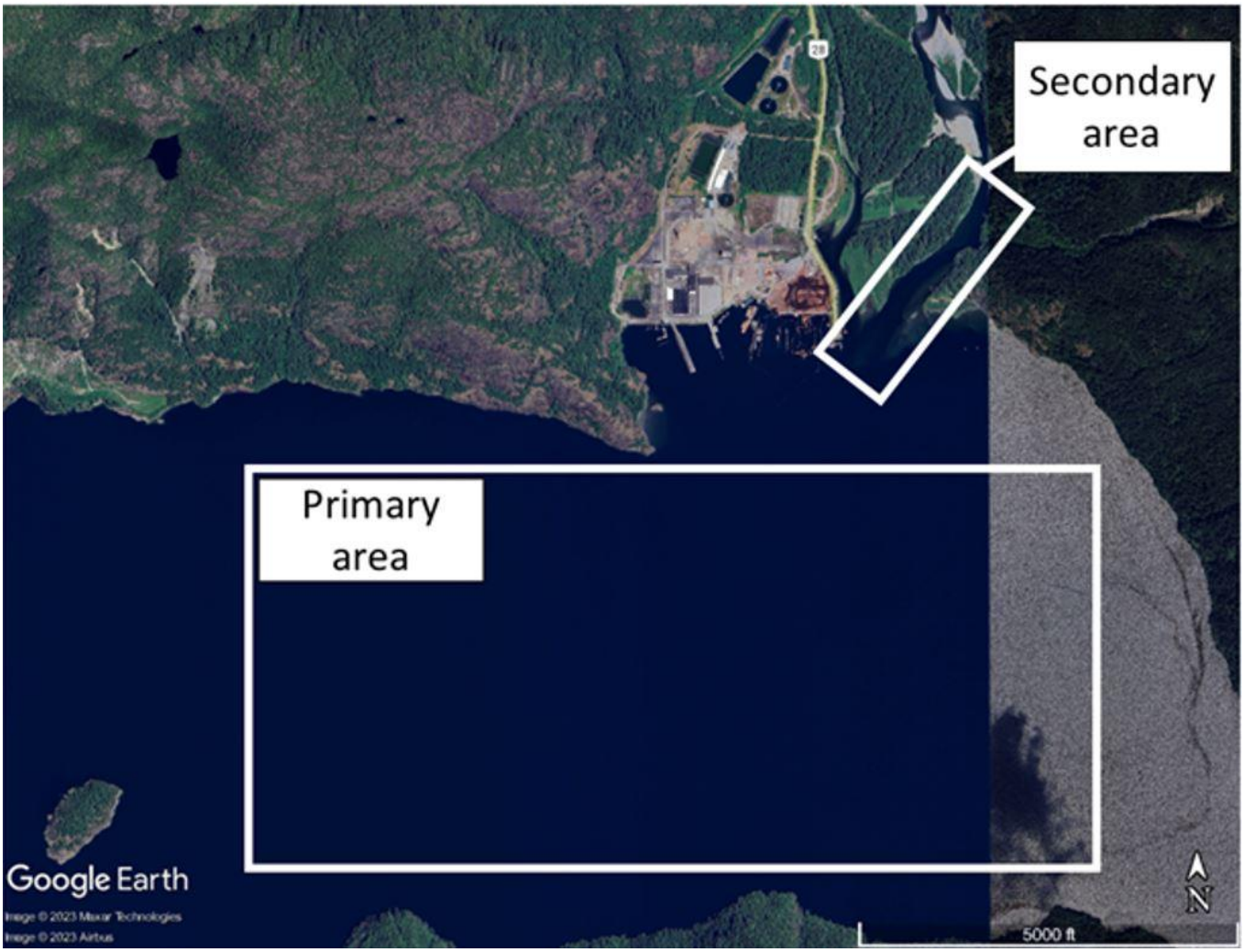

Figure 2: Gold River Water Aerodrome operating areas
(Source: Google Earth, with TSB annotations based on operator description)

The company's operations manual provides no specific guidance on the landing procedure for the secondary area; however, separate from the operations manual, the company does have recommended procedures and best practices for flight operations at many of its locations, including that of the occurrence.

Wreckage and impact information

Based on examination and photographs of the site, the aircraft was proceeding westbound when it struck the trees. The aircraft's right wing separated from the aircraft and lodged in a tree (Figure 3).

The aircraft continued into the wooded area while rolling to approximately 90° of bank before impacting a large tree and coming to rest. The damage to the aircraft and the wreckage trail were indicative of a steep angled descent with low forward velocity, consistent with a stall.

Figure 3: Occurrence aircraft's right wing lodged in a tree (Source: RCMP)

The three-blade propeller was significantly damaged, with one blade being ejected from the propeller assembly. All blades showed chordwise scratches with bending patterns consistent with an engine producing power at the time of impact.

Many of the flight instruments and engine gauges were significantly damaged as a result of the impact, and their examination provided little information useful to the investigation. Flight controls and associated linkages were examined, and no indications of failure before impact were noted. The observed damage was either consistent with impact or attributable to the recovery of the aircraft. There were no indications of a loss of control due to mechanical failure before impact.

Although the aircraft was significantly damaged, all major components were accounted for at the accident site (Figure 4).

A Spidertracks satellite-based flight tracking unit was aboard the aircraft and was functioning at the time of the occurrence. Although the flight tracking unit provided flight position information, the frequency of position reports was approximately once every 15 seconds and, therefore, it did not assist investigators in understanding the final seconds of the flight.

A Garmin GPSMAP 296 device was found at the site and sent to the Telecommunication Standardization Bureau (TSB) Engineering Laboratory in Ottawa, Ontario for examination and data recovery. However, the memory chip was too damaged to recover any data.

Figure 4: Aircraft fuselage, floats, and left wing (Source: TSB)

Aerodynamic stall

While on the right turn to final, the aircraft experienced an uncommanded yaw and roll. The application of aileron in the opposite direction made the condition worse. This is consistent with an aerodynamic stall.

An aerodynamic stall occurs when a wing's angle of attack exceeds the critical angle at which the airflow begins to separate. When a wing stalls, the airflow breaks away from the upper surface, and the amount of lift will be reduced to below that needed to keep the wing flying. While stalls occur at a given angle of attack, they can happen at any speed.

The speed at which a stall occurs depends on several things, including the load factor, the weight of the aircraft and the centre of gravity.

According to the DHC-2 flight manual, the "stall is gentle at all normal conditions of load and flap and may be anticipated by a slight vibration, which increases as flap is lowered." However, during a stall, "if yaw is permitted, the aircraft has a tendency to roll. Prompt corrective action must be initiated to prevent the roll from developing." The manual also states "in tight turns, flight load factors may reach the limit loads, and may also increase the danger of an unintentional stall."

Flight tests completed during certification of the DHC-2 type in the 1940s determined that the aerodynamic buffeting near the stall was a clear and distinctive stall warning. Because this was deemed to have met the design requirements, no further device or stall warning system was mandated to be installed.

In practice, very few aircraft types still in commercial operation today were type certified without a stall warning system. The few types remaining in commercial operation, including the DHC-2, were certified before 1960.

Safety messages

Flying approaches into areas restricted by terrain or obstacles can provide limited opportunity to recover if unpredictable winds require corrective inputs. Pilots need to be keenly aware of their margin of safety from an aerodynamic stall and ensure they maintain appropriate airspeed.

Aircraft originally certified without stall warning systems can benefit from aftermarket systems when they are available. Stall warning systems can reduce the risks pilots face when flying manoeuvres at higher angles of attack, such as arrivals and departures.

TSB Report A24O0048—Tail Rotor Strike During Ground Handling

History of the flight

On April 21, 2024, the pilot of the Aerospatiale AS350 BA helicopter was conducting a series of flights from Attawapiskat Airport, Ontario (CYAT) to various hunting camps located around Attawapiskat and on nearby Akimiski Island, Nunavut under visual flight rules. The flights were in support of the annual goose hunt, carrying passengers and gear to and from various camps.

The pilot began his duty day at approximately 0930 and conducted eight flights before the occurrence flight.

At approximately 1650, the helicopter arrived back at CYAT from Camp 17, which is located on the southwest shore of Akimiski Island (Figure 1), to pick up one passenger and some gear for a return flight to Camp 17.

Figure 1: Occurrence flight path (Source: Google Earth, with TSB annotations)

When the helicopter arrived at CYAT, the passenger and gear were ready for pick up. The pilot stayed in the helicopter with the engine running and rotors turning, while a company aircraft maintenance engineer provided

ground support and the passenger loaded the gear into externally accessible cargo pods on both the left and the right sides of the helicopter fuselage behind the cabin and in an external cargo basket attached to the left skid of the landing gear. When loading was complete, the aircraft maintenance engineer escorted the passenger to the helicopter; the passenger got in the front-left seat beside the pilot and fastened his four-point safety belt. The helicopter departed at approximately 1705 for Camp 17.

The flight to Camp 17 was approximately 15 minutes long, and the helicopter landed within a few hundred feet of the camp. The landing area was free of obstructions, with long grass, icy patches and minimal snow cover.

The pilot landed facing the northeast, where he could see the trail leading to the camp. He left the engine running and rotors turning, and his hands remained on the controls. This technique was often used during ground handling (passenger and cargo loading and off loading) to allow for a swift reaction if the helicopter were to shift or become unstable on the landing area.

An individual on a snowmobile towing a sled arrived to help unload the helicopter. He waited off to the left side of the helicopter, in view of the pilot, until the pilot gave a signal that he could move closer. The pilot told the passenger he could get out of the helicopter and signalled to the snowmobile driver that he could approach the helicopter. The snowmobile and sled were parked near the external cargo basket on the left side, facing the same direction as the helicopter, where it remained throughout the occurrence. The passenger exited the helicopter and refastened the safety belt before closing the front door.

The passenger and the snowmobile driver began unloading and transferring the contents of the basket and left-side cargo pod into the sled. As the passenger completed unloading the cargo pod, the snowmobile driver walked around the front of the helicopter to unload the right-side pod. Once the passenger emptied the cargo pod, he secured its door and started walking toward the tail of the helicopter.

The snowmobile driver saw that the passenger was approaching the back of the helicopter and tried to warn him by yelling and gesturing for him to stay away from the back of the helicopter. The passenger continued along the left side of the tail boom toward the back of the helicopter, past four antennas mounted below the tail boom and past the left-side horizontal stabilizer (Figure 2). He then ducked under the tail boom, aft of the horizontal stabilizer, but forward of the tail's vertical fin. As he crossed to the right side, he was struck by the spinning tail rotor[1] and was fatally injured. The impact caused the tail rotor and most of the tail rotor gearbox to detach from the helicopter.

[1] When a helicopter's tail rotor is spinning, it is difficult, if not impossible, to see.

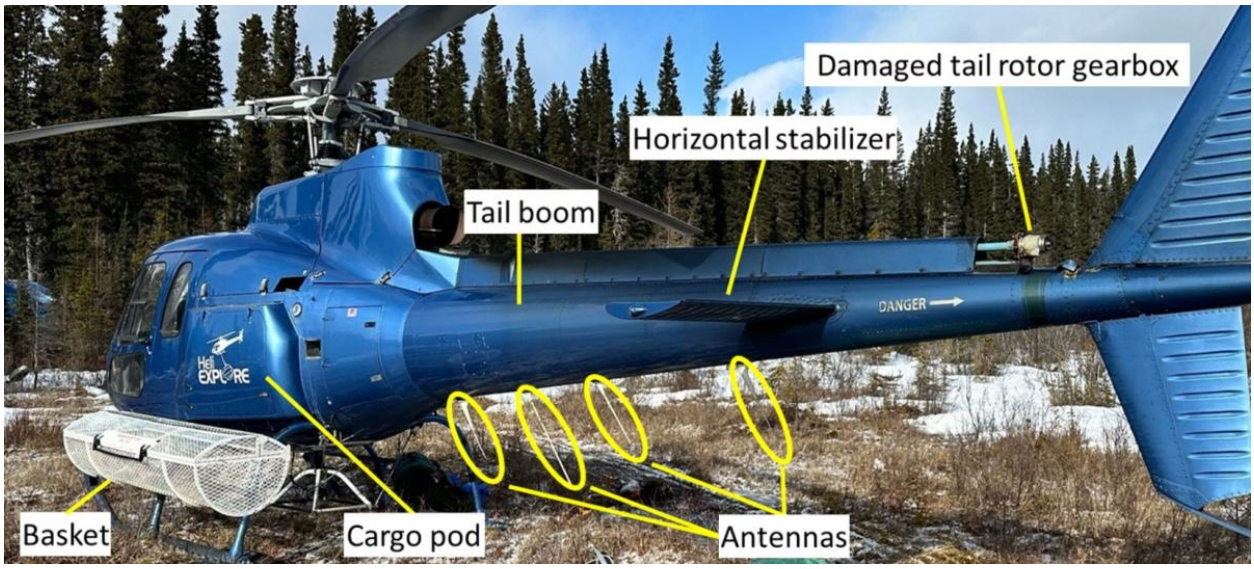

Figure 2: Occurrence helicopter (Source: Heli Explore Inc., with TSB annotations)

The pilot felt an impact and severe vibration in the helicopter; he also saw the snowmobile driver backing away from the helicopter with a panicked look. The pilot immediately shut down the engine, brought the main rotor to a stop, exited the helicopter, saw what had happened, and called Heli Explore Inc. for help using a satellite phone.

Safety briefings and safety information

The *Canadian Aviation Regulations* (CARs) state that "[t] he pilot-in-command shall ensure that passengers are given a safety briefing in accordance with the *Commercial Air Service Standards*."[1] According to the *Commercial Air Service Standards*, the safety briefing must include, among other elements, the "safest direction and most hazard-free route for passenger movement away from the helicopter, and any dangers associated with the helicopter, such as pitot tube locations, tail rotor and main rotor."[2] This requirement is also included in the company operations manual.

In previous years at Attawapiskat, a person employed by the company arranged passenger bookings and provided safety briefings to passengers. This method served several purposes: it was a means of documenting that passengers had received the safety briefing; it helped accommodate the language needs of the passengers, some of whom speak only Cree; and it helped speed up the process of moving many passengers to the various camps.

According to the company operations manual, following the safety briefing, passengers have to sign a form that indicates the general safety procedures to be followed for helicopter flights. The first section of the form, relating to how to approach and move away from the helicopter with the engine running and rotors turning, includes the following statement: "Never approach the rear of aircraft (dangers from tail rotor)." The signed form is required to be given to the pilot to confirm that the passengers have received a safety briefing.

[1] Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, subsection 703.39(1).

[2] Ibid., Standard 723: Air Taxi: Helicopters, paragraph 723.39(1)(d).

In 2024, a new individual from the community was selected to arrange the passenger bookings in Attawapiskat. This individual was not employed by the company and was not required to give safety briefings. The individual was unaware of the requirement to have safety briefing forms signed by the passengers.

Given that it had been common practice in previous years for the person booking the flights to give the safety briefing to passengers, the pilot assumed that this had been done. On the day of the occurrence, the passenger embarked in the helicopter without receiving any safety briefing. However, the passenger had flown by helicopter numerous times to and from the camps, and he had been informed on those occasions that he should stay away from the rear of the helicopter, especially from the tail rotor.

Figure 3: Occurrence helicopter's safety

An aircraft safety card is another way to inform passengers about the hazards and danger areas of a helicopter. A safety card identifies or depicts in graphic form emergency exits, proper use of safety belts, how to approach and leave the helicopter, and danger areas such as engine exhaust areas and main rotor and tail rotor arcs. The occurrence helicopter had this information in a safety card and on a placard (Figure 3) that was on the back of the front seats.

Aircraft markings can also be used to identify safe or danger areas around a helicopter, such as a tail rotor. The occurrence helicopter had the word "DANGER" and an associated arrow painted on the tail boom to identify the tail rotor danger area (Figure 4).

The investigation was unable to determine if the passenger had reviewed the safety card; however, being seated in the front seat, the placard would not have been visible to the passenger. Finally, while the word "DANGER" and the associated arrow were visible on the tail boom; the location of these markings inside the radius of the tail rotor arc limits their effectiveness in identifying the actual danger area and preventing persons from approaching the tail rotor.

Safety action taken

Following the accident, the company required that pilots shut down the engine while disembarking passengers for the remainder of the Goose Break flights during that season.

Figure 4: Occurrence helicopter's tail boom, showing the "DANGER" and arrow markings as well as the approximate radius of the tail rotor arc
(Source: Heli Explore Inc., with TSB annotations)

The company has revised its passenger guidance to provide more information and to warn of the danger of going near the back of a helicopter.

Safety messages

Pilots are reminded to ensure that all passengers and ground personnel are briefed on and understand the hazards of helicopter danger areas, especially the tail rotor, when moving about a helicopter with its engines running and rotors turning.

Passengers and ground personnel are reminded to be vigilant of the hazards of helicopter danger areas when moving about a helicopter with its engines running and with rotors turning.