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# AVIATION SAFETY LETTER

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*Learn from the mistakes of others;*

*You'll not live long enough to make them all yourself...*

Canada 

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## Guest Editorial

### *Unmanned Air Vehicles (UAVs)*

Transport Canada (TC) has seen a significant increase in the number of media calls and inquiries related to safety and the regulatory processes which govern the use of UAVs in Canada. UAVs are regulated under the *Canadian Aviation Regulations* (CARs). There are two fundamental streams based on intended use, which in turn affects the terminology. Any unmanned aircraft used *for recreational purposes only* is known as a “model aircraft”. Any unmanned aircraft used *for non-recreational or commercial purposes only* is known as an “unmanned air vehicle (UAV) system”.

A UAV System operator, regardless of UAV weight, is required to apply for a *Special Flight Operations Certificate* (SFOC). A SFOC details the operating conditions and identifies the safety parameters within which the operator will fly the UAV. A model aircraft operator does not need a SFOC as long as the aircraft weighs 35 kg (77 lbs) or less. Once a Model Aircraft weighs more than 35 kg (77 lbs), it falls under the rules of a UAV System, and its operator is then required to apply for a SFOC.

A lack of understanding and clarity existed around when a SFOC was required, and the SFOC application process. This, combined with recent incidents involving UAVs flying too close to airports and other aircraft, has suggested that all operators—both recreational and non-recreational—required improved guidance to: encourage the safe operation of UAVs; reduce the risk to the public, property, and other airspace users; and encourage regulatory compliance among non-recreational operators. A working group was put together to address those issues in early summer 2014.



*Martin J. Eley*

To improve awareness and encourage compliance without delay, TC launched a variety of communications tools to support this including: a new comprehensive Web site—[www.tc.gc.ca/safetyfirst](http://www.tc.gc.ca/safetyfirst)—and social media messaging; increased outreach and communication with operator associations and interest groups; the development of new published materials to support awareness of the SFOC process; and increased participation at UAV industry events. The new Web site includes an easy-to-use infographic chart to help UAV operators or prospective operators to understand the rules and find out if they need permission to fly, and also provides a link to the SFOC application instructions.

A longer-term plan included the development and implementation of a risk-based UAV strategy. The strategy supports the consideration of key factors—location and complexity of UAV operations—as opposed to the type of operation (recreational vs. non-recreational) in determining suitability for or requirement of an SFOC as these physical characteristics most often influence a UAV’s risk to people or property on the ground and to other airspace users. The objective of this approach is to facilitate all UAV operations, reduce the administrative burden of the SFOC process, preserve the department’s enforcement capacity and allow inspectors to focus on high-risk operations.

As a result, on November 27, 2014, TC issued two new advisory circulars (AC) in support of the UAV strategy. AC No. 600-002, titled “[General Safety Practices—Model Aircraft and Unmanned Air Vehicle Systems](#)”, and AC No. 600-004 titled “[Guidance Material for Operating Unmanned Air Vehicle Systems under an Exemption](#)”. The two ACs should be read in conjunction with each other and are must-read materials for all UAV operators. They are the result of an extensive review by our UAV and regulatory specialists.

These new documents address—among other issues—terminology, safety considerations, applicability and two new SFOC exemptions for operations of UAV systems. The first SFOC exemption is for UAVs with a maximum take-off weight not exceeding 2 kg (4.4 lbs); and the second exemption is for UAVs with a maximum take-off weight exceeding 2 kg (4.4 lbs), but not exceeding 25 kg (55 lbs). There is no change to the model aircraft category, which requires a SFOC only if the model aircraft has a maximum take-off weight exceeding 35 kg (77 lbs).



We invite all current and prospective UAV operators to familiarize themselves with both new ACs and the [www.tc.gc.ca/safetyfirst](http://www.tc.gc.ca/safetyfirst) Web site. We look forward to continue building awareness and improve regulatory processes—both activities which contribute to improved understanding among UAV operators across Canada and, in turn, support a safe airspace for all aviators and Canadians.



Martin J. Eley  
Director General  
Transport Canada, Civil Aviation

## To The Letter

### *A life saving course*

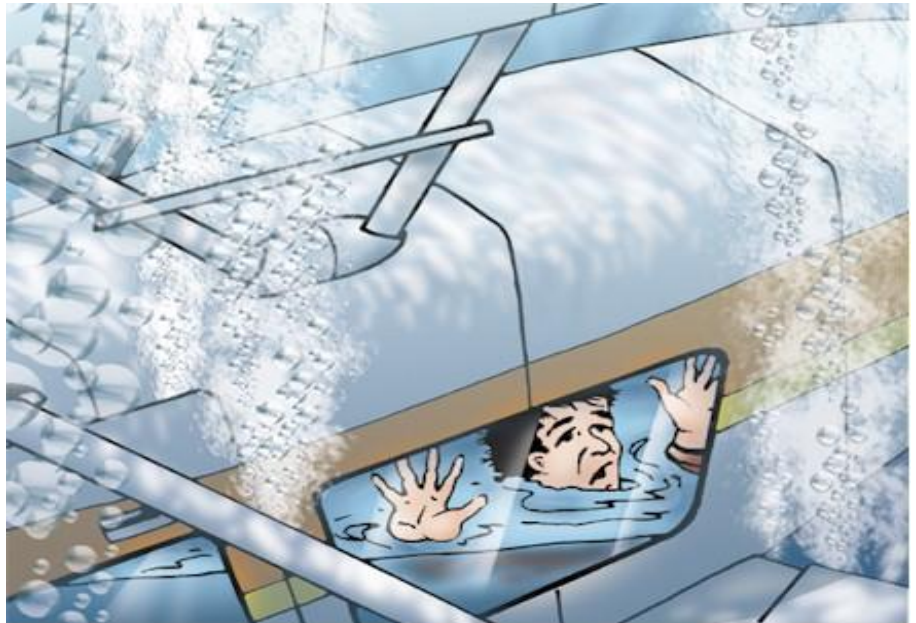
So there I was, hanging upside down in an inverted C180 floatplane, water over my head, and pondering my next move. First on the list was selecting an available exit route. Sliding my hand along the door till I felt the handle, I figured I now had it made. Moving the door lever went fine right up to the part where the door refused to open. I wasn't sure if it was bent and therefore jammed shut, or if water pressure was the culprit. Either way, it was not the most encouraging development and necessitated a brief suppression of severe anxiety in order to concentrate on plan B.

Knowing that the window latch was nearby, I slid my hand along to it and with a quick twist and push was greeted with a deluge of seawater flooding into the cockpit. It was at that point that I'd just about had enough excitement; I pulled the seat belt latch with one hand while firmly grasping the exit window with my other hand so as not to get lost on the way out. Half way out the window, while I was partly blind, totally immersed and still holding my breath, came the last challenge!

My headset was still attached and although it kept my ears warm, the cords were still plugged in and didn't want to let go. One final rush of adrenaline, a pull on the headset, a kick

against the seat and I was out the window and suddenly paddling above water between the inverted floats. The float spreader bar offered a nice place to sit while waiting for a nearby boater to pick me up. Although I was wearing a life jacket, I realized that I'd never inflated it! In fact, the personal flotation device (PFD) was not a hindrance to my escape, even though I went out the window.

The moral of this story is that I owe my life to Bryan Webster and his team of egress training experts along with the installation of shoulder harnesses in the airplane. Without the



*Don't wait for this to happen before taking underwater egress training...*

harnesses, a serious impact injury might have hindered my physical ability to escape. Without the egress training, there would have been no routine to follow and panic would most certainly have become the order of the day, followed by drowning.

Alex Foley  
Vancouver, B.C.

*Thank you Alex for your testimonial in support of underwater egress training, shoulder harnesses and the wearing of life jackets at all times when flying over water. We can never repeat these messages enough.—Ed.*

## COPA Corner—Winter Flying Woes

by Ken Armstrong

Winter flying is less understood and more hazardous to pilots than summer aviating for many reasons. The weather tends to be worse; the aircraft requires extra attention before it is ready for flight; and poor weather days generally make pilots less proficient and more impatient. As a result, more care must be taken with preflight planning and aircraft handling. Nonetheless, it is not necessary to be like many aviators who hang up their wings when the temperature nears freezing. Some of the best flying weather occurs during the clear, cool winter months. In these conditions, the air is smooth, the visibility outstanding and aircraft performance seems "supercharged".

### Preflight planning

Weather makes a big difference; it forces us to consider many aspects during flight planning that we normally wouldn't think about. Are the runways at your departure and arrival airports clear of snow? If there is residual ice on the runway, will your directional control be jeopardized by actual or forecast crosswinds? These are factors you may not be inclined to consider in the summer months. Are forecast fronts approaching that will reduce ceilings and visibilities to impassable limits? Remember that moderate snow will typically produce a half mile visibility.

During your preflight checks, ensure that the static ports are clear, the pitot heat is functioning and that the aircraft lighting (including backup flashlight) is serviceable as limited hours of daylight could lead to a flight in darkness. The entire aircraft—not just the wings and control surfaces—should be free of ice and snow. Accumulations of ice can drastically affect the centre of gravity and the controllability of the aircraft. Because you shouldn't use scrapers or chemically aggressive de-icers on the windshield, it is wise to cover these areas with a water-shedding cover if your aircraft is stored outside. Ensure that the hidden areas around the brakes and controls are free of ice that might impede their operation.

It is wise to carry jumper cables in case of emergency as it is very difficult to hand start an engine when the oil is cold and viscous like glue. If your battery does become drained, take it into warm storage for charging as it could freeze and split the case if left out in sub-zero weather when it is discharged.

Use a multi-viscosity oil (such as 20W50) to ensure all temperature lubrication. This oil will be thin enough to start a cold engine and thick enough to provide good lubrication when operating temperatures are reached. Preheat the engine if below freezing temperatures are anticipated prior to your flight. A light bulb or car heater under the oil pan is usually



adequate—especially if a quilted or insulated blanket is placed over the cowling to retain the heat. Consider preheating the cabin to avoid the misting/frosting of windows and the instrument panel that occurs when occupants exhale in a cold cabin. Wheel pants should be removed lest snow or slush melt on the hot brakes and then refreeze later. I accomplished a short field landing of less than 50 ft in a Cessna 206 with frozen brakes during a sales demo. The clients were very impressed with the shortness of the Super Skywagon's skid—unfortunately the tires needed replacing due to the resulting flat spots.

To protect your engine, ensure that the winter kit is installed on your aircraft to avoid a super-cooled engine during descent and a vapour-ice clogged oil breather. The latter can often be avoided by making a small hole part way up the breather tube, but be sure to follow the advice offered by the manufacturer's instructions or your qualified mechanic.

Before attempting to start, pull the propeller through numerous times to reduce your oil's friction and thereby increase starting ease. Be sure to follow the manufacturer's starting instructions, and stroke hard on the primer for maximum fuel atomization to ensure combustion.

Consider preheating the battery, spark plugs and oil if really cold weather is forecast. Ensure your aviation fuel has anti-icing additives. A 1% concentration of isopropyl alcohol per volume of fuel should absorb water. Avoid letting water accumulate in the aircraft fuel tank. When flying in cold weather, the water may freeze in the lines and stop fuel flow.

And while you're checking your aircraft over, be sure to check out the central processing unit—you! Be sure to have sunglasses available to avoid the intense glare of snow-reflected light. With shorter days, a pilot should polish up his night flying skills lest his planned flight be delayed, thereby necessitating a night landing.

Keep up to date with forecasts as they often change rapidly, and be sure to dress in suitable clothes for weather conditions on the ground and in the air. Also, consider the possibility of being forced to land at a location other than your destination due to weather or unserviceability and carry clothing that would be acceptable for a survival situation.

### *Warm up, taxi and take off considerations*

Air-cooled engines have larger tolerances than their liquid-cooled brethren because they go through more contractions and expansions with temperature changes. Treat your engine like your life depended on it, and use low power settings until the engine warms up. Taxi slowly and turn slower than you normally would on dry pavement. Use small amounts of power to avoid skids and tossing slush and snow onto the airframe where it might stick and freeze. Be sure to check brakes and traction often, but avoid heating the brakes up as they might melt snow into the brake mechanism which may subsequently freeze. If the ground surface is slippery, be prepared to do the high power portion of the engine run-up on the roll. The take-off technique should be similar to the soft/short field method, allowing the aircraft to quickly climb out of the snow/slush. Otherwise, there will be wheel drag and the take-off distance will be significantly extended. Level off after lift-off to blow snow and slush off the wheels and brakes. If you are flying a retractable, leave the gear down to avoid a snow job.

Watch out for signs of possible congealing in the oil cooler by monitoring oil temperature and pressure readings. If the oil becomes too cold in the cooler, it will thicken to the point where it no longer flows. In these conditions, the oil temperature will start to rise rapidly and the pressure will begin to drop. To overcome this situation, raise the nose to reduce the cooling effect of the airflow and land as soon as possible if the temperature and pressure do not return to normal.

### *Descent and landing considerations*

Use partial power descents to keep engine temperatures within limits and to avoid cracked cylinders in air temperatures that create shock-cooling scenarios that can demand expensive overhauls. If the landing surface is snow covered, make a low pass at manoeuvring speed to check the depth and for signs of use. If you see tracks, ensure they are made by an aircraft similar to the one you are flying and not by two-tracked, four-wheeled vehicles that can handle much deeper snow. Check for snow drifts across the runway and for snow banks alongside the runways or taxiways that are high enough to damage your aircraft. Beware of flat light that could adversely

affect your depth perception. Your approach should be similar to a soft/short landing with touchdown occurring at the minimum flying speed to minimize possible undercarriage damage. Landing at the minimum speed will also reduce the risk of hydroplaning on wet slush and the stopping distance on ice-covered surfaces. One inch of slush can add 50% to your landing distance requirement. The low touchdown speed also puts more weight on the wheels, thereby improving braking.

Pilots should employ as much flap as possible (considering crosswind limits) to minimize touchdown speed, and these flaps should be raised as soon as practical after touchdown to improve braking. If you are not down on the runway, in full control, on the first third or less of the runway, go around for a better approach/touchdown. Decrease speed as quickly as possible to a slow taxi. You don't want to roll quickly to the end of the runway only to find that it is ice covered and that you have an imminent appointment with the approach light supports.

### *Survival considerations*

Winter weather can be unfriendly. Be sure to carry not only suitable clothing for the cockpit and the bush, but also sleeping bags and other pertinent survival gear in case you get marooned at an unattended airport or your car breaks down on the airport road. People die needlessly every year because they don't think of the "what if" possibilities. With modern aircraft, it is highly unlikely you will ever enter a survival situation; but wouldn't it be wise to carry suitable gear just to be sure you don't tempt fate?

### *Cool conclusions*

Winter flying can provide the most pleasurable flying experiences possible. Your Cessna 172 will perform like a 182 and you will often have the airports to yourself. The extra flying hours will increase your proficiency and effectively reduce your per-hour fixed aircraft ownership costs.

All it takes to enter this winter wonderland is a little more preflight planning and some extra care and attention. Not much to ask in exchange for new vistas and flying fun. To know more about COPA, visit [www.copanational.org](http://www.copanational.org) △

## Situations That Could Lead to Mistakes

By Jean-Gabriel Charrier. The following text is a translation of a chapter on accidents from Jean-Gabriel Charrier's fine book *L'intelligence du pilote*.

### *The same old traps*

A pilot, with both his experience and his weaknesses, may face tough environments. In such situations, certain attitudes and conditions often arise: they are traps, regardless of a pilot's level of experience. These traps have been analyzed and are discussed below. Even though the examples below involve powered aircraft, there are various factors conducive to accidents that are common to all activities, regardless of whether or not an engine is involved.

### *External pressure*

This is undoubtedly one of the biggest factors that lead to accidents. You promised to take your friends out, but would you call them to cancel? You went all the way to the field, but would you go back home without having flown? Everyone flies in 10-kt crosswinds, why wouldn't you? You absolutely have to fly?

### *Resistance to change*

Sometimes it is necessary to adapt to change, even if it's a hassle—it's not that easy to choose a less direct route that better matches the day's weather; to delay a departure or cancel it entirely; or to use a new procedure.

### *Carelessness*

On the one hand, is precision when planning for and carrying out a flight, and on the other, is slackness which comes with routine and some experience. Checklists are completed with a few shortcuts and safety margins are reduced more or less consciously.

### *Goal: Destination*

A pilot is determined to arrive at his destination. His judgement is altered by this bias. Before his departure, he sees the forecasted improvement in the weather but neglects to read carefully and analyze what is in fact a middling situation. In flight, he cannot think of a solution other than continuing to his destination.

### *The pilot falls behind the airplane*

With a relatively fast airplane and/or a relatively inexperienced pilot, tasks are completed too slowly. The pilot is not sure of his navigation, has not mastered the avionics and is checking his documents for frequencies. Too preoccupied by these tasks, he does not notice changes in his surroundings—the upcoming entry point, the worsening weather...

### *Loss of situational awareness*

There comes a moment when the pilot is completely overwhelmed by the situation. He no longer knows where he is; his attention is taken up by tasks that keep him from noticing certain truths such as the worsening circumstances. Equipped with a GPS, his aircraft accidentally ends up above a seemingly endless cloud or under a cloud ceiling that touches the hill tops.

### *Fuel shortage*

There are many reasons why a fuel shortage may occur: overconfidence, under-preparation, the pilot's "first time" conducting such a long flight. These reasons lead to situations that are at best stressful and at worst dangerous and conducive to accidents.

### *Taking a look*

The conditions are marginal, the terrain rising and the ceiling lowering, but beyond there is a clearing. I'm going to take a look. The weather is poor with a strong crosswind and wind gusts. I'm going to take a look. Taking a look involves having a very reliable way out, a Plan B. If you don't have one, it must be avoided.

### *Entering IMC*

Not nice, not high—a brush up against one stratus cloud, then another before inadvertently entering IMC. Flying IMC requires training, without which, the outcome could be fatal. A study of about 20 inexperienced pilots showed that loss of control occurred between 20 and 480 seconds into IMC. The average time before loss of control is about 3 min. Every pilot in the study lost control of their aircraft!



*Typical accident chronology*



### *Exiting the flight envelope*

The pilot is faced with a situation that he is no longer able to technically control. The outcome might be an exit from the flight envelope, with a stall or breakage in flight. Machines require differing levels of exactitude; some of them are less forgiving than others.

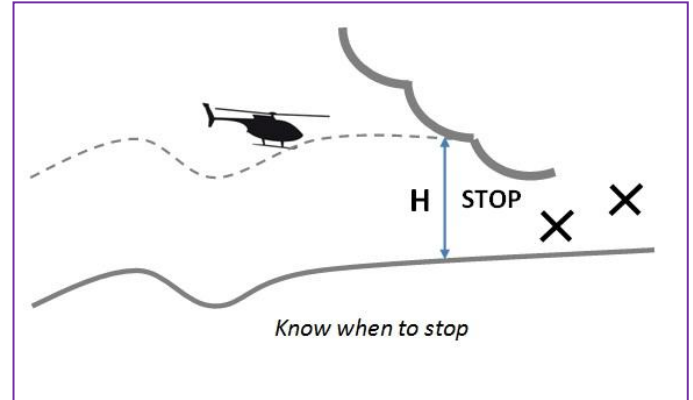
### *Often the same story*

Some of you may have noticed that almost all these components can be arranged chronologically and linked together. In fact, many accidents are a perfect synthesis of these components. I planned my flight with friends well in advance and, despite the poor weather, I wait until the last minute to decide what to do. My passengers are on hand. The weather isn't great, but we could get by. In flight, I encounter bad weather. I descend but even with the GPS I'm not too sure where I am. I see the sky clearing ahead. I continue, it would be silly not to...

The impact of stress on a pilot's mental performance—the ability to analyze, discern, make decisions—is found in most pilots in each link in the chain, and it only gets worse.

Jean Marie, a very experienced private pilot, described a cross-country flight during which he faced deteriorating weather. Once he reached a certain height above the ground, when others would have continued, he turned around. He had reached the limit that he had set, beyond which he would not descend in navigation (even his passengers were surprised by the turn around).

At once, everything became much simpler for him. The questions that need to be asked are: How many times would a more impetuous pilot have arrived at his destination in the



same conditions? Probably a few. And would the risk have been worth it? No, certainly not.

When confronted with this type of situation, think of the sense of well-being and relief that you will feel, along with the satisfaction of having made the right decision, when, after cancelling your flight to your destination, you shut down your engine in the parking lot at your alternate. Using your alternate is not a big deal. What is important is not being exposed to unnecessary risks. Even airline pilots use alternates.



### *The bottom line!*

✓ When it happens to you... think about these different factors and how they might link together. Be aware that when difficulties pile up one after the other, your judgment skills will diminish as your stress levels rise. △





## A Squirrel, a Moose and Loss of Control in Helicopter Accidents

by Lee Roskop, International Helicopter Safety Team (IHST) member. Article republished with the kind permission of the IHST.

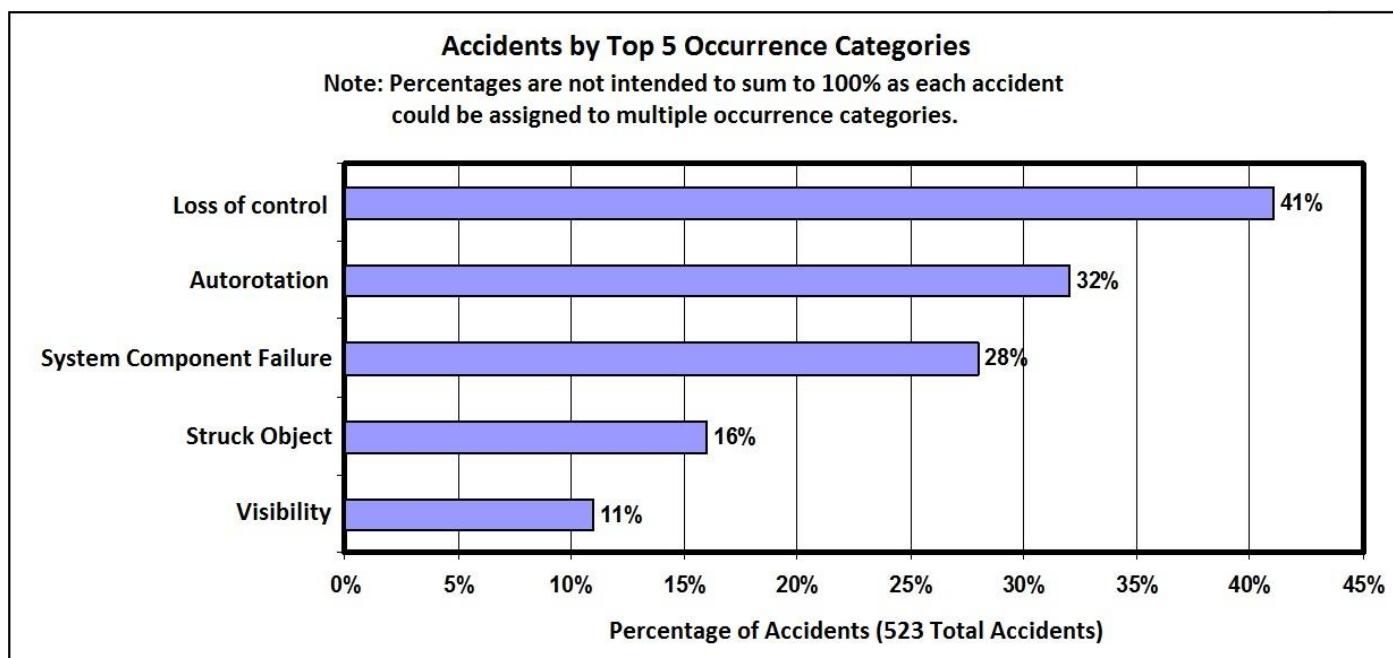
Years ago, many kids used to watch the TV cartoon *Rocky and Bullwinkle*. For those who have never heard of them, Rocky was a reasonable-minded squirrel and Bullwinkle was a dim-witted moose. One of the running gags on the show was a scene where Bullwinkle would say, “Hey Rocky, watch me pull a rabbit out of a hat.” One of Rocky’s typical responses was “But that trick *never* works!” Bullwinkle was not deterred by Rocky’s comment and would respond, “Nothing up my sleeve...Presto!” as he proceeded to try the trick anyway. Inevitably, Rocky was always right. The trick never worked. Every time, Bullwinkle would end up pulling a lion, bear or something he hadn’t planned on out of the hat instead of a rabbit. However, the unsuccessful outcome never stopped him from trying the same trick again and again.

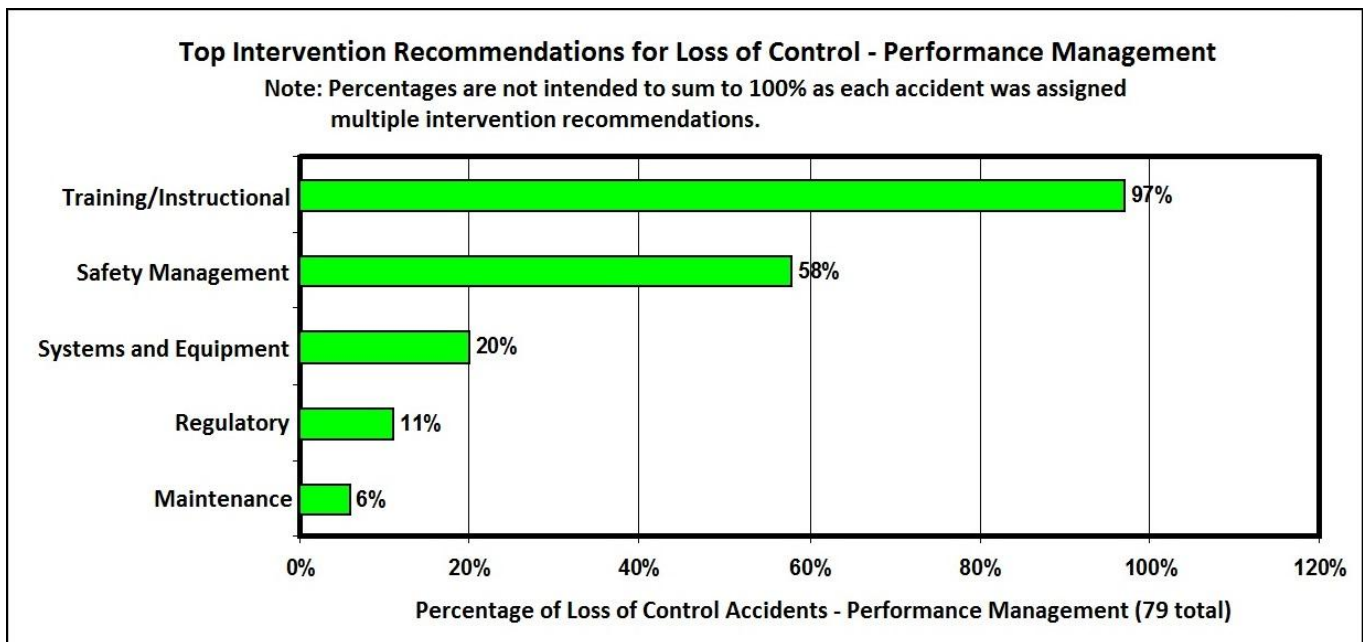
What do Rocky and Bullwinkle have to do with helicopters? The repetition of Bullwinkle’s failed magic act reflects the data involving loss of control helicopter accidents due to performance management. The International Helicopter Safety Team (IHST) defined these accidents as events precipitated by either insufficient engine power or main rotor rpm that were NOT attributable to a mechanical failure. In each accident, the situation deteriorated as the performance demands that were required progressed beyond what the helicopter could provide. The resulting condition exceeded the pilot’s ability to control the aircraft. By that point, it would have taken nothing short of magic to stop the accident. Case after case of these accidents progressed in a similar manner, just like Bullwinkle’s act.

Unfortunately, also just like his act, in the end, it never worked.

This accident data was analyzed by the Joint Helicopter Safety Analysis Team, a sub-committee of the IHST. The IHST was formed in 2005 to lead a government and industry cooperative effort to address factors that were affecting an unacceptable helicopter accident rate. The group’s mission is to reduce the international civil helicopter accident rate by 80 percent by 2016. From 2006 to 2011, the analysis team completed an analytical review of three years of U.S. helicopter accident data from 523 different accidents.

The IHST’s analysis team cited loss of control as an accident occurrence category more frequently than any other. The team noted that loss of control was evident in 217 (41 percent) of the 523 accidents they analyzed, and the following chart shows how loss of control compared to other occurrence categories. Note that percentages in the chart do not add up to 100 percent because the team’s methodology allowed for any accident to be categorized in multiple occurrence categories. One accident may have been included simultaneously in the loss of control, autorotation and abrupt manoeuvre categories if each category was applicable.





There were a number of more detailed occurrence subcategories encompassed under loss of control. However, performance management was selected more than twice as often as any other (79 out of 217 loss of control accidents). According to the National Transportation Safety Board (NTSB) investigations for each of these cases, many of the performance management problems in the accidents involved one of three scenarios:

- low main rotor rpm during practice autorotation;
- tailwind during hovering, takeoff or landing; or
- high density altitude operations.

The analysis team assessed the series of problems that were evident in each event and determined that pilot judgment and actions were contributory to 99 percent of the accidents where loss of control due to performance management occurred. For the three scenarios previously listed, a lapse in pilot judgment and actions manifested itself in the following ways:

- Practice autorotation
  - The instructor allowed low main rotor rpm during their demonstration of the manoeuvre. A power recovery was necessary, but was either not attempted or was delayed until it was too late.
  - The student allowed low main rotor rpm during the manoeuvre and the instructor either chose not to intervene or intervened too late.
- Tailwind
  - The pilot either underestimated or did not consider the increased power demands of hovering, taking off or landing with a tailwind.
- High density altitude
  - The pilot underestimated the effect of density altitude on the power required during an

approach and was unable to arrest the descent rate with the power available.

In perhaps the most important part of the IHST work, a number of interventions were suggested that could have prevented the accidents. The chart shows the intervention recommendations as they applied to the 79 accidents categorized as loss of control due to performance management.

The analysis team made more detailed and specific intervention recommendations that expand upon the broader, high-level recommendations shown in the chart. For the 97 percent of loss of control accidents due to performance management where training/instructional methods is cited as an intervention, some of the more specific recommendations the team highlighted were:

- inflight power/energy management training;
- simulator training—advanced manoeuvres;
- enhanced aircraft performance and limitations training;
- chief flying instructor (CFI) training and refresher on advanced handling, cues and procedures;
- emphasis on maintaining cues critical to safe flight.

The IHST is leading an effort to keep members of the helicopter community from trying the same tricks over and over again even when they don't work. If we can take some of the insight from the accident analysis and apply it to how we go about our day-to-day business, we can be part of a change for the better. The outcome we are pursuing doesn't involve a reasonable-minded squirrel or a dim-witted moose, and hopefully, no attempts at bad magic—just safer flying. △

## Bell 204 Tail Rotor Pitch Link Bolt Failure...

*It happened twice and it could happen again...*

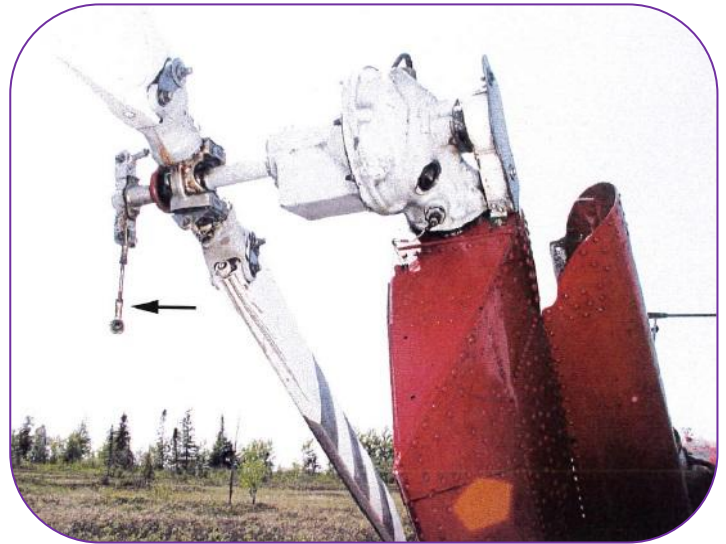
Two nearly identical incidents of Bell 204 tail rotor pitch link bolt failure—one in 2003 and one in 2013—resulted in detached tail rotor pitch links, severe vibrations and thumping, followed by emergency landings in swampy areas. Fortunately, nobody got hurt in those two incidents but there is the potential for catastrophic loss of control and loss of life. Further, the helicopter manufacturer informed the TSB back in 2003 that it was aware of at least three previous similar occurrences; in one of these previous occurrences, the consequences were severe as the tail rotor and gear box assembly were torn free from the helicopter.

### ***The 2003 event—TSB file A03C0133***

On May 31, 2003, a Bell 204B had departed Norway House Airport (CYNE), Man., on a smoke patrol in support of forest fire fighting operations. The helicopter was established in cruise flight at 100 kt and 3 000 ft ASL (2 200 ft AGL) when, approximately 15 to 20 min into the flight, a sudden and constant shudder with an intermittent thumping noise was heard coming from the tail area followed by a slow and smooth 30° to 45° repetitive yaw in both directions. The pilot gently applied pedal and was able to eventually correct the repetitive yaw condition. The thumping was not repetitive but appeared as pedal was applied. The pilot landed the helicopter straight ahead in a swampy area approximately ¼ NM north of Molsen Lake Lodge, Man. The helicopter landed without incurring further damage or injury to the occupants. According to the TSB, the attaching hardware fell out and was never located.

Post-flight examination revealed that one of the tail rotor pitch change link bolts was missing; the pitch change link was hanging free from the tail rotor blade grip horn (see Photo 1), but the link was still attached on the opposite end of the crosshead assembly. The disconnected tail rotor blade had struck the vertical stabilizer several times in flight, causing the banging noise heard by the pilot and the damage to the stabilizer.

The tail rotor assembly was installed as an overhauled unit on July 7, 2002, and had accumulated approximately 211 hr of time in service. The tail rotor pitch link bolts and attachment hardware were transferred from the old tail rotor assembly to the new one at the time of installation. The pitch change link bolts are not lifed items and are controlled as on-condition items. As such, it is not known how long the bolts had been in service at the time of occurrence. Although the pitch change link bolt was not recovered, the wear pattern on the tail rotor blade grip horn pitch change bushings was indicative of an under-torqued or loose bolt arrangement.



*Photo 1: Detached pitch link—2003 occurrence*



*Photo 2: Close-up of the fractured bolt.*

### ***The 2013 event—TSB file A13C0099\****

*\*This event was featured in the Accident Synopses section of Aviation Safety Letter 2/2014.*

On August 15, 2013, a Bell 204B helicopter departed Pelican Narrows (CJW4), Sask., on a smoke patrol, cruising at 2 500 ft ASL. The aircraft encountered turbulence, followed by porpoising, accompanied by left and right yawing and strong vibrations. The pilot initiated a descent to an open area near a lake. During the descent, the aircraft began to yaw to the right. The aircraft landed at the shoreline with the front of the skid gear and nose in the water. The helicopter was shut down and evacuated. Inspection revealed that a bolt securing the pitch change link to the pitch change horn of one tail rotor blade had





*Photo 3: Tail rotor assembly with view of the fractured bolt.*

failed. The blade had struck the side of the vertical stabilizer (pylon). Inspection of the failed bolt indicated that it had failed due to fatigue. There were indications that the bolt had been loose at some time in the past and further investigation of the damaged components indicated reverse bending damage, as would be expected in a loose bolt.

As a result of this occurrence, the operator changed their maintenance practices to ensure that the bolts are replaced at each tail rotor installation. Bolts will also be replaced if they are subsequently found to be loose during service.

On the 2013 flight, there were a total of five people on board. The tail rotor had been installed about 45 hr prior to the occurrence. As it had been the case in the 2003 occurrence, the aircraft maintenance engineer (AME) used the existing attachment hardware. Examination of the hardware by the TSB indicated that the bolt had likely been operated, at some time previous, in a loose condition and probably already had a fatigue crack when the new tail rotor was installed. There was a step worn in both bolts (very small 0.002 in.) and there



*Photo 4: Detached pitch link—2013 occurrence*

were signs that the bolts had been rotating. The attaching washers also had recessed rings worn into them from the bolt heads and the bearing shoulders. These were the indications mentioned in the summary above.

### **Conclusion**

Given the repeated occurrences and the potential serious outcome of such an event, we felt that it was important to highlight this issue. These events demonstrate the value of replacing attachment hardware at each component installation as well as replacing hardware if looseness is ever noted. △

## **2014-2015 Ground Icing Operations Update**

In August 2014, the Winter 2014–2015 *Holdover Time (HOT) Guidelines* were published by Transport Canada. As per previous years, TP 14052, *Guidelines for Aircraft Ground Icing Operations*, should be used in conjunction with the *HOT Guidelines*. Both documents are available for download at the following Transport Canada Web site: [www.tc.gc.ca/eng/civilaviation/standards/commerce-holdovertime-menu-1877.htm](http://www.tc.gc.ca/eng/civilaviation/standards/commerce-holdovertime-menu-1877.htm).

To receive e-mail notifications of *HOT Guidelines* updates, subscribe to or update your “e-news” subscription, and select “*Holdover Time (HOT) Guidelines*” under Publications / Air Transportation / Aviation Safety / Safety Information.

If you have any questions or comments regarding the above, please contact Yvan Chabot at [yvan.chabot@tc.gc.ca](mailto:yvan.chabot@tc.gc.ca).



# CASA 2014-03: Using SMS to Address Hazards and Risks Associated With Unstable Approaches

*As mentioned at the end of our summary of Transportation Safety Board of Canada (TSB) Final Report A11H0002, found in the “TSB Final Report Summaries” section of this issue of the ASL, on June 27, 2014, Transport Canada has released [Civil Aviation Safety Alert \(CASA\) 2014-03](#), in response to TSB Recommendation A14-01. We elected to reproduce the CASA in full below, in addition to a link to it, given the importance of addressing the risks associated with unstable approaches.—Ed.*

## ATTENTION:

- CANADIAN AVIATION REGULATIONS (CAR) SUBPARTS 705 OPERATORS
- CANADIAN AVIATION REGULATIONS (CAR) SUBPARTS 703 and 704 OPERATORS

## USING SMS TO ADDRESS HAZARDS AND RISKS ASSOCIATED WITH UNSTABLE APPROACHES

### PURPOSE:

The purpose of this Civil Aviation Safety Alert (CASA) is threefold:

1. To request Canadian air operators operating under subpart 705 of the *Canadian Aviation Regulations* (CARs) that they use their existing Safety Management System (SMS) to address and mitigate hazards and risks associated with unstable approaches;
2. To advise 705 operators that beginning approximately one year after the publication of this CASA, Transport Canada Civil Aviation (TCCA) plans to direct specific surveillance activities to evaluate the effectiveness of voluntary compliance with this document and will begin looking for evidence of effective mitigations of this hazard; and,
3. As the hazards and risks associated with unstable approaches are not limited to 705 operators, this CASA also serves to raise the concern to 703 and 704 operators who are not yet required to have a SMS, and encourage them to address the issue voluntarily.

### BACKGROUND:

In its Final Report A11H0002, concerning the August 20, 2011, fatal Boeing 737 accident at Resolute Bay, NU, the Transportation Safety Board of Canada (TSB) determined that unstable approaches are a significant hazard, and has recommended that TCCA require CAR Subpart 705 operators to monitor and reduce the incidence of unstable approaches that continue to a landing. (TSB A14-01)

TCCA has determined that this hazard can be mitigated through an air operator's existing SMS, and mitigations

measures developed to manage the associated risks. TCCA committed to issue this CASA to advise industry accordingly.

TCCA is committed to reviewing the effectiveness of the recommendations contained in the CASA through inspection activities.

### RECOMMENDED ACTION:

TCCA requests that this hazard be assessed and mitigated through appropriate use of the following (but not limited to) SMS components:

- safety oversight (reactive and proactive processes);
- training and awareness (promotions);
- voluntary use of Flight Data Monitoring (in order to gain a greater understanding of unstable approaches and the causes.)

This may be determined by performing a proactive assessment of unstable approach hazards (including situations where this is more likely to occur), a review of SMS database to verify the rate of occurrence and to ensure this is being reported and finally, follow up with the pilot community to verify it is being reported and monitored through the SMS in order to verify a decrease in incidents and increased awareness of the hazard and attendant risks.

Alternatively, air operators who indicate that they do not have a problem with unstable approaches in their operation will be asked to demonstrate how they have reached this conclusion. Air operators with an established flight data monitoring program (FDM) are encouraged to use this program to gather and analyze this data.

TCCA will determine if an air operator's SMS is capturing all risks including unstable approaches, and if so, if this risk is being analyzed and addressed properly.

### CONTACT OFFICE:

For more information concerning this issue, contact Transport Canada, Civil Aviation Communications Centre by telephone at 1-800-305-2059 or by e-mail at [services@tc.gc.ca](mailto:services@tc.gc.ca). △

## Answers to the 2014 Self-Paced Study Program

1. an aircraft, vehicle or person
2. with flags, cones or wing bar lights
3. 15 kt or above
4. ATS unit; the name of the location of the RCO followed by the individual letters R-C-O in a non-phonetic form
5. follow normal communications failure procedures; 7600
6. 24 hours; 0000Z, 0600Z, 1200Z, 1800Z
7. (As per CFS)
8. hatched areas enclosed by a dashed green line
9. 200 ft overcast
10. 1300Z
11. 6+ SM
12. 9 900
13. true
14.  $\frac{5}{8}$  SM, 700 ft AGL
15. the pilot
16. inform ATC of this fact since acknowledgement of the clearance alone will be taken by a controller as indicating acceptance
17. A, B, and C; D or E
18. (a) a power-driven, heavier-than-air aircraft shall give way to airships, gliders and balloons;  
(b) an airship shall give way to gliders and balloons;  
(c) a glider shall give way to balloons;  
(d) a power-driven aircraft shall give way to aircraft that are seen to be towing gliders or other objects or carrying a slung load
19. 2 000 ft AGL
20. odd thousands plus 500 ft ASL
21. 3; 1 mi.; 500 ft
22. a clearance; establish two-way communication with the appropriate
23. permission has been obtained from the user agency
24. 1-866-WXBRIEF (1-866-992-7433);  
1-866-GOMÉTÉO (1-866-466-3836)
25. 6.4 kg or 14 lb for each passenger
26. an ATC unit, an FSS, a CARS, or a RCC
27. the termination of all alerting services with respect to search and rescue notification
28. 5
29. 14:00; March 26, 2014
30. +/- 50 ft
31. 100
32. will not
33. (Most recent AIC)
34. water depth; tire pressure; lower
35. lowest (Ref. *Flight Training Manual*, Chapter 9 & *From the Ground Up*, "Turns", pg. 28)
36. water-fog whiteout; blowing snow whiteout; or precipitation whiteout
37. mast bumping (Ref: *Fatal Traps for Helicopter Pilots*)
38. Increasing forward speed; entering autorotation (Ref: *Fatal Traps for Helicopter Pilot*, pg. 42 and *Principles of Helicopter Flight*, pg. 155)
39. upper wing tip (Ref: *Soar*, 6<sup>th</sup> Ed)
40. immediately release from the aerotow. (Ref: *FAA Glider Flying Handbook*, pg. 8-13)
41. forward (Ref. "14-5. Longitudinal Balance" in *Gyroplane Pilot's Manual* by Jean-Pierre Harrison)
42. ambient temperature; actual and forecast winds

### Aviation Safety Letter (ASL) on DVD!

The ASL DVD includes all English and French issues of the ASL, from **1973** through **2013**! These back issues are in PDF only. The search function makes this an invaluable tool for flight schools and training departments. The ASL DVD is available for purchase for only \$11.50 + applicable taxes and shipping. Click here to [purchase your copy of this DVD](#).

# INTERFERENCE

with crew members is not tolerated



## Examples include:

- Disobeying instructions of the crew
- Causing a disturbance
- Assault

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# Inadvertent IMC and Spatial Disorientation: Deadly Combination for Low-Time Pilot

Investigators from the Transportation Safety Board of Canada (TSB) attended the site of a fatal Cessna 172C accident near Torquay, Sask., on June 15, 2014 (TSB File A14C0049). A review of the details gathered at the site, as well as information resulting from subsequent follow-up work, indicated that a full Class 3 investigation was not likely to provide new information that would lead to a reduction of risk to persons, property, or the environment. However, given the lessons that can be drawn from this accident, the TSB provided us the following information for the benefit of the ASL audience and for accident prevention purposes.—Ed.

## Summary

On June 15, 2014, a privately registered Cessna 172C was one of two aircraft en route from Hoffer, Sask., to an event at Lampman, Sask., with a pilot and one passenger on board. The second aircraft lost radio contact with the Cessna 172C, whose wreckage was found beside a municipal road near Torquay, Sask. The two occupants of the 172C did not survive and the aircraft was destroyed by impact forces. There was no fire.



## Pilot and passenger

The pilot-in-command (PIC) was seated in the left forward pilot seat. He held a Transport Canada (TC) Category 3 Medical Certificate valid until May 1, 2016, and a private pilot licence that was valid for single-engine land airplanes in day visual meteorological conditions (VMC).<sup>1</sup>

The PIC received his private pilot training from March 2011 to February 2014 in Estevan, Sask. After four initial training flights, he purchased the Cessna 172C and completed the remainder of his training in it. He passed a private pilot flight test on February 27, 2014, and was issued a private pilot

licence on March 14, 2014. His flying logbook indicates he had accumulated 104 hr of flying experience as of May 7, 2014, including 100 hr in his Cessna 172C.

The passenger had no piloting experience and was seated in the right forward passenger seat.

## History of flight

The flight was conducted under VFR on a flight itinerary from a private aerodrome at Hoffer, Sask., to Lampman, Sask. (see Figure 1). The purpose of the pleasure flight was to attend a breakfast being held at the Lampman airport. A group in a second aircraft was also going to the breakfast and departed from the Hoffer aerodrome first, with the accident aircraft departing shortly afterward, at approximately 07:30.<sup>2</sup>



Figure 1: Area of planned flight

<sup>1</sup> When operating in uncontrolled airspace below 1 000 ft AGL, meteorological conditions must permit pilots operating under VFR to operate their aircraft with visual reference to the surface, clear of cloud, and in no less than 2 mi. flight visibility during the day (Canadian Aviation Regulation 602.115).

<sup>2</sup> All times Central standard time (coordinated universal time minus 6 hr)



The Cessna 172C climbed steadily, reaching 3 700 ft ASL about halfway from Oungre to Bromhead. In the vicinity of Bromhead, both flights encountered clouds and the pilots descended below them to maintain visual reference to the surface. The flight visibility under the clouds was approximately 6 mi.

To ensure separation between the two flights, the second aircraft flew approximately 1 mi. left of the planned flight path shown in Figure 1 and the Cessna 172C turned right and flew about ½ mi. right of the track.

As the second aircraft continued northeast, the cloud base became lower and the pilot continued to descend to 2 300 ft ASL (approximately 400 ft AGL). During this period, the PIC of the Cessna 172C reported by radio that it was at 2 300 ft ASL over a specific farm known to both pilots. Shortly afterward, the pilot of the second aircraft began a climb straight ahead in instrument meteorological conditions (IMC).<sup>3</sup>

At about the same time, the Cessna 172C also commenced a climb straight ahead. It climbed to about 2 700 ft ASL, descended slightly and turned right about 90°. A much steeper climb commenced, with the aircraft reaching about 2 900 ft ASL and then commencing another descent. No further information was available regarding the flight path of the 172C.

At about 07:45, once above the clouds at 3 100 ft ASL, the pilot of the second aircraft made a radio call to the Cessna 172C but did not receive any reply.

The second aircraft returned to Hoffer, and the occupants immediately initiated a ground and communications search. The aircraft wreckage was subsequently found in a field northeast of Torquay, Sask., and both the PIC and the passenger were deceased.

### *Aircraft*

The aircraft was a 1962 Cessna 172C and had about 3 865 hr total air time. It was purchased by the PIC in November 2011. The aircraft had undergone an annual maintenance inspection on March 6, 2014, in Estevan, Sask. A review of aircraft records indicated that the aircraft was maintained in accordance with applicable airworthiness standards. On May 7, 2014, the PIC flew the aircraft from Estevan to the Hoffer aerodrome, and it was not subsequently flown until the day of the accident.

### *Weight and balance*

No weight and balance calculation was found for the accident flight. The empty aircraft weight was 1 405 lb. The weight of the pilot, passenger and items on board was estimated at 475 lb. The estimated fuel weight for departure on the accident flight was 200 lb. The take-off weight is calculated to have been approximately 2 100 lb, which is less than the certified maximum take-off weight of 2 250 lb. The centre of gravity was calculated to be within limits for flight.

### *Crash site and wreckage*

The crash site was a flat, marshy area in a field adjacent to a grid road. There were no observable obstacles in the area. The site was wet and soft with surface water present in the field. Portions of the wreckage came to rest in 3 ft of water, in a drainage ditch adjacent and parallel to the grid road.

Ground scars at the initial point of impact show that the left wing tip contacted the ground first, followed by the leading edge of the left wing and then the nose of the aircraft. The wreckage trail extended 270 ft from the point of contact to where the aircraft came to rest, indicating that the aircraft contacted the ground at high speed with substantial forward momentum.

The aircraft was equipped with a Garmin Aera 510 global positioning system (GPS), and the TSB Engineering Laboratory recovered GPS data from the accident flight (see Figure 2 for the flight path). The final GPS position recorded was about ¾ mi. before the initial point of impact.

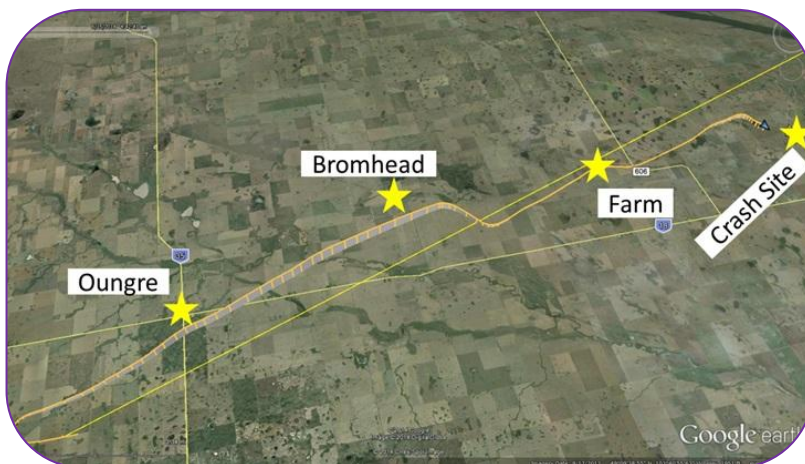


Figure 2: Cessna 172C flight path

<sup>3</sup> In IMC, visual reference is not possible and pilots must maintain aircraft control using only the instruments.

The impact forces destroyed the structure of the aircraft, with the engine detaching from the airframe at the initial point of impact. The cabin structure was destroyed and both forward seats and their seat belts were torn from the structural attach points. Both seat belts were fastened, indicating they had been in use. The aircraft was not equipped with shoulder harnesses.

Examination of the wreckage revealed that there were most likely no pre-impact control anomalies. All flight control surfaces were present and control system continuity was confirmed. The engine and propeller examination revealed that the engine was likely developing power at the time of impact.

### *Weather*

On June 14 and 15, a frontal system was affecting southern Saskatchewan and Manitoba. Estevan airport (CYEN), 20 mi. east of the crash site, is the closest location with an aviation weather report and forecast. The weather at CYEN deteriorated quickly after midnight on June 14, with observed visibility of  $\frac{1}{8}$  mi. in fog from 00:24 to 07:00. At 07:00, visibility began improving. At 08:00, the observed weather at CYEN was: wind 310° true (T) at 2 kt, visibility of 1 mi. in mist, sky overcast with the cloud base at 400 ft AGL, temperature of 11°C, dew point of 11°C, and altimeter setting at 29.61 in. Hg.

An aviation meteorological advisory issued at 03:58 on June 15 stated that surface visibility would be  $\frac{1}{2}$  to 2 mi. in fog within an area that included Hoffer, Estevan and Lampman. A graphical area forecast covering the Prairie Provinces, issued at 05:31, called for extensive areas of low cloud with drizzle and poor visibility throughout southern Saskatchewan.

An aerodrome forecast for CYEN, issued at 05:38, indicated that the fog and poor visibility would persist until about 09:00. This forecast was subsequently revised as the weather improved during the course of the morning.

Low cloud and fog had been present at Hoffer during the evening of June 14, but the local weather improved overnight and the sky was clear with good visibility on the morning of June 15.

The PIC had been monitoring weather on the NAV CANADA Aviation Weather Web Site on the night of June 14, but there was no information as to whether he checked the Web site prior to the flight on the morning of June 15. He did not obtain a pre-flight weather briefing from NAV CANADA by telephone.

### *Pilot disorientation*

Pilots flying in VMC use external visual cues to fly their aircraft and to maintain orientation. When pilots enter IMC,

they must be able to transition to using instruments to fly the aircraft. In order to fly using instruments, instrument flight training is necessary.

Pilots who transition from VMC to IMC may suffer disorientation due to the lack of visual cues and vestibular illusions.<sup>4</sup> The effects of these illusions can give pilots the perception that they are flying straight and level when they are not. Many loss of control accidents have occurred due to these effects. A successful transition is only assured when a pilot is able to fly using flight instruments and to ignore the illusions.

The TC private pilot training syllabus requires that 5 hr of instrument training be completed prior to admittance to the flight test. The pilot must be able to demonstrate straight and level flight for 2 min on an assigned heading, complete a 180° turn and proceed 2 min on the reciprocal heading. Also, the pilot must be able to recover from a nose-down and a nose-up unusual attitude solely by referencing the aircraft flight instruments.

Available records show the PIC received a total of 5.3 hr of instrument training in the Cessna 172C. He successfully demonstrated the manoeuvres described above to a flight test examiner during the private pilot flight test in his Cessna 172C on February 27, 2014.

The aircraft flight path suggests that the PIC successfully climbed in IMC to 2 700 ft ASL before experiencing difficulty controlling the aircraft. The information available is insufficient to determine whether the aircraft was in an uncontrolled descent or under the control of the pilot at the time of the crash.

*Thank you again to TSB Central for providing this additional information. We would like to highlight two safety lessons from this tragedy:*

1. *Check the weather en route before you depart so you can make an informed decision.*
2. *Practise basic instrument flying, at least once a year, to maintain proficiency. This is best accomplished by booking a dual flight with a certified instructor.*  
—Ed. △

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<sup>4</sup> FAA Brochure AM-400-03/1, Spatial Disorientation, Why You Shouldn't Fly By the Seat of Your Pants

## TSB Final Report Summaries

*The following summaries are extracted from final reports issued by the Transportation Safety Board of Canada (TSB). They have been de-identified and include the TSB's synopsis and selected findings. Some excerpts from the analysis section may be included, where needed, to better understand the findings. Unless otherwise specified, all photos and illustrations were provided by the TSB. For the benefit of our readers, all the occurrence titles below are now hyperlinked to the full TSB report on the TSB Web site. —Ed.*

### TSB Final Report A11W0048—Loss of control—In-flight Breakup

**Note:** *The TSB investigation into this occurrence resulted in a major report, with extensive discussion and analysis on many issues such as flight duty times, fatigue, company management, flight recorders, turbine conversion, overspeed operation, tailplane flutter/structural failure, pilot disorientation, pilot incapacitation, and more. Therefore we could only publish the summary, findings and safety action in the ASL. Readers are invited to read the full report, hyperlinked in the title above. —Ed.*

On March 31, 2011, a turbine powered de Havilland DHC-3 Otter departed Mayo, Y.T., on a 94 mi. day VFR flight to the Rackla Airstrip, Y.T. At 1507 Pacific Daylight Time (PDT), approximately 19 min after the aircraft had left Mayo, a 406 MHz ELT alert was received and SAR officials dispatched a commercial helicopter from Ross River, Y.T. The wreckage was located on a hillside 38 NM northeast of Mayo at 1833 PDT. The wheel-ski equipped aircraft had experienced a catastrophic in-flight breakup and the pilot, who was the sole occupant, had sustained fatal injuries. There was no post-impact fire. *The TSB authorized the release of this report on March 6, 2013.*



*Main wreckage site where most of the fuselage and cargo were found.*

#### *Finding as to causes and contributing factors*

1. The aircraft departed controlled flight for reasons which could not be determined, and broke up due to high speed.

#### *Findings as to risk*

1. Inaccurate journey log time entries by pilots may have a negative bearing on pilot duty time monitoring and aircraft maintenance schedules.
2. Pilot exceedance of duty time, such as the 60 hours flight time allowed by regulation for the 7-day period, may increase the risk of fatigue.
3. Non-adherence to Federal Aviation Administration (FAA) Advisory Circular (AC) 23-14 during both the supplemental type certificate (STC) approval process and the familiarization of the STC by Transport Canada may have reduced the safety margins envisaged by AC 23-14, in turn increasing risk for loss of aircraft structural integrity.
4. The operation of unpressurized aircraft at higher altitudes without supplementary oxygen may increase the risk of adverse effect on reaction time and judgment.
5. If owners of a DHC-3 Otter converted in accordance with STC SA02-15 are unaware of or have not complied with AD 2011-12-02, the aircraft may be at risk for loss of structural integrity due to operation at speeds in excess of those determined to be safe by the FAA.
6. The company practice of reconciling flight time and flight duty times on a monthly rather than a daily basis was inadequate to ensure compliance with CARs flight time and flight duty time limitations and rest period requirements.
7. If cockpit or data recordings are not available to an investigation, the identification and communication of safety deficiencies to advance transportation safety may be precluded.
8. If companies do not proactively monitor flight data, the identification and correction of safety deficiencies may be precluded.
9. Identifying human factors is critical to understanding why accidents happen. If companies cannot use voice and video recordings proactively for safety purposes, they are deprived of opportunities to reduce risk and improve safety before an accident occurs.



### Other findings

1. While not considered a factor in the occurrence, the threaded barrel on the aileron balance cable turnbuckle was not lockwired.
2. While not considered a factor in the occurrence, the P2T2 loading spring assembly in the FCU contained incorrect parts from an unknown source.



*Temporary hangar where the wreckage was recovered for initial examination, before it was moved to the TSB lab in Ottawa.*

### Safety action taken

#### Federal Aviation Administration (FAA)

On May 25, 2011, the FAA issued AD 2011-12-02. Effective on June 2, 2011, the AD applied to Viking Air Limited Model DHC-3 Otter airplanes (all serial numbers) that were equipped with a Honeywell TPE331-10 or -12JR turboprop engine installed per Supplemental Type Certificate (STC) SA09866SC (Texas Turbines Conversions, Inc.) and certified in any category.

The AD was prompted by analysis that showed airspeed limitations for the affected airplanes were not adjusted for the installation of a turboprop engine as stated in the regulations. The AD was issued to prevent the loss of airplane structural integrity due to the affected airplanes being able to operate at speeds exceeding those determined to be safe by the FAA. The AD imposed a maximum operating speed ( $V_{MO}$ ) of 144 mph for DHC-3 Otter land/ski aircraft and 134 mph ( $V_{MO}$ ) for DHC-3 Otter seaplanes.

On August 19, 2011, the FAA issued AD 2011-18-11, which became effective on October 3, 2011. The AD applied to all Viking Air Limited Model DHC-3 Otter airplanes that were certified in any category. The AD resulted from an evaluation of revisions to the manufacturer's maintenance manual that added new repetitive inspections to the elevator control tabs. The AD stated that if these inspections were not done, excessive free-play in the elevator control tabs could develop

That condition could lead to loss of tab control linkage and severe elevator flutter, which could lead to a loss of control.

### Operator

As a result of this accident, the operator established a system that correlates flight duty times to flight ticket invoice numbers. The information is entered on a new flight duty form which is delivered to company dispatch daily and entered into company Flight Time/Duty Time/Rest Period records daily.

### Safety action required

The development of lightweight flight recording system technology presents an opportunity to extend FDM approaches to smaller operations. Using this technology and FDM, these operations will be able to monitor, among other things, standard operating procedure compliance, pilot decision making, and adherence to operational limitations. Review of this information will allow operators to identify problems in their operations and initiate corrective actions before an accident takes place.

Furthermore, given the combined accident statistics for CARs Subparts 702, 703, and 704 operations, there is a compelling case for industry and the regulator to proactively identify hazards and manage the risks inherent in these operations. In order to manage risk effectively, they need to know why incidents happen and what the contributing safety deficiencies may be. Moreover, routine monitoring of normal operations can help these operators both improve the efficiency of their operations and identify safety deficiencies before they result in an accident. In the event that an accident does occur, recordings from lightweight flight recording systems will provide useful information to enhance the identification of safety deficiencies in the investigation. Therefore the TSB recommended that :

*The Department of Transport work with industry to remove obstacles and develop recommended practices for the implementation of flight data monitoring and the installation of lightweight flight recording systems for commercial operators not required to carry these systems. (TSB A13-01)*

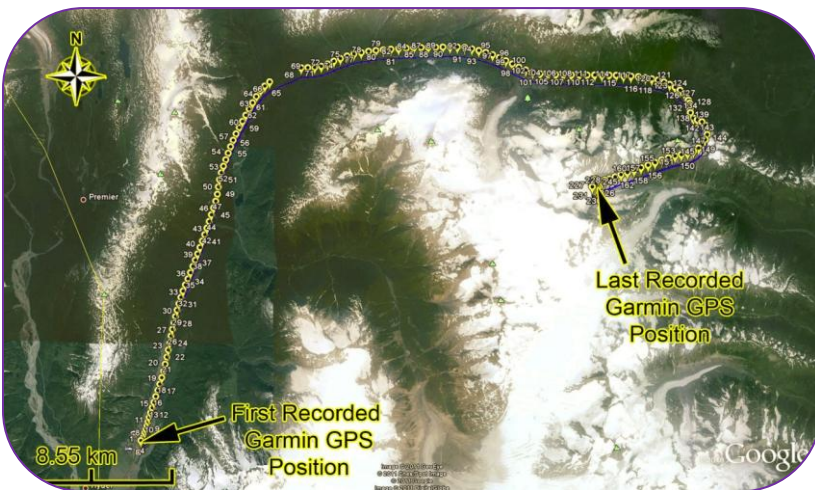
### Transport Canada action

TC supports the voluntary implementation of FDM programs in all sectors of commercial aviation. TC will proceed with the development of a new Advisory Circular in 2015/16 to describe recommended practices regarding FDM programs. This new AC will replace Commercial and Business Aviation Advisory Circular (CBAAC) No.0193–Flight Data Monitoring (FDM) Programs, last issued in 2001. TC will also consider adding FDM principles in future regulatory initiatives/ amendments, which will be consulted through focus groups at that time.



## TSB Final Report A11P0117—Main Rotor Strike and Collision With Terrain

On July 31, 2011, a Bell 407 helicopter departed Stewart Airport (CZST), B.C., at about 9:43 PDT, with the pilot and two passengers on board. The helicopter flew to a geological exploration site 14 NM north of Stewart, B.C., adjacent to the Nelson Glacier. There were no further voice communications with the occurrence aircraft following departure, and flight tracking data stopped at 10:04. Approximately 6 hr later, the wreckage was discovered strewn down the steep mountain side at the exploration site. There were no survivors. The 406 MHz ELT had activated, but the antenna and antenna cable were damaged and a signal was not received by the Canadian Mission Control Centre. There was no fire. *The TSB authorized the release of this report on April 17, 2013.*



*Photo of GPS data showing the flight track  
(Image: Google Earth; diagram added by TSB)*

### History of the flight

Using information retrieved from handheld cameras, a portable global positioning system (GPS) and an on-board GPS tracking system (which sends tracking information to the operator), the investigation determined that, at approximately 9:58, the occurrence helicopter performed a left-skid, toe-in landing on a mountain ledge at 5 100 ft ASL. One passenger was seated in the left front seat adjacent to the pilot; the other was seated in the left rear forward-facing seat. The passengers had flown once before with this pilot.

Both passengers were familiar with helicopter operations and were proficient with hover-entry and -exit procedures. The passenger in the rear seat performed a hover exit to retrieve a climbing rope that had been left behind the previous day. The other passenger remained on board. The helicopter lifted off and backed away to allow the passenger to retrieve the rope. The helicopter then landed a second time to pick up that passenger. This takeoff and subsequent landing were not reported by the GPS tracking system, as the reporting criteria were not met.

At 10:01, the helicopter lifted off again, with both passengers on board. The GPS tracking system reported the takeoff. The helicopter was manoeuvred slowly across the face of the mountain from left to right (when facing the mountain), circled to the left around the peak, and made another slow pass in the same direction across the mountain face. At 10:04, the GPS tracking system reported that the occurrence helicopter had landed about 760 ft above the rope pick-up location. That was the last position and altitude reported by the GPS tracking system. At 10:14, the GPS tracking system software generated an inactive status display, indicating that the system had not received a position report for 10 min.

### Aircrew duty times

With the exception of one 15.1-hour duty day on July 17, 2011, recorded flight- and duty-times did not exceed limitations during the pilot's tour (see **Crew Scheduling**). In the 15 days preceding the accident, the average length of the pilot's duty day was 12.75 hours. Duty days on July 28 and 29 were 12.75 hours each, with 5.6 hours of flight time each day. On July 30, the pilot was on duty for 11.5 hours, flying 6 flights and logging 3.8 hours of flight time. These recorded duty-day times cover the daily period between first departure and last landing, and do not include allowance for pre-flight or post-flight duties. The operator's company operations manual (COM) (in accordance with CARs 700.16 [1]) limits a pilot's workday to 14 hours in any 24-hour period. The operator provides forms that record the entire duty day. The pilot had not yet completed the form, which was to be submitted monthly. Every day included several periods of more than 30 minutes between flights. On one occasion, there was a break of 4.5 hours between flights. These break periods, as well as departure times, were completely random. During the occurrence pilot's tour, approximately 100 flight hours were accumulated, reaching a maximum of 40 hours over any 7-day period.

The occurrence pilot stayed at base camps during the tour. The camps were described as comfortable, with good bedding and good food. The pilot stayed at an operator staff house in Stewart on the night before the accident. On the morning of the accident, the pilot appeared to be rested and in good spirits.

### Crew Scheduling

The normal rotation for this project was a 4-week tour followed by 2 weeks of leave. In some cases, tour lengths were extended to meet operational requirements or to accommodate leave requests of other pilots. The occurrence pilot commenced a 3-week tour on July 12, 2011, after an extended leave of 27 days off. The pilot had requested the extended period of leave, which was approved by the employer. The 3-week tour was part of an operator effort to realign pilots' schedules back to the 4-on/2-off rotation. On July 28, 2011, the occurrence pilot was advised that the tour



*Strewn wreckage on the steep mountain side*

would have to be extended by 10 days. The pilot was to report to Stewart on July 30 to accommodate a leave request made by another pilot. In response to this request, the pilot expressed deep frustration with the extension and the short notice of it.

The area surrounding Stewart is an active area for mineral exploration. The terrain is very rugged, and pilots perform operations such as toe-in landings and hover exits/entries, as well as external-load operations in support of mineral-exploration activities. Many flying days are lost because of weather. The investigation determined that the occurrence pilot felt that the work in Stewart was very demanding, and that pilot fatigue could make it unsafe near the end of a four-week tour. The pilot had also expressed displeasure about the fact that the tour had been extended just before the pilot was scheduled to leave, and felt that such an extension affected a person's ability to focus on the job and also caused problems at home. On at least one previous occasion, the pilot had requested to be relieved due to fatigue. In that instance, the operator's scheduler arranged for a relief pilot to arrive within 2 days. The investigation determined that the operator supported a pilot's decision not to fly due to concerns about being tired, and it was not an issue for the exploration group to postpone work to allow a pilot to get some additional rest. The occurrence pilot did not request that work be postponed, nor indicate a need to be relieved from the current tour due to fatigue.

The pilot arrived in Stewart on the day before the accident, which was the pilot's nineteenth day of work. The pilot was new to the Nelson Glacier project. A crew-change briefing was provided by the outgoing pilot; it covered the location and description of the work sites, and provided a map review of low weather routes. The occurrence pilot declined an offer of a familiarization flight. At the end of that day, the occurrence pilot picked up 4 passengers at other sites, plus the 2-person exploration crew from the Nelson Glacier site, and returned them to Stewart. The occurrence flight was the pilot's second trip to that site.

## Operator

In its safety policy, the operator considers safety to be a core value, and imposes upon its employees not only a right but a responsibility to refuse work when unsafe conditions or risk of imminent harm exist. The investigation determined that the operator had previously supported employees who identified unsafe working conditions and had taken the necessary steps to mitigate risk to acceptable levels.

## Analysis

There is no indication that a helicopter system failure or malfunction contributed to this occurrence.

The recorded GPS data showed the helicopter in, or near, a stationary hover for 54 seconds until electrical power was interrupted, or the GPS signal was lost. The ECU data indicated a small, gradual power reduction, followed by a sudden reduction in main-rotor rpm. It is likely that the decrease in main-rotor speed occurred as a result of the main-rotor blades making contact with an obstacle as the helicopter manoeuvred in close proximity to the rock face. Any damage to rotor blades, which provide both a supporting and a control surface, is likely to result in an unstable control condition or a complete loss of control. The sudden increase in torque to 150% is consistent with a significant rotor strike. The subsequent divergence of the main-rotor speed (decreased) and power turbine speed (increased) is indicative of a sudden release of torque due to severing of the driveshaft between the engine and the transmission. While working in close proximity to steep terrain, for undetermined reasons, the helicopter's main-rotor blades made contact with terrain, causing a subsequent loss of control and collision with terrain.

Flight following is a defence against potential adverse consequences when an aircraft goes missing or is overdue. This defence began to break down when the verbal flight plan did not provide a specific time of return to Stewart. In the absence of a documented operational flight plan, a means of recording changes to that flight plan, and explicit guidance on when a flight is to be considered overdue, assumptions made by ground personnel about the status of an aircraft may lead to delays in initiating the overdue-aircraft response plan.

An emergency locator transmitter (ELT) is another defence that can aid in reducing delays in the initiation of search and rescue. This defence failed when the antenna was broken and the antenna cable was severed. As a result, the ELT signal was not detected by the Canadian Mission Control Centre. The operator's ground personnel believed that they would have been contacted by the Joint Rescue Coordination Centre (JRCC) if the occurrence helicopter had been in an accident. Damage to the ELT or its antenna increases the likelihood that a distress signal will not be detected. As a result, injured flight crew and passengers will be at elevated risk for death due to delays in life-saving search-and-rescue services. Operator procedures and personnel involved in flight following need to take account of the limitations of ELTs.



According to the COM, the overdue-aircraft response plan should have been initiated when the aircraft was considered to be overdue. However, the absence of a reported ELT signal, combined with having not received an emergency notification via the GPS tracking system, led ground personnel to believe that the situation did not warrant initiating the overdue-aircraft response plan. This belief contributed to the delay in initiation of search-and-rescue action. The operator's overdue-aircraft response plan required that the JRCC be notified that search-and-rescue services may be required. This step did not occur, and the JRCC was not notified of the overdue aircraft.

Consecutive days of work can have a cumulative effect on fatigue in helicopter pilots, particularly when the work involves tasks that require high levels of concentration, increasing the pilot's workload. Cumulative fatigue can build up when a sleep debt is carried over from preceding days of inadequate sleep.

The occurrence pilot had indicated concerns about four-week tour lengths, due to the demanding nature of the job. The investigation determined that there may have been a conflict between the pilot's personal plans and the employer's operational needs. This conflict may have been the catalyst for the pilot to express frustration to operator personnel and relate it to flight-safety concerns. However, there was no indication that the pilot was experiencing the effects of fatigue at the time of the occurrence. In the days before the occurrence, the pilot's flying times and duty days were within the prescribed limits as per regulations. On the morning of the occurrence, the pilot was in good spirits and appeared well rested. In addition, the pilot had not indicated to the operator or the exploration group, as he had done on a previous tour, that he was experiencing the effects of fatigue. The investigation did not establish a link between 4-week tour lengths and pilot fatigue in this occurrence.

#### *Finding as to causes and contributing factors*

While working in close proximity to steep terrain, the helicopter's main rotor blades made contact with terrain, causing a subsequent loss of control and collision with terrain.

#### *Findings as to risk*

1. When there is a gap between operator procedures and actual practice, flight crew and passengers may be placed at increased risk of injury or death following an accident.
2. If the joint rescue coordination centre (JRCC) is not notified in a timely manner once an aircraft is determined to be overdue or has been involved in an accident, the flight crew and passengers of that aircraft are placed at increased risk of injury or death as a result of delays in potentially critical, life-saving search-and-rescue (SAR) services.
3. Damage to the ELT or its antenna increases the likelihood that a distress signal will not be detected. As a result, injured flight crew and passengers will be



at elevated risk of death due to delays in life-saving SAR services.

4. Procedures such as toe-in landings and hover exits require passengers to release their restraint systems. Passengers conducting hover exits are at increased risk of injury if restraint systems are unfastened for periods longer than necessary.
5. If cockpit or data recordings are not available to an investigation, this may preclude the identification and communication of safety deficiencies to advance transportation safety.

#### *Other finding*

1. The investigation did not establish a link between four-week tour lengths and pilot fatigue in this occurrence.

#### *Safety action taken*

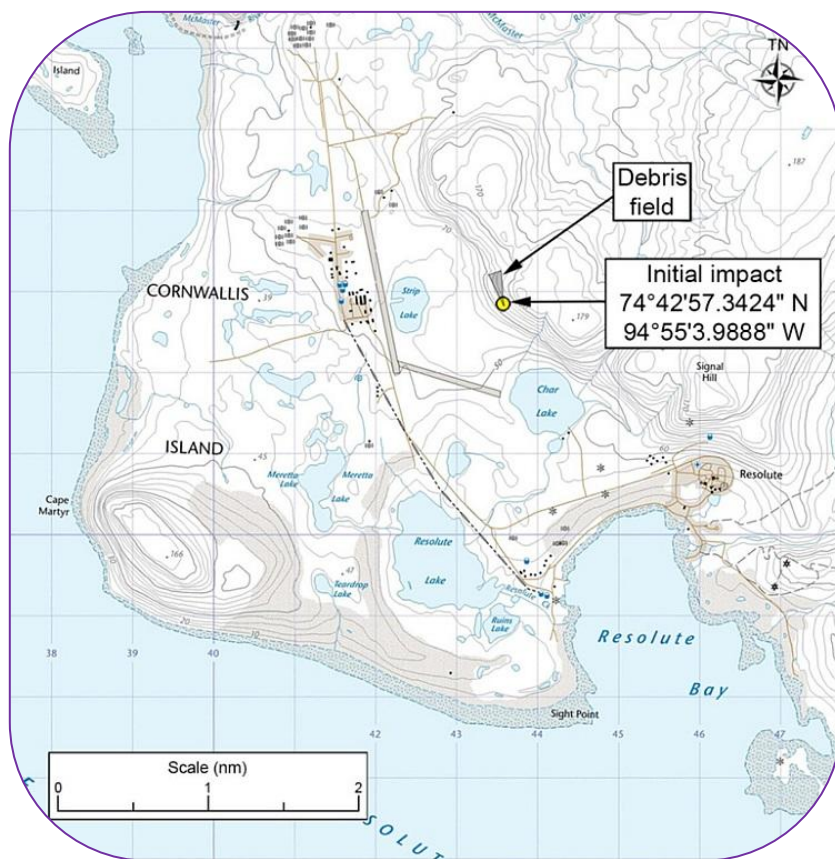
The operator has undertaken efforts to work with manufacturers of flight data monitoring systems to develop and test vendor hardware and software that would further meet the needs of VFR helicopter operations.

#### **TSB Final Report A11H0002—Controlled Flight Into Terrain**

**Note:** *The TSB investigation into this occurrence resulted in a major report, with extensive discussion and analysis on many issues. Therefore we could only publish the summary, findings and safety action in the ASL. Readers are invited to read the full report, hyperlinked in the title above. —Ed.*

On August 20, 2011, a Boeing 737-210C combi aircraft was being flown from Yellowknife, N.W.T., to Resolute Bay, Nun. At 1642 Coordinated Universal Time (1142 Central Daylight Time), during the approach to Runway 35T, the aircraft struck a hill about 1 NM east of the runway. The aircraft was destroyed by impact forces and an ensuing post-crash fire. Eight passengers and all 4 crew members sustained fatal injuries. The remaining 3 passengers sustained serious injuries and were rescued by Canadian military personnel, who were in Resolute Bay as part of a military exercise. The accident

occurred during daylight hours. No emergency locator transmitter signal was emitted by the aircraft. *The TSB authorized the release of this report on March 5, 2014.*



*Accident site*

#### *Findings as to causes and contributing factors*

1. The late initiation and subsequent management of the descent resulted in the aircraft turning onto final approach 600 feet above the glideslope, increasing the crew's workload and reducing their capacity to assess and resolve the navigational issues during the remainder of the approach.
2. When the heading reference from the compass systems was set during initial descent, there was an error of  $-8^\circ$ . For undetermined reasons, further compass drift during the arrival and approach resulted in compass errors of at least  $-17^\circ$  on final approach.
3. As the aircraft rolled out of the turn onto final approach to the right of the localizer, the captain likely made a control wheel roll input that caused the autopilot to revert from VOR/LOC capture to MAN and HDG HOLD mode. The mode change was not detected by the crew.
4. On rolling out of the turn, the captain's horizontal situation indicator displayed a heading of  $330^\circ$ , providing a perceived initial intercept angle of  $17^\circ$  to the inbound localizer track of  $347^\circ$ . However, due to

the compass error, the aircraft's true heading was  $346^\circ$ . With  $3^\circ$  of wind drift to the right, the aircraft diverged further right of the localizer.

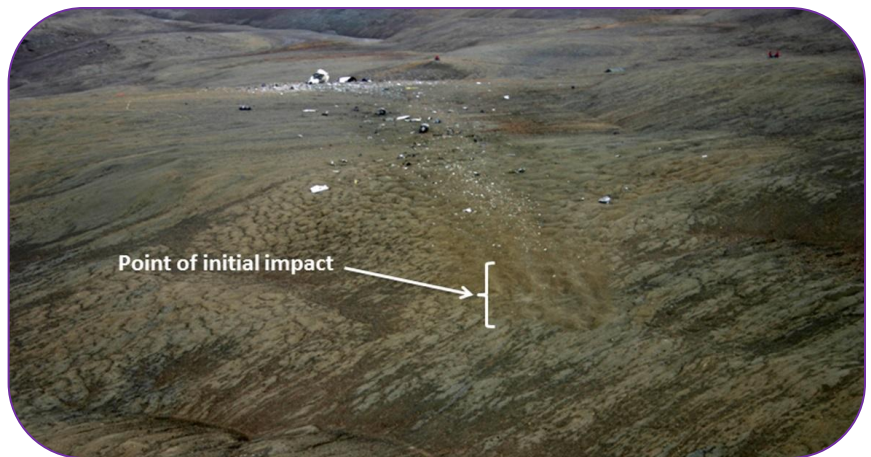
5. The crew's workload increased as they attempted to understand and resolve the ambiguity of the track divergence, which was incongruent with the perceived intercept angle and expected results.
6. Undetected by the pilots, the flight directors likely reverted to AUTO APP intercept mode as the aircraft passed through  $2.5^\circ$  right of the localizer, providing roll guidance to the selected heading (wings-level command) rather than to the localizer (left-turn command).
7. A divergence in mental models degraded the crew's ability to resolve the navigational issues. The wings-level command on the flight director likely assured the captain that the intercept angle was sufficient to return the aircraft to the selected course; however, the first officer likely put more weight on the positional information of the track bar and GPS.
8. The crew's attention was devoted to solving the navigational problem, which delayed the configuration of the aircraft for landing. This problem solving was an additional task, not normally associated with this critical phase of flight, which escalated the workload.
9. The first officer indicated to the captain that they had full localizer deflection. In the absence of standard phraseology applicable to his current situation, he had to improvise the go-around suggestion. Although full deflection is an undesired aircraft state requiring a go-around, the captain continued the approach.
10. The crew did not maintain a shared situational awareness. As the approach continued, the pilots did not effectively communicate their respective perception, understanding, and future projection of the aircraft state.
11. Although the company had a policy that required an immediate go-around in the event that an approach was unstable below 1000 feet above field elevation, no go-around was initiated. This policy had not been operationalized with any procedural guidance in the standard operating procedures.
12. The captain did not interpret the first officer's statement of "3 mile and not configed" as guidance to initiate a go-around. The captain continued the approach and called for additional steps to configure the aircraft.
13. The first officer was task-saturated, and he thus had less time and cognitive capacity to develop and execute a communication strategy that would result in the captain changing his course of action.



14. Due to attentional narrowing and task saturation, the captain likely did not have a high-level overview of the situation. This lack of overview compromised his ability to identify and manage risk.
15. The crew initiated a go-around after the ground proximity warning system “sink rate” alert occurred, but there was insufficient altitude and time to execute the manoeuvre and avoid collision with terrain.
16. The first officer made many attempts to communicate his concerns and suggest a go-around. Outside of the two-communication rule, there was no guidance provided to address a situation in which the pilot flying is responsive but is not changing an unsafe course of action. In the absence of clear policies or procedures allowing a first officer to escalate from an advisory role to taking control, this first officer likely felt inhibited from doing so.
17. The crew's crew resource management was ineffective. The operator's initial and recurrent crew resource management training did not provide the crew with sufficient practical strategies to assist with decision making and problem solving, communication, and workload management.
18. Standard operating procedure adaptations on the accident flight resulted in ineffective crew communication, escalated workload leading to task saturation, and breakdown in shared situational awareness. The operator's supervisory activities did not detect the standard operating procedure adaptations within the Yellowknife B737 crew base.

#### *Findings as to risk*

1. If standard operating procedures do not include specific guidance regarding where and how the transition from en route to final approach navigation occurs, pilots will adopt non-standard practices, which may introduce a hazard to safe completion of the approach.
2. Adaptations of standard operating procedures can impair shared situational awareness and crew resource management effectiveness.
3. Without policies and procedures clearly authorizing escalation of intervention to the point of taking aircraft control, some first officers may feel inhibited from doing so.
4. If hazardous situations are not reported, they are unlikely to be identified or investigated by a company's safety management system; consequently, corrective action may not be taken.
5. Current Transport Canada crew resource management training standards and guidance material have not been updated to reflect advances in crew resource management training, and there is no requirement for accreditation of crew resource management



*Accident site looking north*

- facilitators/instructors in Canada. This situation increases the risk that flight crews will not receive effective crew resource management training.
6. If initial crew resource management training does not develop effective crew resource management skills, and if there is inadequate reinforcement of these skills during recurrent training, flight crews may not adequately manage risk on the flight deck.
7. If operators do not take steps to ensure that flight crews routinely apply effective crew resource management practices during flight operations, risk to aviation safety will persist.
8. Transport Canada's flight data recorder maintenance guidance (CAR Standard 625, Appendix C) does not refer to the current flight recorder maintenance specification, and therefore provides insufficient guidance to ensure the serviceability of flight data recorders. This insufficiency increases the risk that information needed to identify and communicate safety deficiencies will not be available.
9. If aircraft are not equipped with newer-generation terrain awareness and warning systems, there is a risk that a warning will not alert crews in time to avoid terrain.
10. If air carriers do not monitor flight data to identify and correct problems, there is a risk that adaptations of standard operating procedures will not be detected.
11. Unless further action is taken to reduce the incidence of unstable approaches that continue to a landing, the risk of controlled flight into terrain and of approach and landing accidents will persist.

#### *Other findings*

1. It is likely that both pilots switched from GPS to VHF NAV during the final portion of the in-range check before the turn at MUSAT.
2. The flight crew was not navigating using the YRB VOR or intentionally tracking toward the VOR.
3. There was no interference with the normal functionality of the instrument landing system for Runway 35T at CYRB.

4. Neither the military tower nor the military terminal controller at CYRB had sufficient valid information available to cause them to issue a position advisory to the B737.
5. The temporary Class D control zone established by the military at CYRB was operating without any capability to provide instrument flight rules separation.
6. The delay in notification of the joint rescue coordination centre did not delay the emergency response to the crash site.
7. The NOTAMs issued concerning the establishment of the military terminal control area did not succeed in communicating the information needed by the airspace users.
8. The ceiling at the airport at the time of the accident could not be determined. The visibility at the airport at the time of the accident likely did not decrease below approach minimums at any time during the arrival of the B737. The cloud layer at the crash site was surface-based less than 200 feet above the airport elevation.

*Safety actions (selected items only; see all on TSB Web site)*  
*Safety actions taken*

#### **Transportation Safety Board of Canada**

On April 26, 2012, TSB investigators presented a briefing to the operator's senior management personnel regarding the company's CRM training. The operator conducts its initial CRM training during type training for newly hired pilots. TSB investigators attended an initial CRM training course from the operator on April 3, 2012; this was the first initial CRM course conducted since the accident. The course was time-compressed, and did not address all of the modules required under CAR 705.124—Training Program, and *Commercial Air Service Standards* (CASS) 725.124(39)—Crew Resource Management Training. Additionally, the content of the material presented was dated and did not include practical tools and strategies. It was suggested that the company may want to allocate more time to CRM training and update the course content.

#### **Operator**

##### **Standard operating procedures**

The operator completed a review of B737, B767, ATR42, ATR72, and L382 standard operating procedures (SOPs) to identify adaptations of SOPs. Knowledge and procedural deficiencies were identified as areas for review and improvement.

##### **Ongoing actions**

The chief pilots of all aircraft types met for several days in the second half of 2012 to discuss common calls and procedures across all fleets. SOPs for all aircraft types have been rewritten in a common format.



*Accident site at the surface*

#### **Crew resource management**

The crew resource management training was reviewed and updated with more modern content. The length of the initial course was increased to one full day.

#### **Reporting system**

A review of the reporting system and requirements was conducted. As part of the review, it was identified that certain policies in force may have contributed to reporting fatigue in limited areas. Several policies in place required items that were part of normal operations to be reported regularly, such as a normal diversion due to weather. Given the complex nature of the operating environment, other items may not have been reported due to the workload and the complexity of the policy and form used.

The air safety report has been amended to remove the requirements to report expected normal operations items, decluttering it to provide more opportunity to describe any events that require attention. The importance of ongoing reporting of hazards was included within the notification to the crews of the air safety report form and policy changes. These actions were completed in October 2012.

Additionally, the manager of flight safety published two articles in the company newsletter promoting reporting in all aspects of flight operations.

#### **Training standards**

A review and revision of the Line Check Pilot Course was completed. The aim of this course is to ensure that all training and check personnel have a common standard by which to validate the training and to ensure that all company procedures are understood and followed. The first course was delivered on July 24, 2012.

#### **Maintenance**

Maintenance Services has initiated a program to determine the drift rate of the directional gyros while on the ground. If excessive drift rates are detected, an enhanced maintenance



program will be put in place to provide acceptable performance. Coupled with this program will be feedback to flight crews to increase awareness of the operation of this system and of the reports required to maintain reliability.

#### **Flight data monitoring program**

The operator's flight data monitoring (FDM) program has been reviewed, and an outside company has been contracted to provide assistance and guidance in detecting SOP adaptations and other areas requiring training enhancement. The manager of the program produces quarterly reports, which are reviewed at the executive safety management meetings on a quarterly basis. This initiative has provided data for improvements in training and day-to-day operations for all aircraft types in the operator's fleet.

#### *Safety action required*

##### **Unstable approaches**

In this accident, the aircraft arrived high and fast on final approach, was not configured for landing on a timely basis, had not intercepted the localizer and was diverging to the right. This approach was not considered stabilized in accordance with the company's stabilized approach criteria, and the situation required a go-around. Instead, the approach was continued. When the crew initiated a go-around, it was too late to avoid the impact with terrain. Unstable approaches continue to be a high risk to safe flight operations in Canada and worldwide.

Flight Safety Foundation research concluded that 3.5% to 4% of approaches are unstable. Of these, 97% are continued to a landing, with only 3% resulting in a go-around. To put these figures in context, there were, in 2012, 24.4 million flights worldwide in a fleet of civilian, commercial, western-built jet airplanes heavier than 60 000 lb. This means that between 854 000 and 976 000 of those flights terminated with an unstable approach, and approximately 828 000 to 945 000 continued to a landing. The potential negative consequences of continuing an unstable approach to a landing include CFIT, runway overruns, landing short of the runway and tail-strike accidents.

Occurrences in which an unstable approach was a contributing factor demonstrate that the severity can range from no injuries or damage to multiple fatalities and aircraft destruction. In Resolute Bay, the continuation of an unstable approach led to a CFIT accident and the loss of 12 lives. Without improvements in stable approach policy compliance, most unstable approaches will continue to a landing, increasing the risk of CFIT and approach and landing accidents.

In this investigation, the Board examined in detail the defences available to air carriers to mitigate the risks associated with unstable approaches and their consequences.

These mainly administrative defences include:

- A company stabilized-approach policy, including no-fault go-around policy;
- Operationalized stable approach criteria and standard operating procedures (SOPs), including crew phraseology;
- Effective crew resource management (CRM), including empowering of first officers to take control in an unsafe situation;
- Use of flight data monitoring (FDM) programs to monitor SOP compliance with stabilized approach criteria;



*Final approach track relative to runway  
(image: Google Earth, with annotations by TSB)*



- Use of line-oriented safety audits (LOSA) or other means, such as proficiency and line checks, to assess CRM practices and identify crew adaptations of SOPs;
- Non-punitive reporting systems (to report occurrences or unsafe practices);
- Use of terrain awareness and warning systems (TAWS).

While the operator had some of these defences in place, including a stabilized approach policy and criteria, a no-fault go-around policy, safety management system (SMS) hazard and occurrence reporting, the two-communication rule and an older-generation ground proximity warning system (GPWS), these defences were not robust enough to prevent the continuation of the unstable approach or collision with terrain. Other TSB investigations have shown that non-adherence to company SOPs related to stabilized approaches is not unique to the operator.

In addition, the use of newer-generation TAWS with forward-looking terrain avoidance features will enhance a flight crew's situational awareness and provide increased time for crew reaction. However, if the risk in the system is to be reduced significantly, the industry must take other steps and not rely on purely technological solutions.

The first step is for operators to have practical and explicit policies, criteria, and SOPs for stabilized approach that are enshrined in the company operating culture.

The second step is for companies to have contemporary initial and recurrent CRM training programs delivered by qualified trainers and to monitor and reinforce effective CRM skills in day-to-day flight operations. Effective CRM is a defence against risks present in all phases of flight, including unstable approaches.

The third step involves monitoring of SOP compliance through programs such as flight data monitoring (FDM) and line-oriented safety audits (LOSA). In Canada, TC requires large commercial carriers to have SMS, cockpit voice recorders (CVRs), and flight data recorders (FDRs). However, these carriers are not required to have an FDM program. Even so, many of these operators routinely download their flight data to conduct FDM of normal operations. Air carriers with flight data monitoring programs have used flight data to identify problems such as unstabilized approaches and rushed approaches, exceedance of flap limit speeds, excessive bank angles after take-off, engine over-temperature events, exceedance of recommended speed thresholds, GPWS/TAWS warnings, onset of stall conditions, excessive rates of rotation, glide path excursions, and vertical acceleration.

FDM has been implemented in many countries, and it is widely recognized as a cost-effective tool for improving safety. In the United States and Europe—thanks to ICAO—

many carriers have had the program for years. Some helicopter operators have it already, and the Federal Aviation Administration (FAA) has recommended it.

Worldwide, FDM has proven to benefit safety by giving operators the tools to look carefully at individual flights and, ultimately, at the operation of their fleets over time. This review of objective data, especially as an integral and non-punitive component of a company safety management system, has proven beneficial in proactive identification and correction of safety deficiencies and in prevention of accidents.

Current defences against continuing unstable approaches have proven less than adequate. In Canada, while many CAR 705 operators have voluntarily implemented FDM programs, there is no requirement to do so. The operator was not conducting FDM at the time of this accident. Furthermore, FDM programs must specifically look at why unstable approaches are occurring, how crews handle them, whether or not crews comply with company stabilized-approach criteria and procedures, and why crews continue an unstable approach to a landing. Unless further action is taken to reduce the incidence of unstable approaches that continue to a landing, the risk of approach and landing accidents will persist.

Therefore, the Board recommends (A14-01) that:

*Transport Canada require CARs Subpart 705 operators to monitor and reduce the incidence of unstable approaches that continue to a landing.*

### Transport Canada response

Since 2005, Canadian air operators operating under subpart 705 of the Canadian Aviation Regulations (CARs) must have a safety management system (SMS). Transport Canada (TC) has determined that this hazard can be mitigated through an air operator's SMS. On June 27, 2014, TC issued [Civil Aviation Safety Alert \(CASA\) No. 2014-03](#) to communicate this information to each air operator operating under subpart 705 of the CARs.

TC is committed to reviewing the effectiveness of the recommendations contained in the CASA through inspection activities. TC will determine if an air operator's SMS is capturing all risks including unstable approaches, and if so, if this risk is being analyzed and addressed properly. Alternatively, operators who indicate that they do not have a problem with unstable approaches in their operation will be asked to demonstrate how they have reached this conclusion.

Finally, as the issue of unstable approaches is not limited to 705 operators, the CASA was also addressed to 703 and 704 operators to encourage them to address the issue voluntarily.

## TSB Final Report A11Q0168—Collision With Terrain Following Night-Time Takeoff

On August 27, 2011, at approximately 2100 Eastern Daylight Time, a Robinson R44 Raven II, a privately-owned helicopter, departed from the Saint-Ferdinand Aerodrome (CSH5), Que., with the pilot and 3 passengers on board for a night flight to Saint-Nicolas, Que., under visual flight rules. At 2109, a distress signal emitted by the emergency locator transmitter was detected by the SARSAT (search and rescue satellite-aided tracking) system. The aircraft was found approximately 2 hours and 35 minutes later in a wooded area, about 3 940 feet from its point of departure. The helicopter was destroyed on impact, but did not catch fire. All of the occupants perished in the crash. *The TSB authorized the release of this report on June 26, 2013.*

### Analysis

#### General

The pilot had the necessary licence and qualifications to fly the aircraft, and there is no evidence that the pilot's capacities were diminished by physiological factors. There is nothing to indicate that fatigue, weather conditions, or the airworthiness of the aircraft played a role in this accident. Consequently, this analysis will focus on plausible scenarios that could have caused the crash, and on the risks associated with night flight.



#### Plausible scenarios

Given that it was night and that the aerodrome was not equipped with a lighting system, take-off was not allowed under the *Canadian Aviation Regulations* (CARs). It is not known why the pilot would have chosen to fly knowing that the aerodrome did not have a lighting system; however, the following may have influenced the pilot's decision:

- The occupants of the aircraft had planned to return home the same day.
- The weather conditions were conducive to visual flight.
- It was a short flight.

- The approach of post-tropical storm Irene would have affected flight conditions the next day.

In the absence of eye witnesses, radar data, and global positioning system (GPS) data, the take-off path could not be determined. However, it is reasonable to believe that the aircraft crashed shortly after take-off. The occupants arrived at the aerodrome around 2050, and the first emergency locator transmitter (ELT) signal was received at 2109. The 19 minutes between the arrival at the aerodrome and the first ELT signal can be explained as follows:

- Time required for a pre-departure walk-around inspection of the aircraft
- Time required for the pilot and passengers to board the aircraft
- Time required to start and warm up the engine
- Time required for the GPS receiver to collect the satellite data and establish the aircraft's current position, which can take up to 5 minutes
- Time required to enter the route in the GPS
- Fifty-second delay between the impact and the coded message transmitted by the ELT

Due to light, variable surface wind, the pilot had 4 take-off options:

1. Take off from the current position and proceed directly to the destination
2. Take off following the Runway 05 centreline before turning left
3. Backtrack Runway 23 and take off following the runway centreline
4. Take off from the current position following the departure path of Runway 23 and turn right

Scenarios 1 and 2 are unlikely for the following reasons:

- The departure in these directions offered few visual references.
- The rising terrain reduced obstacle clearance during the initial climb.
- The area was more wooded, offering less chance of a forced landing in the event of engine failure during the initial climb.

Scenario 3 is also unlikely. It would have been difficult for the pilot to hover-taxi and make a 180° turn above a runway without markings, particularly when it was dark in the aerodrome's immediate surroundings.

Scenario 4 was the best choice and is the assumption used, for the following reasons:

- Hover-taxiing was not required.



- There was a 1 400-foot unobstructed field at the end of the runway.
- The terrain was descending, which increased the obstacle clearance during the initial climb.
- The villages of Bernierville and Saint-Ferdinand provided visual references for the initial climb.
- There were more fields in the area in the event that a forced landing became necessary.

By following the extended centreline of Runway 23, the pilot had the choice of turning left or right. Since a left-hand circuit is standard, if the pilot wanted to turn right, a climb should have been performed on the extended centreline of the runway to 1 000 ft above ground level (AGL), before turning right toward the destination. It would have been unwise to do so below 1 000 ft AGL, given the rising terrain in this direction. Moreover, the aircraft crashed east of the threshold of Runway 23, which is not the path of a right turn after take-off. However, a left turn after take-off, which is part of a left-hand circuit, was possible at 500 ft AGL. In addition, the crash site and the wreckage path are consistent with a left turn after take-off to intercept the desired track. On its arrival in Saint-Ferdinand, the aircraft disappeared from the radar screen at about 500 ft AGL. Since on departure, no target was captured by radar, it is highly likely that the aircraft did not reach 500 ft AGL after take-off.

Other than the fact that the CLUTCH warning light had come on, as indicated by the stretched filament, an examination of the aircraft, the engine, and its accessories did not reveal any reason to believe that an anomaly had occurred requiring an emergency landing. While it is possible that the CLUTCH warning light came on during the flight, it is impossible to conclude from the examination of the wreckage and the clutch whether the warning light was on for more than 7 or 8 seconds. The clutch circuit breaker was found “IN”, suggesting that the appropriate procedure had not been initiated or was not necessary. However, the location of the breaker panel requires the pilot to bend to the left to touch the breakers and to find the one with the red ring, which could take some time. If this happened while the pilot was making a turn with little visual reference, it could have caused spatial disorientation attributable to the Coreolis illusion.

If the light comes on for more than 7 or 8 seconds, the procedure calls for an immediate landing. If this happened, the pilot was in a dangerous situation, since a return to an unlit runway or a safe emergency landing in a field was practically impossible. The environment offered few visual references, and there was insufficient moonlight to allow for a clear view of the terrain and obstacles.

### Risks associated with helicopter night flights

The lack of visual cues inherent at night in poorly lit areas can make night flying, take-offs, and landings challenging. In fact, one of the safety notices issued by the manufacturer indicates that one should never fly at night unless one has clear weather



*Aerial view of the Saint-Ferdinand area*

with unlimited or very high ceilings, and plenty of celestial or ground lights for reference. While the ceiling was high the night of the accident, there were few ground lights and no celestial light, increasing the risk of spatial disorientation.

Being aware that disorientation can occur during flight and conducting a proper instrument check can prevent these problems. Awareness of the risk of spatial disorientation is one of the best ways to prevent related accidents, and most of the strategies to reduce the risk of spatial disorientation involve pre-flight preparation. Just because a pilot becomes spatially disoriented does not necessarily mean loss control of the aircraft will occur. That said, in all likelihood, the pilot of the helicopter lost control of the aircraft shortly after take-off due to spatial disorientation.

If taking off down the centreline of Runway 23, the pilot would have had visual references provided by the villages of Bernierville and Saint-Ferdinand. However, assuming the pilot made a left turn after take-off, visual references would have been greatly reduced, and the pilot would have found himself in a black hole. The pilot's night vision may have been affected by the transition from the bright lights of the village to darkness. Although the Transportation Safety Board (TSB) could not determine the light intensity provided by the instrument panel and the GPS696 in the cockpit, inappropriate settings can also hamper night vision, making it difficult for the pilot to make out the few outside visual references available to help maintain spatial orientation. Moreover, the angular acceleration created during the left turn may have



given the pilot the impression of turning in the opposite direction once the aircraft had finished turning, an impression that can last anywhere from 10 to 20 seconds. That length of time would have been enough for the pilot to lose control of the aircraft, especially when coupled with the fact that there were few outside visual references.

The pilot may have tried to control the helicopter with reference to flight instruments, as trained to do. However, the pilot did not have practical instrument flying experience, and had had little exposure to night flying outside metropolitan areas. As a result, the pilot may have become rapidly spatially disoriented.

The number of private helicopter licence holders in Canada more than doubled in the space of 20 years. This number has continued to grow, and could increase even more if the current 320 student-pilot permit holders obtain their licences. Sixty percent of private helicopter pilots in Quebec are night rated, which may explain why 5 out of the 6 accidents that occurred at night were in Quebec.

The popularity of the R44 has grown in recent years, as evidenced by the number manufactured. Almost 60% of the R44s in the country are privately operated, and 43% of these are operated in Quebec. Although 35% of private helicopter accidents in Canada over a 10-year period involved the R44, the majority were due to pilots having trouble controlling the aircraft rather than to mechanical problems.

Given the growing number of private helicopter pilots, it is reasonable to assume that there will be an increase in night-rated pilots. It is difficult to predict the impact that this increase could have on the number or rate of night-flying accidents involving all types of helicopters combined. However, it is reasonable to believe that the minimum requirements necessary to obtain a private helicopter pilot night rating may not be sufficient to adequately educate and demonstrate to private helicopter pilots the risks involved in night flying, including visual illusions that could lead to spatial disorientation. Present night-rating requirements are the same for private helicopter pilots as for private fixed-wing aircraft pilots, yet the environments in which they may operate at night can vary greatly.

According to Robinson Helicopter Company Safety Notices SN-18 and SN-26, helicopters have less inherent stability and much faster roll rates than aeroplanes. Loss of the pilot's outside visual references, even for a moment, can result in spatial disorientation, wrong control inputs, and loss of control.

The circumstances surrounding this accident attest to the risk of spatial disorientation during night visual flight rules (VFR) operations, and reinforce the importance of the warnings included in safety notices SN-18 and SN-26 issued by the manufacturer.

#### *Findings as to causes and contributing factors*

1. The pilot had few outside visual references during the night flight.
2. The pilot probably lost control of the aircraft shortly after take-off due to spatial disorientation.

#### *Findings as to risk*

1. Take-off at night from an unlit aerodrome increases the risk of collision with obstacles or the ground.
2. Pilots without extensive night flight experience outside well-lit areas are at higher risk for spatial disorientation.
3. When information in the Canadian Beacon Registry is not updated following a change in owner or registration, additional efforts are required to find the owner's contact information, which could delay the deployment of search-and-rescue services.
4. It is possible that the minimum requirements to obtain a private helicopter-pilot night rating may not be sufficient to adequately educate and demonstrate to private helicopter pilots the risks involved in night flying, including visual illusions that could lead to spatial disorientation.

#### *TSB Final Report A12A0085—Engine Failure and Hard Landing*

On August 12, 2012, a Bell 407 helicopter was slinging a drill tower approximately 4 NM southwest of Wabush, N.L. While approaching the drill base frame, the helicopter lost engine power, then immediately descended and yawed to the left. The pilot released the drill tower before the helicopter struck the terrain. The pilot, who was the sole occupant, sustained minor injuries and was able to exit the aircraft. The helicopter was substantially damaged, and the 406-megahertz emergency locator transmitter activated as a result of the impact. There was no post-crash fire. The accident occurred in daylight hours at 1300 Atlantic Daylight Time. *The TSB authorized the release of this report on October 2, 2013.*



*Occurrence third-stage power turbine wheel*

### Analysis

The third-stage turbine wheel failed due to the overstress extension of high-cycle fatigue cracks in the blade trailing edges, in a manner consistent with a known pattern, resulting in a loss of engine power. Rolls-Royce Corporation (RRC) has not been able to specifically identify what engine operating condition, or conditions, cause the tensile residual stresses to be induced at the blade hub trailing edges. Also, it is unknown what extended engine operations are being conducted in the 68.4% to 87.1% power turbine speed ( $N_2$ ) range. As a result, there is a continued possibility of engine failure, in turn increasing the risk of injury and helicopter damage.

After the power loss occurred, the collective lever was not immediately lowered, and no action was taken to correct the left yaw. When the collective lever is not immediately lowered, main rotor speed ( $N_R$ ) may decrease to a point where loss of control of the helicopter may result. Additionally, anti-torque input must be applied to maintain directional control. The engine power loss occurred with the helicopter operating in the height-velocity diagram (HVD) “avoid” range, and it cannot be determined whether immediate action to maintain  $N_R$  and directional control would have reduced injury or helicopter damage. When there is a delay in carrying out the required actions to maintain control following an engine power loss, there is an increased risk of injury and helicopter damage.

The helicopter was operating within the HVD avoid range. The engine power loss occurred at an altitude from which a safe landing could not be assured, resulting in minor injury and substantial helicopter damage.

The pilot was not wearing a flight helmet, and no head injuries were sustained. Despite the recognized benefits of head protection, there are no regulations for helicopter pilots to wear helmets. When helicopter pilots do not wear flight helmets, they are at a higher risk of head injuries incurred in a crash.

### Findings as to causes and contributing factors

1. The third-stage turbine wheel failed due to the overstress extension of high-cycle fatigue cracks in the blade trailing edges in a manner consistent with a known pattern, resulting in a loss of engine power.
2. The engine power loss occurred at an altitude from which a safe landing could not be assured, resulting in minor injury and substantial helicopter damage.

### Findings as to risk

1. Rolls-Royce Corporation has not been able to specifically identify what engine operating condition, or conditions cause the tensile residual stresses to be induced at the blade hub trailing edges. As a result there is a continued possibility of engine failure, in turn increasing the risk of injury and helicopter damage.

2. When there is a delay in carrying out the required actions to maintain rotor speed following an engine power loss, there is an increased risk of injury and helicopter damage.
3. When helicopter pilots do not wear flight helmets, they are at a higher risk of head injuries incurred in a crash.

### TSB Final Report A1200138—Collision with Terrain

On August 24, 2012, a Cessna 172S rented from a local flying club departed the Kitchener/Waterloo Airport (CYKF), Ont., at 1815 Eastern Daylight Time, under visual meteorological conditions. The aircraft flew to Niagara Falls, Ont., then to the city of Toronto, Ont., and back to a practice area north of Kitchener Waterloo. At approximately 2016 Eastern Daylight Time, the aircraft crashed into a field, 25 NM north of CYKF. The aircraft was destroyed; the pilot and 3 passengers were fatally injured. There was no post impact fire. The emergency locator transmitter activated upon impact. *The TSB authorized the release of this report on December 18, 2013.*



### Analysis

The aircraft was complete and intact before the impact. There was a fracture with the stall warning system, but the effect of the fracture on the stall warning system operation could not be determined. No other abnormalities with the aircraft or its systems were discovered. The pilot was appropriately licensed, and was certified and qualified in accordance with the applicable regulations.

It was determined that the passengers switched seats during the flight. Currently, no regulation prohibits passengers from exchanging seat positions while the aircraft is airborne. However, because of the confined cabin space and proximity to the pilot and the flight controls, it is not a safe practice; switching seats could lead to inadvertent contact with the flight controls or the pilot, affecting the controllability of the



aircraft. Movement within the cabin would also shift the aircraft's centre of gravity, possibly adding to control issues. The seat exchange was not a factor in the occurrence, as all occupants were seated and wore their seat belts and shoulder harnesses.

The investigation determined that the aircraft entered a spin. Therefore, this analysis focuses on reasons for stall/spin entry and non-recovery.

The aircraft was not approved for spins when operated in the normal category. This limitation was stated in the pilot's operating handbook (POH) and on a placard located in the aircraft. The flying club's policies also prohibited spins without an instructor on-board.

The aircraft climbed to a higher altitude and broadcast the intention of performing airwork in the practise area, indicating that the pilot intended to perform some type of manoeuvre (airwork). However, it could not be determined whether the spin was entered intentionally or unintentionally; both possibilities are discussed in this analysis.

The pilot held a Commercial license, was experienced on the aircraft type, and was aware of the limitations and company

policies. If the spin was entered intentionally, then the limitations and policies were ignored. The pilot may not have realized that exceeding these limitations may change the stall recovery characteristics of the aircraft.

The spin may have been entered unintentionally. As discussed, a stall must precede a spin manoeuvre. If an aircraft is slowed, the airspeed can decrease to a point that a stall may occur. Additionally, the stall speed increases with the angle of bank. While manoeuvring, the aircraft may have been intentionally slowed and/or banked, resulting in an unanticipated stall occurring with an aft centre of gravity (CG). Also, if the stall warning was either erroneous or absent, the aircraft may have stalled with little or no prior warning from the stall warning horn.

During the spin, the angle of attack increased due to an aft CG. As a result, the horizontal tail likely blanketed the airflow over the rudder, reducing its efficiency and delaying spin recovery. In the normal category, the aircraft is certified to recover from a one-turn spin in less than one additional turn, assuming the proper control inputs are applied.

#### *Finding as to causes and contributing factors*

1. The aircraft entered a spin in a weight and balance configuration for which spins were not authorized; the pilot did not recover from the spin prior to ground impact.

#### *Findings as to risk*

1. If passengers switch seat positions during flight in a small aircraft, there is an increased risk of inadvertent flight control movement as well as a risk of causing the centre of gravity to shift, possibly adding to control issues.
2. If a stall warning horn is damaged, it may activate too late or fail to activate, increasing the risk that pilots are not warned of an impending stall in a timely manner.

#### *Safety Action Taken*

##### **Flying club**

Since this occurrence, the flying club implemented the following measures to its flight program and aircraft:

- Re-emphasized to all pilots the difference between operations in the "Normal" and "Utility" categories as well as the club's policies regarding the requirement that an instructor be on-board to perform airwork;
- Strengthened the airwork component of their groundschool programs.

The flying club's entire fleet will also be equipped with a global positioning system (GPS) tracker and a cockpit voice recorder.

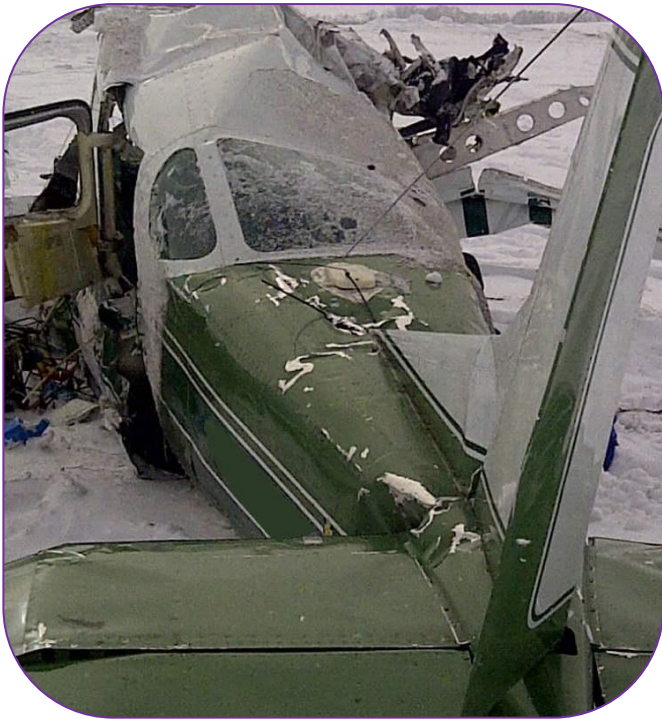




## TSB Final Report A13C0014—Continued Visual Flight Into Instrument Meteorological Conditions—Collision With Terrain

*This accident received additional media attention due to the fact that the three passengers were young local boys from the small community of Waskada, Man. Knowing a little more about the real impact the accident had on their community seems to bring the safety message a little closer to home, and personal. —Ed.*

On February 10, 2013, at approximately 12:30 CST, a privately registered Cessna 210C departed a private airstrip located at Waskada, Man., with a pilot and three passengers on board for a sightseeing flight in the local area. Approximately 30 min after the aircraft departed, fog moved into the area. At 13:17 CST, an ELT signal was received in the area. A search was undertaken and the wreckage was located 3 NM north of Waskada. All occupants suffered fatal injuries. There was no post crash fire. *The TSB authorized the release of this report on January 29, 2014.*



### History of the flight

The pilot had recently acquired the aircraft and had accumulated approximately 5 hr of flight time on it since its purchase. Although aware of the reported poor weather in the area, the pilot wanted to get some more flight hours on his new aircraft and considered that the local weather was suitable for a VFR flight. The pilot was planning to tour the local area, then fly to Brandon, Man., for lunch.

### Winter weather conditions and whiteout

The accident occurred in an area of gently rolling hills, which were completely snow covered. There were few trees or other features to provide visual references. The terrain, coupled with the reported meteorological conditions, was conducive to whiteout. Section AIR 2.12.7 of the *Transport Canada Aeronautical Information Manual* (TC AIM) states:

Whiteout (also called milky weather) is defined in the *Glossary of Meteorology* (published by the American Meteorological Society) as:

*An atmospheric optical phenomenon of the polar regions in which the observer appears to be engulfed in a uniformly white glow. Neither shadows, horizon, nor clouds are discernible; sense of depth and orientation is lost; only very dark, nearby objects can be seen. Whiteout occurs over an unbroken snow cover and beneath a uniformly overcast sky, when with the aid of the snowblink effect, the light from the sky is about equal to that from the snow surface. Blowing snow may be an additional cause.*

Flight in whiteout conditions may result in a poorly defined visual horizon that affects the pilot's ability to judge and stabilize aircraft attitude or reduces the pilot's ability to detect changes in altitude, airspeed and position. If visual cues are sufficiently degraded, the pilot may lose control of the aircraft or fly into the ground or surface of the water.

The TC AIM recommends that pilots avoid such conditions unless the aircraft is equipped with the suitable instruments, and they are sufficiently experienced. In order for a pilot to escape from whiteout conditions, it is necessary to either effectively transition from visual to instrument flight or be able to quickly regain sight of visual contrast. If at low level, a climb or a turn toward an area where sharp terrain features can be seen should be initiated. It is generally considered to be a difficult task for even an experienced instrument pilot to make a successful transition from visual to instrument flight after inadvertent entry into instrument meteorological conditions (IMC).

Vision is the dominant sense enabling pilot spatial orientation. Peripheral vision is the primary source of spatial orientation, with vestibular organs and kinesthetic sensors also contributing. In the absence of adequate visual cues when peripheral vision is limited, vestibular and kinesthetic illusions or false impressions can occur. This sometimes results in pilot disorientation and loss of situational awareness, which can lead to loss of aircraft control. In IMC, the pilot must rely on instruments instead of instinct to overcome illusions or false impressions. In visual meteorological conditions (VMC), the pilot relies on outside references to control the aircraft.



*Emergency personnel and TSB investigators at the crash site near Waskada, Manitoba. This photo of the accident site illustrates how the area was conducive to whiteout.*

#### **Inadvertent flight into IMC and loss of control**

Transport Canada has published many articles concerning whiteout and flight into IMC with no instrument rating endorsement. The information available concerning inadvertent flight into IMC by unqualified pilots and the inevitable outcome is widely available in documents such as Transport Canada publication number TP 2228E-1: [Take Five for Safety—178 Seconds](#).

#### **Analysis**

No aircraft technical malfunction was identified.

The meteorological conditions at takeoff were VMC, but some areas of IMC were forecast in the graphic area forecast (GFA).

The snow-covered terrain, combined with the meteorological conditions, was conducive to whiteout. In whiteout conditions, the snow and fog would blend together and under these conditions, the pilot would not be able to fly using visual references. Whiteout would also make it more difficult to identify an area of local fog and more difficult to exit such an area if it were encountered.

It is therefore probable that the pilot encountered whiteout conditions and was unable to accurately judge, through visual reference, his altitude above the ground. In the absence of a visible horizon, the pilot likely experienced spatial disorientation, particularly if he initiated a turn to avoid the deteriorating weather. The pilot's lack of instrument training and experience would have made him more susceptible to the effects of whiteout and spatial disorientation.

#### **Findings as to causes and contributing factors**

1. The meteorological conditions in the area were conducive to whiteout.
2. The pilot likely flew inadvertently into IMC and lost situational awareness and control of the aircraft, resulting in impact with terrain.

#### **Finding as to risk**

1. Aircraft equipped with 121.5 MHz ELTs, which require procedures to be followed that take more time than 406 MHz ELTs, are at increased risk of delay in the initiation of search and rescue procedures. [△](#)

## **Flying an unmanned air vehicle?**

You may need special permission from Transport Canada

[tc.gc.ca/safetyfirst](http://tc.gc.ca/safetyfirst)

**Canada**

## Accident Synopses

*Note: The following accident synopses are recent Transportation Safety Board of Canada (TSB) Class 5 events. These occurrences do not meet the criteria of classes 1 through 4, and are recorded by the TSB for possible safety analysis, statistical reporting, or archival purposes. The narratives may have been updated since publication. Unless otherwise specified, photos are provided by the TSB. For more information on any individual occurrence, please contact the TSB.*

— On November 1, 2013, a **de Havilland DHC6 Twin Otter** landed on Runway 09 at Sanikiluaq Airport (CYSK), Nun. During the landing roll, the pilot lost directional control. The aircraft came to rest approximately 100 ft off the runway and sustained substantial damage. The two pilots on board were not injured. The wind at the time of the occurrence was from 010° at 25 kt, with gusts up to 35 kt. The aircraft manufacturer's crosswind limitation listed in the flight manual was 26 kt. After the accident, a special weather reading was taken and it reported winds coming from 350° at 25 kt, with gusts of 37 kt. The operator performed a safety management system (SMS) investigation of the event and of company policies. The investigation resulted in the implementation of many corrective actions to prevent similar incidents from occurring. *TSB File A13Q0185.*

— On November 3, 2013, an **amateur-built Murphy Elite** was in the landing phase for Runway 24 at St-Georges-de-Beauce Airport (CYSG), Que., when its right landing gear broke. The aircraft veered off the runway and, at the same time, the left gear separated from the fuselage. The propeller and wing tips touched the ground before the aircraft came to a stop. The pilot and owner of the aircraft had installed a conventional wheeled landing gear the day before. A post-accident aircraft examination revealed that the landing gear's mounting bolts (AN4-23) were unscrewed. No washers had been installed under the nuts and the bolts were a bit too short to keep the nuts from loosening. The pilot was not injured; the passenger suffered minor injuries. *TSB File A13Q0189.*

— On November 4, 2013, a **Calidus AutoGyro gyroplane**, with only the pilot on board, was conducting touch-and-gos at Rivière-du-Loup Airport (CYRI), Que. During landing, one of the wheels hit the ground hard and the aircraft fell on its right side. The pilot was not injured. The aircraft was substantially damaged. *TSB File A13Q0193.*

— On November 7, 2013, privately-owned **Cessna 182P** with one person on board departed Cornwall, Ont., for Owen Sound, Ont. A VFR flight plan was filed prior to departure with an estimated time of arrival (ETA) in Owen Sound of 0040 UTC. The last radio communication with the aircraft occurred approximately 85 NM east of Midland, Ont., while the aircraft was at 6 500 ft AGL, with a ground speed of 110 kt and in marginal weather conditions including snow squalls. Due to the location of the flight path, radar coverage was lost around the same time as the last communication. At 0140 UTC, approximately one hour after the ETA, the London flight information centre (FIC) contacted the Trenton Joint

Rescue Coordination Centre (JRCC Trenton) and a search was initiated along the estimated flight path. The following day, aircraft debris was found on the water approximately 4.8 NM north of Wasaga Beach, Ont., along the direct path to Owen Sound airport. Aircraft identification was based on the colours of the debris found on the water. The search for the aircraft had been hampered by the weather. Human remains were found on April 30, 2014, in the area of Big Sand Bay, Christian Island, Ont. Forensic examination positively identified the remains as those of the missing pilot. *TSB File A13O0213.*

— On November 13, 2013, a **float-equipped Cessna R172K** with only the pilot on board was taxiing on Lake Beverly, located south of Smiths Falls, Ont. Wind conditions were 15 to 20 kt with higher wind gust values. As the aircraft was turning for the takeoff run, a gust lifted the tail of the aircraft; it nosed over in the water and became inverted. The pilot was wearing a three-point harness and was not injured. The pilot evacuated and sat on the floats until search and rescue (SAR) personnel arrived at the scene. *TSB File A13O0214.*

— On November 14, 2013, a privately owned **Cessna 150G** took off from Victoriaville Airport (CSR3), Que., for Sainte-Croix de Lotbinière, Que., on a VFR flight with two occupants on board. At Laurier Station, the pilot conducted an approach on a road in a field to see whether a landing was possible. After pulling up to go-around, the aircraft turned right. The right stabilizer struck a power line and the aircraft crashed in a wooded area. The two occupants suffered minor injuries. The aircraft was substantially damaged. *TSB File A13Q0194.*

— On November 16, 2013, a **Pezetel SZD-50-3 glider** was being towed for takeoff; it was approximately 10 ft in the air when the speed brakes partially deployed. The tow cable was released and the glider landed hard, damaging the fuselage and the spoilers. There were no reported injuries. *TSB File A13O0218.*

— On November 18, 2013, a **Pipistrel Virus 912SW** was returning to Abbotsford, B.C., due to poor weather about 3 min after departing for Pitt Meadows, B.C. ATC cleared the pilot to land on any runway and saw the aircraft circle and proceed westbound along Highway 1 before it disappeared off radar. ATC was unable to re-establish communication with the pilot. Search and rescue (SAR) helicopters were dispatched to an area where a faint and erratic emergency locator transmitter (ELT) signal was picked up. Ground SAR technicians located the wreckage on the north side of Maclure Road about 4 mi.



from Abbotsford airport. The sole occupant was fatally injured. *TSB File A13P0291*.

— On November 20, 2013, a privately owned **Piper PA-28R-200** took off on a VFR flight from St-Hyacinthe Airport (CSU3), Que., to Mascouche Airport (CSK3), Que., with only the pilot on board. On arrival at his destination, the pilot did not extend the landing gear and the aircraft landed on its belly. No anomaly was noted before or after the accident. The propeller was substantially damaged. The pilot was not hurt. *TSB File A13Q0197*.

— On November 22, 2013, a **M20BX Mooney** was landing at Yorkton Municipal Airport (CYQV), Sask. The landing gear was selected down. The GUMPS (Gas, Undercarriage, Mixture, Propeller, Seat belts and Switches) check was performed on the downwind leg and again on final approach. The initial touchdown and landing rollout were uneventful. Toward the end of the landing roll, the landing gear handle became unlatched and moved to the gear up position. The landing gear collapsed as the aircraft came to a stop. *TSB File A13C0162*.

— On November 29, 2013, a **Quad City Challenger II ultralight** was completing circuits at Baldwin Airport (CPB9), Ont. During takeoff from Runway 01, while climbing through 200 ft to 300 ft, the aircraft suffered a power loss (Rotax 503) and the pilot attempted to turn right to return to the field. During this turn, the aircraft stalled and impacted the ground in a wooded area 200 m west of the departure end of the runway. The aircraft was destroyed on impact; however, the pilot, who was wearing a helmet and four-point seatbelt, suffered only minor injuries. *TSB File A13O0223*.



*TSB File A13O0223*

— On December 6, 2013, a **Beechcraft C23** was conducting a VFR flight from Rivière-du-Loup Airport (CYRI), Que., to Rimouski Airport (CYXK), Que., with a pilot and a passenger on board. While the aircraft was cruising, the engine (Avco Lycoming O-360-A4K) started to vibrate and lose power. The pilot conducted an emergency landing on Route 132, heading west. After landing, the aircraft veered off the road to avoid a vehicle and came to a stop in a ditch. No one was hurt but the aircraft was substantially damaged. There was no post-impact fire. The engine will be examined in order to find the cause of the problem. *TSB File A13Q0205*.

— On December 14, 2013, a **Cessna 421B**, with two persons on board, was flying IFR en route from Abbotsford, B.C., to Tofino, B.C. The aircraft was lost on ATC radar in the vicinity of Tofino. A search commenced and the aircraft wreckage was located the following morning on Vargas Island, about 11 NM northwest of Tofino Airport. Both persons on board are assumed fatally injured as the aircraft was partially buried in a marsh, and the bodies were not visible. There was no fire. *TSB File A13P0305*.



*The Cessna 421B that crashed on Vargas Island, B.C.  
(photo: Ray Barber / Airport-data.com)*

— On December 14, 2013, a **Cessna P210N** was departing Lloydminster Airport (CYLL), Alta., on an IFR flight to High River Airport (CEN4), Alta. Shortly after departure, the aircraft collided with terrain 1.6 NM northeast of CYLL. The aircraft tumbled and slid into a residential home causing some damage to the home. No occupants of the home were injured. The pilot, who was the sole occupant of the aircraft, was fatally injured. There was a small post-impact fire that was extinguished by first responders. *TSB File A13W0188*.

— On December 22, 2013, a **Sikorsky S76A helicopter** had been dispatched to a private residence. The crew performed two low reconnaissance passes and chose an approach to the east over some wires to land on a wide part of the driveway near the house. The on-board medics were placed on live intercom and were briefed to report on any observed obstacles.

The crew selected continuous ignition and entered a high hover to blow away snow accumulation at the scene. The crew was avoiding a park bench to the left. During the manoeuvre, a whiteout condition was created. As the visibility cleared, the crew descended but the helicopter inadvertently drifted aft and to the right. The crew received a warning that trees were in close proximity at the four o'clock position immediately prior to main rotor contact with the trees. Control was maintained and the helicopter was moved away. A landing was performed straight ahead. The rotor was unbalanced, and the crew were briefed not to exit until the helicopter had been shut down. There were no injuries. The helicopter sustained damage to all four rotor blades. *TSB File A13C0182.*

— On January 14, 2014, a **Cessna 337G** was returning from an aerial survey with the pilot and one passenger on board. The aircraft was on approach for Runway 30 at Dryden Regional Airport (CYHD), Ont., and landed with the landing gear retracted. There were no injuries and the aircraft sustained substantial damage. Information indicated that the pilot was very busy during the final approach and did not hear the gear warning horn. *TSB File A14C0011.*

— On January 15, 2014, a privately owned **Piper PA-20-115** was conducting a training flight on Runway 23 at Trois-Rivières Airport (CYRI), Que., with two pilots on board. During the second touch-and-go, the aircraft veered to the left during the landing roll. The pilot tried to correct the aircraft's trajectory using the control column. The aircraft veered off the runway, struck a snow bank and flipped over. The two occupants were uninjured in the accident. *TSB File A14Q0006.*

— On January 19, 2014, a **Cessna 150M** was taxiing for a local training flight at Saskatoon/John G. Diefenbaker International Airport (CYXE), Sask. The aircraft was taxied behind an ATR completing an engine run-up. The instructor estimated the distance between the Cessna and the ATR to be about 120 to 150 m. The propeller wash from the ATR lifted the left wing of the Cessna 150, causing the right wing tip and propeller to strike the ground and sustain substantial damage. There were no injuries. *TSB File A14C0014.*

— On January 21, 2014, a **Diamond DA 20-C1** was on a round trip training flight, from Fredericton, N.B., to Moncton, N.B., with the student pilot as the sole occupant. At about 10 NM northeast of Fredericton International Airport (CYFC), the aircraft engine lost power and the pilot declared a MAYDAY before the aircraft impacted terrain. The pilot used a cellular telephone to alert first responders who located the

site about two hours later and transported the pilot to hospital with injuries. Examination of the wreckage determined that the aircraft lost power due to fuel exhaustion. *TSB File A14A0004.*

— On January 23, 2014, a **Bell 206B** helicopter had just been started with a ground power unit (GPU) at Haines Junction Airport (CYHT), Y.T. The pilot exited the aircraft in order to disconnect the GPU, when a gust of wind pushed the helicopter into the trees next to the helipad. The pilot was not injured. *TSB File A14W0010.*

— On January 25, 2014, a **Cessna 152** was on a flight from St. Andrews, Man., to Lac du Bonnet Regional Airport (CYAX), Man. The pilot conducted a low pass to inspect the runway before landing. On touchdown, the aircraft encountered snow up to 12 in. deep. The aircraft veered left to the edge of the runway, struck a snow drift and overturned. The pilot and passenger exited without injuries. The aircraft sustained substantial damage to its wings, tail and propeller. *TSB File A14C0018.*



*TSB File A14C0018*

— On January 27, 2014, a **Schweizer 269C-1** helicopter with two persons on board was operating at low level along the Pitt River, B.C., north of Pitt Lake, B.C. The helicopter struck something on the ground. The pilot lost control and the helicopter rolled over. Both persons on board escaped with minor injuries. The 406 ELT activated, and the aircraft was located by search and rescue (SAR). The two occupants were hoisted aboard and flown to Abbotsford. *TSB File A14P0010.*

**CATS CAN SEE IN  
THE DARK...**



**YOU CAN'T**

**BE AWARE OF THE  
HAZARDS OF NIGHT FLYING**



Transport  
Canada

Transports  
Canada

TP 13717E  
(02/2001)

Canada



# EACH TAXI SCENARIO IS DIFFERENT. BE SURE!



## RUNWAY INCURSIONS ARE REAL!



Transport  
Canada

Transports  
Canada



Canada

# 2014 Flight Crew Recency Requirements

## Self-Paced Study Program

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*Refer to paragraph 421.05(2)(d) of the Canadian Aviation Regulations (CARs).*

*Completion of this questionnaire satisfies the 24-month recurrent training program requirements of CAR 401.05(2)(a). It is to be retained by the pilot.*

*All pilots are to answer questions 1 to 33. In addition, aeroplane and ultra-light aeroplane pilots are to answer questions 34, 35 and 36; helicopter pilots are to answer questions 36, 37 and 38; glider pilots are to answer questions 39 and 40; gyroplane pilots are to answer question 41; and balloon pilots are to answer question 42.*

**Note:** *References are listed at the end of each question. Many answers may be found in the Transport Canada Aeronautical Information Manual (TC AIM). Amendments to that publication may result in changes to answers and/or references. The TC AIM is available online at:*

<http://www.tc.gc.ca/eng/civilaviation/publications/tp14371-menu-3092.htm>

1. A runway incursion is any occurrence at an aerodrome involving the incorrect presence of \_\_\_\_\_ on the protected area of a surface designated for the landing and takeoff of aircraft.  
(GEN 5.1)
2. How are temporarily displaced thresholds marked? \_\_\_\_\_  
(AGA 5.4.1 NOTE)
3. At a Transport Canada certified airport, a dry wind direction indicator (windsock) that is blown horizontal indicates a wind speed of \_\_\_\_\_.  
(AGA 5.9)
4. On initial contact with an FSS through an RCO, pilots should state the name of the \_\_\_\_\_ controlling the RCO, the aircraft identification, and \_\_\_\_\_.  
(COM 5.8.3)
5. Before using a cell phone to contact ATS in the event of an in-flight radio communications failure, you should \_\_\_\_\_ and squawk Code \_\_\_\_\_.  
(COM 5.15)
6. Refer to a recent copy of the Canada Flight Supplement (CFS). What is the TAF period of coverage and issue times for Whitehorse/Erik Nielson Intl Airport? \_\_\_\_\_  
(MET 3.2.1 and CFS)
7. Open a recent copy of the Canada Flight Supplement (CFS) and locate the "Planning" section (section C). In the "VFR Chart Updating Data", read the information for your region of Canada. Record one of the topic names here: \_\_\_\_\_.  
(CFS)
8. Areas of showery or intermittent precipitation are shown on a GFA Clouds and Weather Chart as \_\_\_\_\_.  
(MET 3.3.11)

**TAF CYJT 041136Z 041212 24010KT ½ SM -SHRA -DZ FG OVC002 TEMPO 1213 3SM BR  
OVC008 FM 1300Z 29012G22KT P6SM SCT006 BKN015 BECMG 2123 30010KT SCT020 RMK  
NXT FCST BY 18Z=**

9. From the preceding TAF, what is the lowest forecast ceiling for CYJT? \_\_\_\_\_  
(MET 3.9.3)
10. From the preceding TAF, at what time could you first expect to have VFR weather in the CYJT control zone? \_\_\_\_\_  
(MET 3.9.3)
11. From the preceding TAF, what is the forecast visibility for CYJT after 2300Z? \_\_\_\_\_  
(MET 3.9.3)
12. What coded group is used, in an Upper Level Wind and Temperature Forecast (FD), when the wind speed is less than 5 kt? \_\_\_\_\_  
(MET 3.11)
13. In a METAR, wind direction is given in degrees true/magnetic.  
(MET 3.15.3)
14. **METAR CYBC 211700Z 0912G20 5/8SM BLSN VV007 M03/M05 A2969 RMK SN8 SLP105**  
In the preceding weather report, the prevailing visibility is \_\_\_\_\_ and the ceiling is \_\_\_\_\_.  
(MET 3.15.3)
15. Who is responsible for obstacle avoidance when a VFR aircraft is being radar vectored? \_\_\_\_\_  
(RAC 1.5.5)
16. If an ATC clearance is not acceptable, what should the pilot-in-command immediately do?  
\_\_\_\_\_.  
(RAC 1.7)
17. Which classes of airspace require the use of a functioning transponder? All Class \_\_\_\_\_ airspace and any Class \_\_\_\_\_ airspace specified as transponder airspace.  
(RAC 1.9.2)
18. When two aircraft are converging at approximately the same altitude, the pilot-in-command of the aircraft that has the other on its right shall give way, except as follows:  
(a) \_\_\_\_\_;  
(b) \_\_\_\_\_;  
(c) \_\_\_\_\_; and  
(d) \_\_\_\_\_.  
(RAC 1.10)
19. To preserve the natural environment of national, provincial and municipal parks, reserves and refuges, and to minimize the disturbance to the natural habitat, overflights of these areas should not be conducted below \_\_\_\_\_.  
(RAC 1.14.5)
20. What are the VFR cruising altitudes appropriate to an eastbound track above 3 000 ft AGL?  
\_\_\_\_\_.  
(RAC 2.3.1)
21. In controlled airspace, the minimum VFR flight visibility is \_\_\_\_\_ mi., and the minimum distance from cloud is \_\_\_\_\_ horizontally and \_\_\_\_\_ vertically.  
(RAC 2.7.3)



22. Before entering Class C airspace, VFR flights require \_\_\_\_\_ from ATC and before entering Class D airspace, VFR flights must \_\_\_\_\_ ATC unit.  
(RAC 2.8.3 and 2.8.4)
23. An aircraft could be permitted in Class F restricted airspace only if \_\_\_\_\_.  
(RAC 2.8.6)
24. Pilot Briefing Services are available at telephone number \_\_\_\_\_.  
Bilingual Pilot Briefing Services are available at telephone number \_\_\_\_\_.  
(RAC 3.2)
25. After asking the passengers for their personal weights, what weight should be added for clothing on a winter flight? \_\_\_\_\_.  
(RAC 3.5.1)
26. A flight itinerary may be filed with a responsible person. A “responsible person” means an individual who has agreed to ensure that an overdue aircraft is reported to \_\_\_\_\_.  
(RAC 3.6.2)
27. The closing of a flight plan or flight itinerary prior to landing is considered as filing an arrival report, and as such, it will result in \_\_\_\_\_.  
(RAC 3.12.2)
28. Where possible, pilots are required to report at least \_\_\_\_\_ min prior to entering an MF or ATF area.  
(RAC 4.5.7)
29. **140230 CYUL ST-JEAN**  
**CYJN UNMANNED AERIAL VEHICLE OPS RADIUS 1.1 NM CENTRE**  
**451813N 732553W (APRX 6 NM WNW AD) SFC TO 600 FT MSL**  
**1400-1900 DLY**  
**1403261400 TIL 1403271900**
- Refer to the NOTAM above. The UAV activity is expected to start at \_\_\_\_\_ UTC on \_\_\_\_\_ (date).  
(MAP 5.6.1)
30. An aircraft altimeter which has the current altimeter setting applied to the subscale should not have an error of more than \_\_\_\_\_ when compared to the known ground elevation.  
(AIR 1.5.1)
31. The effect of a mountain wave often extends as far as \_\_\_\_\_ NM downwind of the mountains.  
(AIR 1.5.6)
32. If the background landscape does not provide sufficient contrast you will/will not see a wire or cable while flying near power lines.  
(AIR 2.4.1)
33. The NAV CANADA Aviation Weather Web Site is found at  
[https://flightplanning.navcanada.ca/cgi-bin/CreePage.pl?Langue=anglais&NoSession=NS\\_Inconnu&Page=forecast-observation&TypeDoc=html](https://flightplanning.navcanada.ca/cgi-bin/CreePage.pl?Langue=anglais&NoSession=NS_Inconnu&Page=forecast-observation&TypeDoc=html)  
Go to the Forecasts and Observations Web page and familiarize yourself with the Aeronautical Information Circulars (AICs) and AIP Supplements. Record the most recent AIC number here: \_\_\_\_\_  
(NAV CANADA Web site)

## Aeroplane

34. Hydroplaning is a function of the \_\_\_\_\_, \_\_\_\_\_ and speed. Moreover, the minimum speed at which a non-rotating tire will begin to hydroplane is \_\_\_\_\_ than the speed at which a rotating tire will begin to hydroplane.

(AIR 1.6.5)

35. To achieve a turn of the smallest radius and greatest rate for a given angle of bank, fly at the \_\_\_\_\_ safe airspeed for the angle of bank.

(Use aeroplane references)

## Aeroplane and helicopter

36. In addition to the classic whiteout condition of unbroken snow cover beneath a uniformly overcast sky, name two other phenomena that are known to cause whiteout. \_\_\_\_\_, and \_\_\_\_\_.

(AIR 2.12.7)

## Helicopter

37. On a two-bladed helicopter with a teetering rotor system, a flight manoeuvre that causes even a small amount negative G force could result in \_\_\_\_\_.

(Use helicopter references)

38. What are the two methods of recovery from a vortex ring state? \_\_\_\_\_ or \_\_\_\_\_.

(Use helicopter references)

## Glider

39. During a medium banked turn on tow, the glider's nose should be pointed towards the towplane's \_\_\_\_\_.

(Use glider references)

40. What should you do when slack in the towline is excessive or beyond a pilot's capability to safely recover? \_\_\_\_\_

(Use glider references)

## Gyroplane

41. If a gyroplane took off with its centre of gravity aft of the longitudinal limit, the aircraft may not be able to establish level flight, even with maximum \_\_\_\_\_ cyclic.

(Use gyroplane references)

## Balloons

42. No person shall operate a balloon over a built-up area without carrying on board sufficient fuel to permit the balloon to fly clear of the built-up area, taking into consideration the take-off weight of the balloon, the \_\_\_\_\_ and \_\_\_\_\_, and possible variations of those factors.

(CAR 602.18)

*Answers to this quiz are found on page 14 of ASL 3/2014.*