Transport Canada Transports Canada

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Issue 3/2018

AVIATION SAFETY LETTER

In this issue...

Learn from the mistakes of others;

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

Canada

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Please address your correspondence to:

Jim Mulligan, Editor
Aviation Safety Letter
Transport Canada (AARTT)
330 Sparks Street, Ottawa ON K1A 0N8
E-mail: TC.ASL-SAN.TC@tc.gc.ca
Tel.: 613-957-9914 / Fax: 613-952-3298
Internet: www.tc.gc.ca/ASL

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How to Increase the Number of Pilots and Retain Them

by André Durocher, IFR pilot

Flying may be a passion or just a way to move from one location to another. The weekend flyer flies with friends and family; the businessman flies to meetings. But the number of pilots has declined drastically since the 1980s… Why do pilots stop flying? And while we're asking, why do aviation amateurs fail to start? It could be the high cost, the lack of time, the low utility, the fear, etc.

Photo credit: iStock

The high cost and lack of time are easy to understand. What about utility? Here is my experience: A new and enthusiastic pilot gets his or her private (or recreational) licence and waits until the weather is in VMC (VFR meteorological condition) perhaps that weekend or perhaps the next (sometimes, it can take a while), and he or she enjoys a quick flight to a nearby destination (50 to 100 NM away). This is the so-called "$100 Hamburger"!

From what I've observed, while some newly licensed pilots may buy an aircraft shortly after (or on rare occasion, *before*) they obtain their licence, the vast majority of new pilots rent their aircraft. Indeed, if we cannot fly regularly—and most new pilots can't—it's more cost effective (and financially accessible) to rent an aircraft rather than buying one. However, renting an aircraft makes it difficult to leave for more than just a local flight because many flying clubs will either refuse to rent out their aircraft for multiple days or charge handsomely for it.

For the new pilot who flies under VFR, flying regularly can be a challenge, especially when faced with dicey weather conditions. For instance, the weather can be VMC en route to the destination but uncertain for the return trip. So, VFR pilots usually choose to stay close to home and eat more $100 Hamburgers—when the weather is cooperating. Don't forget that weather is one of the main factors in general aviation (GA) accidents.

New pilots gain more flying experience by flying within a 100-NM radius for a while, but they usually do so in hopes of eventually flying further away from the nest! After 1, 2, or 3 years of this local flying around, many pilots become bored of it. They end up flying less often, until they finally quit. The businessman tries, and hopes, to fly to his meetings but once he realizes that VMC weather does not necessarily coincide with his engagements, he will quit too.

This all leads us to fear, which can arise when a pilot doesn't fly enough. So not flying leads to increased anxiety about flying, which in turn causes the pilot to fly less often. This is bad for GA not only because there are fewer pilots in the air, but also because the pilots who are flying have less experience, a trend that can, sadly, be the cause of accidents.

One way to fly more often without being stopped by the weather, the only way as far as I know, is to get an IFR (instrument flight rules) rating. Of course, an IFR rating is sometimes prohibitively expensive, takes time to get, and requires a lot of studying, not to mention the TC (Transport Canada) written test at the end, which is a challenge to say the least. And there is more: after you get your licence you are required to fly a minimum number of hours and approaches, plus you'll require a renewal every 2 years. It's a huge step going from the VFR rating to the IFR rating. In fact, if you have an IFR rating, a commercial licence, and a minimum amount of experience, you can fly for an airline!

GA pilots need a new type of rating, an intermediate rating between the VFR and the IFR rating. Yes, the VFR over-the-top (OTT) rating exists but only allows the pilot to fly during the day and over the clouds, *if* he can climb in a scattered sky (that is, a sky with 50% or less cloud cover). Who can tell if the sky is 49% or 51% covered? Pilots also need a minimum vertical distance of 1 000 ft from the clouds and 5 miles visibility, and when they fly between two layers, the layers must be at least 5 000 ft apart. What do you do if the layers squeeze and the visibility falls down below 5 miles? With no practice, a pilot's flight into the clouds could be his or her last. The VFR OTT rating also doesn't seem to satisfy a need. After all, who is using it?

Photo credit: iStock

Europe and Australia have introduced the en-route flight rules (EFR) qualification to give more flexibility to GA pilots. A similar qualification in Canada could be a good option for GA pilots: it would be kind of similar to a VFR OTT qualification but a bit more advanced and less restrictive. With the EFR rating, a pilot could take off in VMC (for example, with a ceiling of 1 500 ft and a visibility of 3 NM), fly into and over the clouds, and descend at his VMC destination airport (e.g. 3 000 ft and a visibility of 5 NM). There would be a required forecast at the destination airport (e.g. 3 000 ft, 5 NM for +/- 2 hours of the ETA).

The EFR rating would open doors for VFR pilots by allowing them to fly more often and in non-VMC weather often found between point A and point B. New EFR pilots would use the services of air traffic control (ATC) and would become more accustomed to them. So many pilots are afraid to talk to ATC. So many pilots are unable to execute a 180° turn or to climb or descend into the clouds because they learned 10, 20, or 30 years ago and never practised it again. The EFR rating would be a step towards the IFR rating.

I believe that an EFR rating would help to keep, and add, more pilots up in the air. This would also reduce the number of accidents involving loss of control (LOC) and controlled flight into terrain (CFIT). In short, an EFR rating could improve the safety and utility of GA flying. Whether you believe it or not, some pilots prefer to hit the ground than to hit the clouds! What is your choice?

Blue sky or fly IFR…or perhaps, in the future, EFR! △

Situation Awareness and the General Aviation Pilot

by Kathleen Van Benthem, Ph.D., ACE Lab, Visualization and Simulation Centre, Carleton University, Ottawa, Canada

This article is the second in a series of reports from the Advanced Cognitive Engineering Laboratory at Carleton University, Ottawa, ON. We are pleased to share the results of our studies on human cognition and pilot risk. Each topic will follow this format: we will introduce aspects of cognition integral to flight safety. Interwoven in the narrative will be opportunities for you to contemplate what this information means for you.

What is situation awareness?

The second cognitive function we will highlight is *situation awareness*, or SA. While in the last issue we spoke about *prospective memory*, an important topic in aviation but one discussed less often, SA is perhaps one of the most commonly studied aspects of pilot cognition.

Your Turn: Take a minute and think about the last time you thought about your SA during flight. How would you define SA? According to your definition of SA, are you ever not using SA while you fly?

A frequently used definition of SA was first promoted in the late 1980s by Dr. Mica Endsley. In Endsley's characterization of SA there are three levels of information processing. Level One SA involves **detecting** information (i.e. you visually perceive an oncoming aircraft). Level Two SA takes Level One information and adds **meaning** to it, such as whether the other aircraft you just detected is a threat to your safety. Level Three SA is all about **predicting** the near-future state of elements in your world.[1] It is best not to think of SA in such a linear fashion, since you may already be thinking: how do I know if another aircraft is a threat unless I can first make a prediction of both our near-future locations? The key take-away from this definition of SA is that it involves stages of information processing, and that Level One SA is essential; without it you cannot make sense of the world, nor predict its future state. It is no surprise that SA has been described as "perhaps the most critical factor for achieving successful performance in aviation".[2] The importance of SA is also highlighted by the number of resources and safety nets that have been integrated into the aviation domain over the last few decades, such as independent GPS and airborne collision avoidance systems. Many features of modern cockpits are designed to enhance pilot SA.

Your turn: What do you think has the most impact on your successful performance in aviation?

At the ACE Lab at Carleton University we have spent more than a decade studying SA and general aviation. We have collected data on more than 200 participants and examined how age, expertise, cognitive factors, and context affect SA. We collected SA performance data in a series of experiments where the focus ranged from circuit flight, management of a surprise incursion, communication, diversion management, and navigation. Considering its importance, we have paid particular attention to how these factors affect SA Level One. We also surveyed the experiences of examiners and instructors in Canada to establish patterns of concern with general aviation (GA) pilots across the age range. The following discussion is a summary of some published findings:

Age-range issues. In a Canada-wide survey we asked flight examiners and instructors to compare competency and safety concerns for younger versus older pilots during flight training and also during currency checks.[3] Although SA was reported as an issue for both age groups, it was noted more frequently as a problem with older pilots, particularly when it came to currency reviews. When they were asked for reasons as to why pilots failed flight tests, SA was also cited more often for older pilots than for younger pilots. Flight simulation studies may explain these observations by examiners and instructors, as our findings show that all levels of SA are vulnerable to the effects of older age.[4-6] For example, older pilots may deviate from assigned altitudes, know fewer details about other relevant traffic, and incorrectly project their own and other aircraft locations. Level One SA appears particularly vulnerable to age effects, and this may be explained by the strong association of age with cognitive processing speed and visual attention. Therefore, older pilots may be slower in detecting relevant information from the environment and show reduced capacity to hold both visual and auditory information in short-term memory, compared to younger pilots. The association between cognition and aging is certainly not limited to pilots—with all aspects of "fluid" cognition showing effects of age in the general population.[7]

Your turn: What will you do to enhance your SA processes as you fly in your older years? Have you ever been surprised by elements of the environment that you had not detected as early as you should have?

Pilot expertise and task workload. A key question in flight simulation research pertains to whether higher levels of expertise result in better SA, and importantly, whether expertise can also protect against negative age effects. Our work, and that of others, clearly shows that more expert licences, higher ratings, and more recent and total hours flown tend to reflect better SA scores.[4-6] Expertise and workload are discussed together, as the true effects of pilot expertise are most easily observed when workload is high. When flying simple circuits in low-volume traffic with minimal communication requirements, most pilots will have good SA. However, when the mental workload is increased by adding traffic and communication demands (not to mention unexpected events), lower-licensed and lower-rated pilots begin to exhibit diminished SA, while expert pilot behaviour tends to continue to reflect good SA. A clear example of older age and the protective effects of expertise comes from the results of a simulation study in which 109 pilots were exposed to a surprise runway incursion while on approach.[7] As shown in Figure 1, age had a stronger impact on the low-expertise pilots, as compared to those pilots with higher levels of expertise. On average, the low-expertise pilots had scores that reflected a high risk for a collision due to poor Level One SA (which involved not detecting or correctly interpreting the aircraft on the runway). After the age of 70 years, the protective effect of expertise on managing the surprise incursion was diminished, but still very much present.

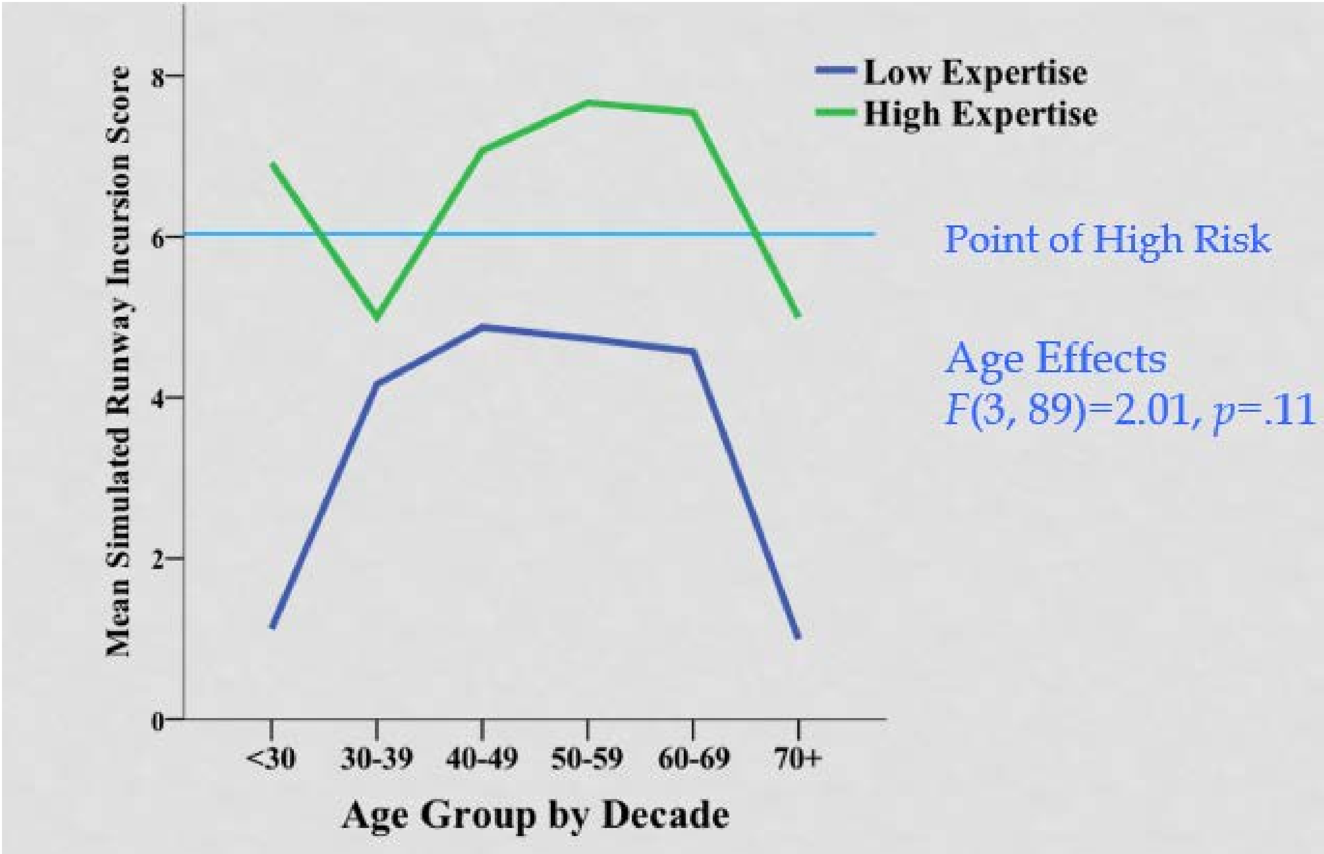

Figure 1. Influence of expertise on relationship between age and incursion management. Scores reflect the detection and quality of the management of the incursion. Figure from Van Benthem, K., & Herdman, C.M. (2015). Individual pilot factors predict simulated runway incursion outcomes. Presentation for the 17th International Symposium on Aviation Psychology. *Dayton, Ohio*.

Your turn: Have you considered how upgrading your licence and ratings might positively affect your SA and your ability to fly safely at and beyond the age of 70?

In summary, SA is a principal factor in pilot safety. Rather than being one unified construct, SA is essentially a dynamic state of awareness of the factors important to the task of flying. SA is produced by detecting information and assigning meaning to that information. Your SA is used for making predictions and decisions, and the success of those actions is contingent on the quality of the SA information. Something I like to mention when talking about SA is that awareness, while important, is not the reason pilots fly. Instead, pilots fly for many other reasons, including work, recreation, and transportation. SA is simply *the cognitive factor most involved in supporting* the safe and successful work, recreation, and transportation of pilots and their passengers.

Potential defences against low SA:

1. Be aware of situations in which you could be more vulnerable to low Level One SA and in which extra practice (on the ground), scanning out the window, and listening for details over the radio could lead to enhanced SA in flight. Vulnerable situations might include:
   a) Surprise events;
   b) High workload during takeoff and landing;
   c) A workload that is higher than expected at any point during the flight;
   d) A diminished underlying cognitive performance in processing speed and attention due to:
      - Older age
      - Fatigue
      - Use of new over-the-counter medications

- Stress
- An injury, such as a mild concussion (be sure to seek medical advice before flying in this case).

2. Evaluate whether you are flying in conditions in which your expertise does not meet the demands of the task and adjust your plans and tasks accordingly. For example:
   - Low recent pilot-in-command hours: Your mental resources will be taken up by procedural tasks, and less attention can be paid to SA-related processes;
   - High communication demands. The brain does not respond well to *competing and simultaneous* needs for visual and auditory information. This may lead to poor Level One SA.
3. Make use of the numerous aids available to pilots to enhance their SA. For example:
   - Learn how to use certified electronic navigational aids. Become adept at using these devices in simulated flight *first* to reduce unnecessary "heads down" time in the cockpit.
   - Visually inspect the details and locations of alternate aerodromes using charts, maps, and electronic devices before the flight.

We would appreciate hearing your thoughts on SA and safety in GA! Please send your comments to kathy.vanbenthem@carleton.ca and we will share them in the future. We hope you will enjoy the next report in the series where we will explore research on the topic of managing diversions during cross-country VFR flight. △

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My First Flight From VMC Into IMC

by Fred Grootarz, private pilot and typical weekend flyer

One Sunday afternoon in October, I decided to follow my friend in his 172 for a short flight from Burlington to Kitchener (CYKF). There were some broken rain clouds over the western sky at approximately 2 000 ft. Below that was clear, unobstructed visibility. My friend took off on Runway 14, made a right turn to about 270°, and aimed for a divided opening between the clouds (through the gap between the escarpment on the west side of the airport and the Milton continuation of the escarpment), heading directly towards Kitchener Airport. I saw him climbing through the opening gap and intended to follow him the same way.

However, before leaving the ramp I looked at my fuel gauges again and decided to top off my tanks at the self-serve pumps before flight, just in case I would have to divert to an alternative airport because of the weather. By the time I had taxied to the pumps, fought with the tangled ground wire, put the fuel in, and gotten my receipt from the machine, some 15 minutes had gone by. By this time my friend had just about landed in Kitchener. I should mention that I didn't let my friend know over the radio that I had decided at the very last minute to first get some more fuel in Burlington.

15 minutes later I finally took off from Runway 14, also with a right turn out. However, I noticed just before takeoff that that gap between the clouds had closed. So I decided to fly southwest towards Brantford and then turn north to Kitchener instead. I figured that by that time the cloud front had passed northbound and by the time I would reach Brantford, I would be behind and clear of that cloud front. Just before departure I called my wife to let her know I was flying with my buddy to Kitchener and then later back to Burlington. She was watching on TV the live Oktoberfest parade in Kitchener at that time and told me that it was raining in Kitchener at the moment. I acknowledged her observation and told her that by the time I would arrive in Kitchener by taking the little detour via Brantford, the rain in Kitchener would have passed on. I told her not to worry about me getting into bad weather.

So I took off with a right-turn climb-out heading directly for Brantford. To the east during my climb-out turn was nothing but clear, unobstructed sky, and that was the case with anything southeast of the Burlington Skyway bridge towards St. Catharines.
However, looking ahead southwest, I was facing the solid cloud overcast. At this time I had reached an altitude of 1 900 ft and figured that that was the highest I would climb to stay well below the cloud level in front of me. I looked left and could clearly see Hamilton Airport. That was just outside the northern arc of Hamilton's control zone.

When I turned my head and looked forward again, I had just flown into a cloud in front of me. I looked down and expected to see patches of ground again, as I believed that was just a very little bit of intermittent cloud. After all, 30 seconds earlier, flying at 1 900 ft, I clearly was below that solid cloud layer I had seen in front of me.

Photo credit: iStock

But the patches of ground did not appear, and I did not simply pass through this cloud. Looking left, I suddenly saw all solid clouds, making Hamilton Airport invisible. I then started to realize that those clouds were all around me. Also gone was the clear sky behind me. I was indeed in solid IMC!

It took me about 10 to 15 seconds to realize and confirm to myself that I now was in real, solid IMC. The first thing that came to my mind was what I was taught so many times during my flight training and what I heard and read about this dangerous situation. All right, I said to myself, then let's better do what the instructor drilled into me for a situation like this: AVIATE, NAVIGATE, COMMUNICATE, in that order.

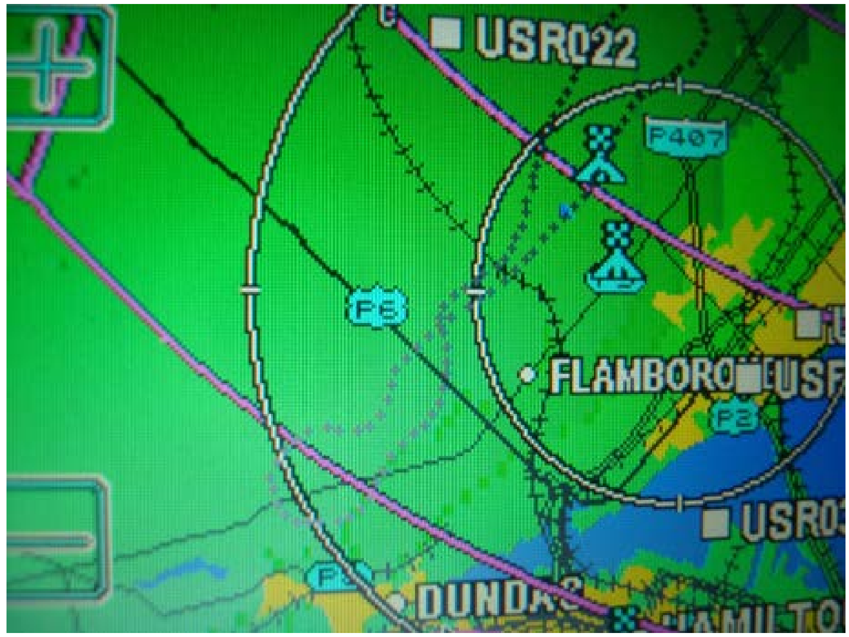
The first thing to do is look at the instruments and don't follow your feeling or instinct. Level the airplane. Sure enough, the attitude indicator showed I was in a 30° bank. The bank angle indicator confirmed the turn and the vertical speed indicator showed a slight descent at this time, meaning my nose was pointing slightly earthbound—the perfect set up for a spiral dive to follow. Looking back at the attitude indicator, I saw that the little red ball was also slightly below the centre line. The "You have 178 Seconds to live" TC take five came to mind. YUP! They were correct so far. There is a 10- to 15-second delay before your brain realizes you are really in full IMC. During this time you briefly tend not to pay full attention to your attitude, and you allow the airplane to enter into an unwanted bank.

Again, my instructor's words flashed through my mind: "Your brain will tell you that you are flying level at this time." And it really feels that way. I can confirm that 100%.

Immediately, I stopped the bank and levelled the airplane, primarily watching the attitude indicator's artificial horizon come back to level with the little red dot right on that little white centre line again. Simultaneously, I glanced at the turning indicator, which had levelled out too, and with my feet on the rudder pedals I made sure the ball was remaining dead centre as well. A quick glance at the vertical speed indicator showed "0" (level flight without any new upward or downward trend). The altimeter now showed 1 800 ft. So far so good. I was now back in controlled level flight, but still in the clouds. A quick look outside confirmed it. But immediately, my eyes were focused again on the continual scanning of the instruments to make sure I maintained my level flight. I did not want to get caught up in anything else written on that "You have 178 seconds to live" take five.

Meanwhile, my trusty little yoke-mounted Avi8or provided me with perfect situational awareness and "a look through the clouds to the ground". That, I think, gave me the confidence that I was doing the right thing and on track, if you want to call it that. That's how I completed the AVIATE part.

Since I felt somewhat safe at this point, I dialed up Hamilton Tower and asked if they could see the moving weather front along the Brantford/Kitchener line. Although the controller said that he could only see actual precipitation (and not any clouds), he added that by the time I would reach Brantford, the rain would have moved north from there, and that I should be behind it if I then turned north towards Kitchener. I didn't tell him that I was already in solid IMC; I was too embarrassed to admit that I had messed up on that. I decided that I had enough of the low clouds around and didn't want to take further chances, and I told Hamilton Tower that I would turn around and fly back to the clear weather towards Toronto. That's the COMMUNICATE part.



Avi8or snapshot of flown route (dotted line)

I knew that that there were several high towers in the area below me. So, before turning around, I decided to climb up to a safer altitude of 2 400 ft. My only concern was possible icing in the clouds. I checked my temp probe sticking out through my left front windshield— no icing. I also checked my installed "icing warning system" on the left wing (that was four strips of black electrical tape around the leading white edge halfway up my left wing)—also no icing.

Then I initiated a gentle climb to 2 400 ft before commencing a 180° rate one turn to head back to where I had come from and knew that the sky was nice and clear.

I am not sure, if after the 180° turn, it took two or four or five minutes before my eyes caught a small view of ground again through the clouds. I didn't want to look long at this welcome site, since I was still flying in IMC without any outside horizon reference at this time. This is the NAVIGATE part.

And then, as suddenly as the clouds had first appeared, the most welcome view of the day arrived: a clear, unobstructed view of Hamilton and even all the way to the Toronto skyline! I had successfully survived my first VMC into IMC encounter. Ten minutes later I landed in Burlington, just as if nothing special had happened during that little flight encounter with the clouds. I taxied my plane to the hangar and drove home. But there was one important thing I had forgotten in all of that excitement. My buddy in his 172 was seriously worried why he had neither heard from me nor seen me land. Later that day he called me and gave me (rightfully so) an earful in no uncertain terms. I humbly apologized for not letting him know and thanked him for his genuine concern. That's what flying buddies are all about. A lesson well learned.

Some conclusion in hindsight:
I had checked the weather prior to driving to the airport that Sunday morning. I was aware of the rain front and associated cloud levels at that time. I then assumed that it would be clear and safe for me to fly just like my buddy did. I knew he always checks the weather thoroughly before flight. He also has a lot more flying experience than I have. He holds a multi-engine IFR rating and his personal minimums are surely well above mine. So no contest here.

An experienced aviator told me once: "In aviation you must scare yourself from time to time, so you will remember not to do certain things again." This phrase of wisdom stuck with me, and since that time I have added a few other scary incidents to my "not to do" list. I am sure there will be others in the future. I am just glad that I survived my first VMC into IMC and lived to tell about it. I now can vouch firsthand that that "You have 178 seconds to live" take five is absolutely true and has not just been written up for fun.

Fly safe! △

A Dangerous Situation With an Exhaust Muffler/Heat Muff

During a recent investigation Transport Canada uncovered a dangerous situation with an Exhaust Muffler/Heat Muff from a Piper PA-28-140.

We became aware of the defect approximately 13 flight hours/3 months following the completion of the Airworthiness Directive (AD) CF-90-03R2 Muffler Inspection (The AD requires the muffler to be inspected annually or every 150 hours).

The Aircraft Maintenance Engineer (AME) who performed the AD did not remove the heat shroud to facilitate the inspection and instead chose to open it at the split line and use a mirror to perform the inspection. As the AME did not remove the shroud as required by the AD, it is probable that he overlooked a defect in the muffler that contributed to the failure. △

Figure 1. Damaged muffler

Figure 2. Damaged muffler

TSB Final Report Summaries

The following summaries were extracted from the 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. Unless otherwise specified, all photos and illustrations were provided by the TSB. For the benefit of our readers, the occurrence titles are hyperlinked to the full TSB reports on the TSB Web site. —Ed.

TSB Final Report A16P0180—Loss of control and collision with terrain

Summary

On 10 October 2016, at approximately 08:20 Pacific Daylight Time, a privately operated de Havilland DHC-2 Beaver aircraft on amphibious floats departed from Vanderhoof Airport, B.C. for a day visual flight rules flight to Laidman Lake, B.C. The pilot and 4 passengers were on board. Approximately 24 minutes (min) into the flight, the aircraft struck terrain about 11 nautical miles (NM) east of Laidman Lake. The pilot was fatally injured, and 2 passengers were seriously injured. The other 2 passengers sustained minor injuries.

Factual information

History of the flight

At 14:30 on 09 October 2016, the pilot and 4 passengers met at the pilot's place of business in Saskatoon, Saskatchewan to go on a hunting trip to the Cariboo region of B.C. Their plan was to drive overnight to Vanderhoof Airport (CAU4), B.C., where the pilot kept his aircraft, and then fly to his recreational property on Laidman Lake, B.C. At approximately 17:30, the group loaded a pickup truck with their personal belongings and left for the drive to Vanderhoof. The pilot drove the first leg of the trip, to Edmonton, Alta. The group departed Edmonton at approximately 23:00. The pilot slept in the back seat of the truck for approximately 5½ hours while another member of the group drove.

The group arrived in Vanderhoof at approximately 05:00 on 10 October. They stopped for breakfast and then drove to the airport. Following arrival at CAU4 at around 06:45, the pilot slept for 1 additional hour in the truck.

At CAU4, the group transferred their belongings from the truck to the aircraft, a de Havilland DHC-2 Beaver on amphibious floats. The cargo was loaded into the aft area of the cabin, but was not weighed or secured. A small number of personal items were placed in one of the compartments of the aircraft's amphibious floats. The pilot fuelled the aircraft with 131 L of aviation fuel (AVGAS), and the pilot and passengers boarded the aircraft. The 3 rear-seat passengers fastened their lap belts, and the passenger in the right-hand front seat fastened his lap belt and shoulder harness. The pilot fastened his lap belt. Although the pilot normally used the shoulder harness, he did not fasten it before the occurrence flight.

The aircraft departed CAU4 at about 08:20. Shortly after takeoff, the pilot reduced the aircraft's engine power to a climb power setting and climbed to about 500 feet (ft) above ground level (AGL). The pilot made no further changes to engine power for the rest of the flight.

On previous trips to the recreational property, the pilot had usually flown a direct track for the majority of the route and then entered and followed a river valley that led to Laidman Lake (Figure 1). Ground elevations along that valley routing remained relatively constant at about 3 100–3 200 ft above sea level (ASL). Accordingly, for approximately 20 min after departure, the flight continued in a southwesterly direction at approximately 300–500 ft AGL. When the aircraft was about 12 NM from Laidman Lake, the pilot diverted from the usual route and turned the aircraft to fly over a mining exploration site located on higher terrain east of the lake. Ground elevations in that area rise from 3 200−4 600 ft ASL over a distance of about 4.5 NM. The aircraft continued to fly at a constant altitude over the rising terrain for about 4 min until its height above the hillside had decreased to approximately 100 ft above the trees.

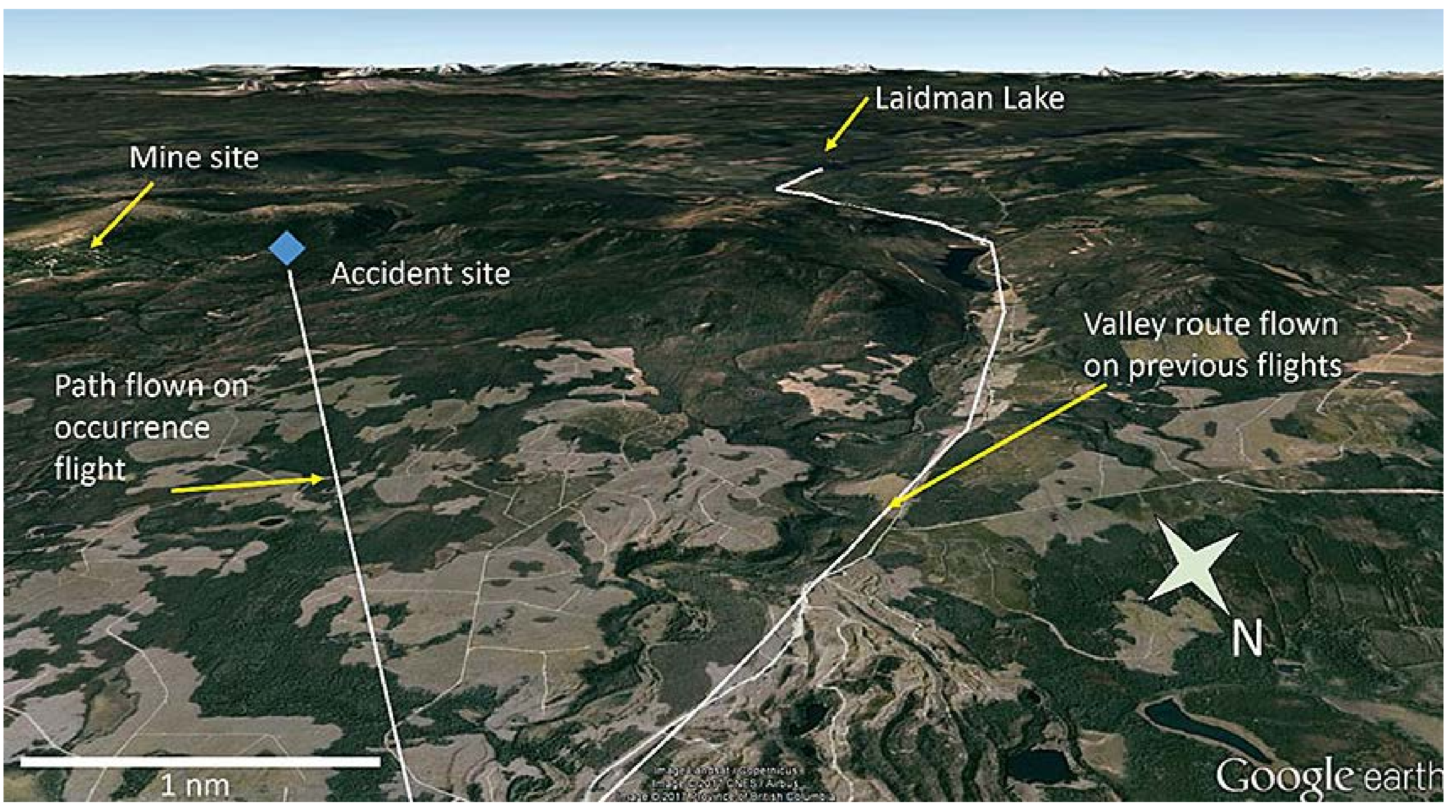


Figure 1. Aerial view of the general flight area from the direction of CAU4 (Source: Google Earth, with TSB annotations)

The pilot then banked the aircraft steeply to the left toward lower terrain. The aircraft rolled abruptly further to the left, then to the right and again to the left. At about 08:44, the aircraft struck the trees and the ground.

The aircraft was substantially damaged on impact. The baggage stored in the aft cabin area was thrown forward by impact forces and struck the aircraft occupants. The pilot was fatally injured, and 2 passengers were seriously injured. The 2 other passengers sustained minor injuries. The 406 MHz emergency locator transmitter (ELT) activated on impact. The ELT's signal was detected by the Cospas-Sarsat satellite system, and a search and rescue operation was initiated by the Joint Rescue Coordination Centre (JRCC) Victoria. One of the passengers was able to call 911 using a cell phone, and the call was transferred to JRCC Victoria so that he could assist them in locating the accident site.

Wreckage and accident site examination

The aircraft was substantially damaged when it struck trees and the ground (Figure 2).

Figure 2. Photo of the accident site showing the aircraft wreckage, as viewed from the direction of flight

The aircraft entered the trees in a wings-level, slightly nose-high attitude, at an elevation of approximately 4 600 ft ASL. The initial impact occurred when the aircraft's right horizontal stabilizer struck the treetops. The aircraft then continued through the trees in the direction of flight for approximately 130 ft before pitching forward and striking the ground in a steep nose-down and right-wing-low attitude. The aircraft came to rest nose down and semi-inverted (Figure 3).

The majority of the wreckage was located near the fuselage. Both wings and both floats had separated from the fuselage, and each of these components showed impact damage resulting from contact with the trees. The fuel selector was found set to the forward tank, which contained sufficient fuel for the remainder of the flight to Laidman Lake. Damage to the engine and propeller were consistent with a high power setting at the time of the occurrence.

The aircraft's 406 MHz ELT activated on impact and transmitted a signal until search-and-rescue personnel arrived.

Weather

At the time of the occurrence, there were high cirrus clouds, the temperature was −5 °C, and winds were light and variable from the northwest. The altimeter setting was 30.09 inches (in.) of mercury, there was no precipitation, and flight visibility was unlimited.

Pilot information

Records indicate that the pilot was certified and qualified for the flight in accordance with existing regulations. He had held a private pilot licence since 15 January 2016 and had accumulated approximately 280 hours of flying experience.

He had accumulated 23.1 hours of flight time on the aircraft, of which 5.7 hours had been flown while the aircraft was configured with amphibious float.

On each of the 2 nights prior to the night before the occurrence, the pilot had obtained 5 to 6 hours of sleep at home. On the night preceding the occurrence, during travel by road to Vanderhoof, he obtained 6 to 7 hours of sleep, but it is likely that the quality of that sleep was adversely affected by noise and motion during travel.

Aircraft information

General
The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The aircraft was not equipped with a stall warning system.

Weight and balance
The aircraft's empty weight at the time of the occurrence was 4 036 pounds (lbs). According to the aircraft type certificate, the maximum allowable gross weight of the DHC-2 Beaver when configured with floats is 5 090 lbs, which provides a useful load capacity of 1 054 lbs.

The investigation determined that the aircraft was carrying 495 lbs of cargo and 209 lbs of fuel, and that the combined weight of its occupants was 1 032 lbs. Its resulting total weight was 5 772 lbs, with a centre of gravity (C of G) 9.2 in. aft of the datum which placed the aircraft 682 lbs over its maximum allowable gross weight, with a C of G 3.1 in. beyond the aft limit.

Survival aspects
Impact forces during the occurrence were focused primarily on the right side of the aircraft, resulting in more extensive damage to that side. The pilot's seat had broken free of the aircraft's floor structure during the impact, fatally injuring the pilot, while the front passenger seat remained attached to the floor.

The investigation determined that the rear seats had partially detached from the aircraft structure during the occurrence. The damage to the seats was consistent with the forward shift of the unsecured cabin baggage during the occurrence. The rear-seat passengers sustained injuries caused by the unsecured baggage in addition to aircraft impact forces.

Figure 3. *The occurrence aircraft at the accident site*

DHC-2 stall characteristics

General
In 1947, the DHC-2 Beaver was certified in accordance with the *British Civil Airworthiness Requirements* and its stall characteristics were found to be acceptable. At the time of certification, there was no requirement to include a stall warning system in the aircraft design.

The airspeed at which a stall occurs is related to the load factor of the manoeuvre performed. The load factor is defined as the ratio of the load acting on the wings to its gross weight, and represents a measure of the stress (or load) on the structure of the aircraft. By convention, the load factor is expressed in *g* (the unit of measure for vertical acceleration forces) because of the perceived acceleration due to gravity felt by an occupant in an aircraft. In straight and level flight, lift is equal to weight, and the load factor is 1 g. However, in a banked, level turn, greater lift is required. It can be achieved by, among other things, increasing the angle of attack (by pulling back on the elevator control), which increases the load factor. As the load factor increases with bank angle, there is a corresponding increase in the stall speed at which the stall occurs.

The DHC-2 Beaver flight manual indicates that when the aircraft is configured with flaps up, an unaccelerated aerodynamic stall will occur at an indicated airspeed of 60 mph. It goes on to state that, during the stall, "If yaw is permitted, the aircraft has a tendency to roll. Prompt corrective action must be initiated to prevent the roll from developing."

When an aircraft is manoeuvred with an aft C of G, there is more pitch-up authority than with a forward C of G. This condition permits a higher rate of pitch-up acceleration with the flight controls, which can result in a more severe stall than would occur in an aircraft with a forward C of G position.

Analysis

The examination of the aircraft did not reveal any engine or aircraft system failures or malfunctions. Therefore, this analysis will focus on pilot fatigue, optical illusions created by rising terrain, aerodynamic stall and the effects of aircraft loading on performance, and survivability.

Pilot fatigue
The TSB conducted a fatigue analysis to determine what role, if any, fatigue may have played in this occurrence. One of the 6 fatigue risk factors examined was found to have played a role in this occurrence: on the night prior to the occurrence, the pilot experienced mild acute sleep disruption. Although the pilot obtained his usual amount of sleep the night before the occurrence, it was likely of poor quality as it was obtained in the back of a truck en route to the Vanderhoof airport.

If pilots do not obtain quality sleep during the rest period prior to flying, there is a risk that they will operate an aircraft while fatigued, which could degrade pilot performance.

Optical illusions
The prevailing conditions at the time of the occurrence were conducive to optical illusions associated with low-altitude flight over rising terrain. The lack of features to provide scale in the snow-covered terrain, together with the minimal contrast among the dense trees given the diffuse light conditions, likely disguised the upsloping terrain and the actual horizon.

These visual characteristics would have made it challenging to judge the distance of the aircraft from the rising terrain and may have led the pilot to underestimate the increasing slope and overestimate the time available to complete a successful turn away from it.

As the slope steepened, the perceived horizon would have moved upward in the windscreen, and the pilot may have pitched the aircraft up to maintain a constant angle between the pilot's reference point on the aircraft and the rising terrain. The increased nose-up attitude would have resulted in a reduction of airspeed, bringing the aircraft into the slow-flight speed regime. As the aircraft approaches an aerodynamic stall condition in this speed regime, coordinated flight is more difficult to maintain.

The increased optical flow resulting from flight closer to terrain as the pilot approached the first mountain ridge would have provided the illusion of increasing speed. Without periodic reference to the aircraft's instruments, the pilot may not have detected the decreasing airspeed resulting from the increased nose-up attitude.

There was no indication that the pilot recognized that an aerodynamic stall and a loss of control were imminent. In the moments before impact, power was not increased and the flaps were left in the 0° setting—indications that, at least until the initiation of the attempt to turn away from the mountain ridge, the pilot was unaware that the aircraft was approaching the stall speed.

As the aircraft approached the mountain ridge, the high overcast ceiling and uniform snow-covered vegetation were conducive to optical illusions associated with flight in mountainous terrain. These illusions likely contributed to the pilot's misjudgment of the proximity of the terrain, inadvertent adoption of an increasingly nose-up attitude, and non-detection of the declining airspeed before banking the aircraft to turn away from the hillside.

Aerodynamic stall

Aircraft handling

The pilot commenced a turn away from the hillside, suggesting that the pilot recognized that the aircraft was low and slow over the rising terrain and would be incapable of climbing over it. As the angle of bank increased during the turn, the stall speed also increased and the aircraft entered an accelerated stall.

Weight and balance

The pilot did not weigh or secure the cargo and did not calculate the aircraft's weight or C of G before departure. At the time of the accident, the aircraft was 682 lbs over its maximum weight and its C of G was 3.1 in. beyond the aft limit. The aircraft's out-of-limit weight-and-balance condition increased its stall speed and degraded its climb performance, stability, and slow-flight characteristics. As a result, its condition, combined with the aircraft's low altitude, likely prevented the pilot from regaining control of the aircraft before collision with the terrain.

Stall warning

Given that the aircraft was not equipped with a stall warning system, the stall occurred without aural or visual warning. It is reasonable to conclude that the absence of a stall warning system deprived the pilot of the last line of defence against an aerodynamic stall and the subsequent loss of control of the aircraft.

Survivability

Cargo securement

When the aircraft struck the ground, the unsecured cargo shifted forward, hitting the passengers and the pilot. As a result, the rear seats were damaged and partially detached from the aircraft structure.

The forward shifting of the unsecured cargo and the partial detachment of the rear seats during the impact resulted in injuries to the passengers. If cargo is not secured, there is a risk that it will shift forward during an impact or turbulence and injure passengers or crew.

Findings

Findings as to causes and contributing factors

1. As the aircraft approached the mountain ridge, the high overcast ceiling and uniform snow-covered vegetation were conducive to optical illusions associated with flight in mountainous terrain. These illusions likely contributed to the pilot's misjudgment of the proximity of the terrain, inadvertent adoption of an increasingly nose-up attitude, and non-detection of the declining airspeed before banking the aircraft to turn away from the hillside.
2. As the angle of bank increased during the turn, the stall speed also increased and the aircraft entered an accelerated stall.
3. The aircraft's out-of-limit weight-and-balance condition increased its stall speed and degraded its climb performance, stability, and slow-flight characteristics. As a result, its condition, combined with the aircraft's low altitude, likely prevented the pilot from regaining control of the aircraft before the collision with the terrain.
4. The absence of a stall warning system deprived the pilot of the last line of defence against an aerodynamic stall and the subsequent loss of control of the aircraft.
5. The forward shifting of the unsecured cargo and the partial detachment of the rear seats during the impact resulted in injuries to the passengers.
6. During the impact sequence, the load imposed on the pilot's lap-belt attachment points was transferred to the seat-attachment points, which then failed in overload. As a result, the seat moved forward during the impact and the pilot was fatally injured.

TSB Final Report A17P0007—Collision with trees and power lines after rejected landing

Summary

On 19 January 2017, a Cessna 172 aircraft departed from Victoria International Airport, B.C., for a day visual flight rules (VFR) training flight with an instructor and a student pilot on board. About 1½ hours (hrs) into the flight, the aircraft made an approach to Runway 31 at Duncan Aerodrome, B.C., to conduct a short-field landing. At 13:11 Pacific Standard Time, the aircraft touched down approximately one-third of the way down the runway and after an attempt to brake, a takeoff was attempted. The aircraft struck trees and then power lines off the north end of Runway 31 and came to rest upside down under the power lines, about 500 feet (ft) from the departure end of the runway. The instructor was seriously injured, and the student sustained minor injuries.

Factual information

History of the flight

At 11:43 on 19 January 2017, a Cessna 172 aircraft departed from Victoria International Airport (CYYJ), B.C., with an instructor and a student on board. The instructor was the pilot-in-command and was seated in the right seat. The student was the pilot flying and was seated in the left seat. The purpose of the flight was for the student to practise various flight exercises before a commercial flight test scheduled for the following day.

After departing CYYJ, the aircraft flew about 21 nautical miles (NM) northwest and the crew conducted various flight exercises for about 1 hr. The aircraft then flew to Duncan Aerodrome (CAM3), B.C., so that the crew could conduct additional exercises, including a precautionary approach to a short-field landing with a full stop.

During the initial overflight inspection of the aerodrome, the instructor and student noted that the windsocks indicated that the wind was light and variable (less than 5 knots (kt)), but that it generally favoured an approach to Runway 13. However, due to low cloud north of the aerodrome, they elected to accept the slight tailwind and land on Runway 31. The aircraft flew 1 left-hand circuit to conduct a runway overflight inspection before flying a second left-hand circuit to conduct the short-field landing (Figure 1). On the final approach leg of the second circuit, when the aircraft was established on final approach at about 700 ft above sea level (ASL)—400 ft above the aerodrome elevation—and about 3 000 ft from the runway threshold, the instructor and student observed that the aircraft was above the normal approach path. They briefly discussed the issue and decided to continue the approach with idle power, full flaps, and some slipping.

Radar data showed that the aircraft's ground speed was about 70 kt on final approach. The Cessna 172 pilot's operating handbook (POH) recommends an airspeed of 61 kt on approach for short-field landings in smooth air conditions, and states

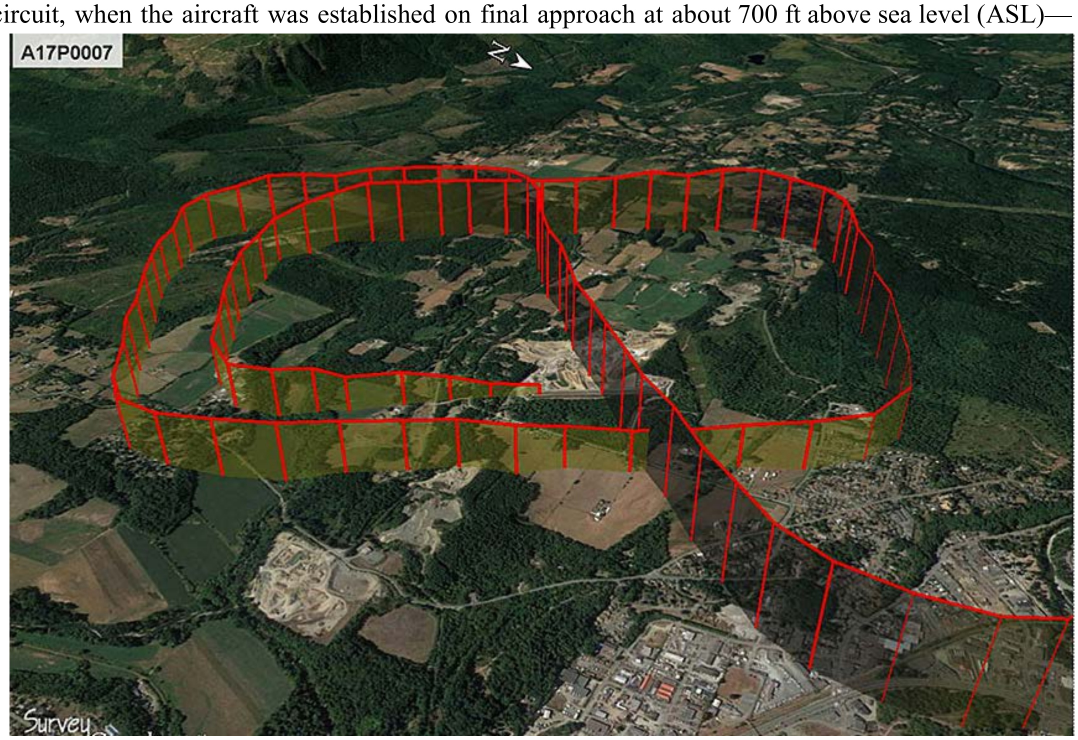


Figure 1. Radar track of flight path at CAM3, as seen from the northeast (Source: Google Earth, with TSB annotations)

that "slightly higher approach speeds should be used in turbulent air conditions." The descent angle to the runway threshold was about 7°, placing the aircraft significantly above the commonly used 3° flight path with which the student pilot was familiar. However, steeper approaches are often used for short-field landings. The investigation later determined that a rate of descent of about 1 000 ft/minute (min) had been required.

The aircraft touched down about one-third of the way down the runway, at which point the instructor took over control of the aircraft from the student pilot, retracted the flaps, and pulled the control column to the full nose-up position. However, the aircraft bounced and became airborne several times before the tires remained in contact with the runway, and it was therefore not possible to apply full braking until the aircraft's weight was fully transferred to the landing gear. Subsequently, after full braking had been applied, the instructor determined that the aircraft could not be brought to a stop before the end of the runway. The instructor then rejected the landing and attempted to take off, releasing the aircraft's brakes, applying full throttle, and reselecting the flaps to 20°.

The aircraft left the departure end of the runway and continued across a 10-foot-wide gravel strip situated between the end of the runway pavement and the precipice of an embankment. Its main-gear tires produced tracks in the gravel. After crossing the gravel strip, the aircraft became airborne and immediately descended about 10 to 15 ft, then flew horizontally for about 400 ft while attempting to climb. In the process, the aircraft struck multiple small treetops and then a large treetop. It flew another 150 ft, descending slightly, until it struck and severed the first of a set of 6 high-tension power lines. The aircraft came to rest inverted under the power lines on wet, brush-covered ground, about 550 ft down the embankment about 60 ft below the runway end. The flaps were found extended to about 20°.

Both pilots were wearing lap belts and shoulder harnesses. The student pilot sustained minor injuries, and was able to exit the aircraft and call 911 for assistance. The instructor received life-threatening injuries and remained suspended upside down in the wreckage for approximately 1½ hrs before the power lines could be deactivated and first responders could safely access the aircraft. The instructor was transported by air ambulance to the hospital.

Aerodrome information
CAM3 is a registered aerodrome and does not have overrun areas at either end of the runway, nor are they required by regulation. CAM3 has a single asphalt runway (Runway 13/31). The runway is 30 ft wide and 1 494 ft long; the aerodrome elevation is 300 ft.

The edition of the *Canada Flight Supplement* (CFS) that was current at the time of the accident provided a caution section for CAM3 that stated:

“Ravines at both ends; gravel pit & 4′ windrow W side rwy. Downdrafts, crosswinds & wind shear may be encountered. Trees on apch to Rwy 31. Strongly recommended that only pilots familiar with aprt & terrain should use this aprt dur hrs of darkness.”

The trees on the approach to Runway 31 are located approximately 350 ft from the runway threshold.

Instructor
Records indicate that the instructor was certified and qualified for the flight in accordance with existing regulations, and had approximately 3 763 hrs of accumulated flying time. The majority of those hrs had been on Cessna 172-model aircraft, and included approximately 300 hrs on the occurrence aircraft.

Student
Records indicate that the student was certified and qualified for the flight in accordance with existing regulations, and was working toward earning a commercial pilot licence at the time of the occurrence. He had accumulated a total of about 225 hrs of flying time, all of which had been on Cessna 172-model aircraft (including approximately 17 hrs on the occurrence aircraft).

Weather information
At 12:00, approximately 17 min after the aircraft took off from Runway 09 at CYYJ and about an hr prior to the accident, the wind at CYYJ was from 140° true (T) at 3 kt.

At 13:00, about 11 min before the accident, the wind was from 070°T at 3 kt, with varying direction from 010° T to 110° T. The weather conditions at that time also included:

- visibility: 30 statute miles (SM);
- temperature: 8° C and dew point 7° C;
- barometric pressure: 29.43 inches (in.) of mercury; and
- few clouds at 900 ft, few clouds at 4 500 ft, scattered cloud at 7 000 ft, broken cloud at 12 000 ft, and broken cloud at 25 000 ft.

Cessna 172
Photo credit: iStock

Aircraft information
It was a 1999 Cessna 172S equipped with a 180-horsepower, fuel-injected Lycoming IO-360 engine. Its maximum take-off weight was 2 550 pounds (lbs). The Flight Dispatch Authority form signed by the instructor prior to the flight indicated that the weight at takeoff was 2 155 lbs and that its centre of gravity (C of G) would remain inside of the allowable envelope throughout the flight. Based on the aircraft's take-off weight, TSB calculations indicate that the 172S would have weighed about 2 060 lbs at the time of the accident.

The "Performance" section of the Cessna 172S POH indicates that, given the temperature and pressure-altitude conditions at the time of the occurrence, and with an aircraft weight of 2 550 lbs, the required distance for a short-field landing over a 50-ft obstacle is 1 320 ft (including a 565-ft landing roll), leaving 174 ft of runway at CAM3. The POH figures are based on zero wind; a paved, level, and dry runway; and a speed of 61 kt at 50 ft above ground level (AGL). The POH states that, "for operation with tail winds up to 10 kt, [pilots should] increase landing distances by 10% for each 2 kt. Given that the conditions at the time of the occurrence included a light tailwind component of less than 5 kt, the distance required for a short-field landing by the Cessna 172S would have been more than 1 320 ft. Neither the student pilot nor the instructor performed short-field performance calculations on the day of the accident.

The POH provides the following procedures for short-field and balked landings:

SHORT FIELD LANDING

- Airspeed – 65 – 75 KIAS [knots indicated airspeed] (flaps UP)
- Wing Flaps – FULL DOWN (30°)
- Airspeed – 61 KIAS (until flare)
- Power – REDUCE to idle after clearing obstacle
- Touchdown – MAIN WHEELS FIRST
- Brakes – APPLY HEAVILY
- Wing Flaps – RETRACT

BALKED LANDING

- Throttle – FULL OPEN
- Wing Flaps – RETRACT TO 20°
- Climb Speed – 60 KIAS
- Wing Flaps – 10° (until obstacles are cleared), RETRACT (after reaching a safe altitude and 65 KIAS)

The POH also indicates that a short-field takeoff under the same conditions by an aircraft weighing 2 200 lbs would require 1 130 ft (including a 655-ft ground roll) to clear a 50-ft obstacle. The POH states that for takeoffs "with tailwinds up to 10 knots, [pilots should] increase distances by 10% for each 2 knots".

Analysis

The aircraft was functioning normally before it struck the trees and power lines. Therefore, the analysis will focus on operational factors, including pilot decision making.

Flight operations at Duncan Aerodrome

Because landing at Duncan Aerodrome (CAM3), B.C., poses significantly more risk than landing at most airports, the flying club in question in this event does not permit its students to land there without an instructor. The runway at CAM3 is short, particularly in comparison with those at Victoria International Airport (CYYJ), where the student pilot had landed most often during training. CAM3 is also unusual in that there are ravines at both ends of the runway rather than overrun areas. The CFS cautions pilots that downdrafts, crosswinds, and wind shear may be encountered at CAM3, and warns of trees on the approach to Runway 31. The instructor was familiar with the aerodrome, and the student had landed there 5 times, always with an instructor. Despite these known risks, the short-field landing exercise was carried out with a light and variable tailwind on a short runway with no overrun area, even though no pre-flight short-field landing performance calculations had been made.

The aircraft was high on final approach, and the approach was steeper than commonly used and faster than was prescribed. With idle power and the flaps fully extended, a slip was subsequently necessary for the aircraft to descend steeply enough to land on the runway. As a result, the aircraft crossed the runway threshold above the intended touchdown speed and remained airborne in ground effect for at least one-third of the runway length before touching down.

The landing attempt was continued even after the aircraft touched down well beyond the intended touchdown point.

Pilot decision making

The instructor took over control of the aircraft from the student. Initially judging that the aircraft could be brought to a stop, the instructor elected to continue the landing. However, after several seconds, during which the aircraft continued to slow, the instructor decided to abort the landing.

It could not be determined exactly how far down the runway the aircraft was when the instructor made the decision to reject the landing, or how fast it was travelling at that point. Given that its tires were still in contact with the ground when it left the runway and that it dropped immediately into the ravine before flying horizontally, it is likely that the aircraft left the runway at only slightly above stall speed. The attempt to stop the aircraft was made at a point where insufficient runway remained to bring it to a stop, and then the takeoff was attempted with insufficient airspeed and with insufficient remaining runway. The aircraft left the runway below a safe flying speed and, once out of ground effect, sank below runway elevation, resulting in its collision with several trees and power lines.

Findings

Findings as to causes and contributing factors

1. The short-field landing exercise was carried out with a light and variable tailwind on a short runway with no overrun area, even though no pre-flight short-field landing performance calculations had been made.
2. The aircraft was high on final approach, and the approach was steeper than commonly used and faster than was prescribed.
3. The aircraft crossed the runway threshold above the intended touchdown speed and remained airborne in ground effect for at least one-third of the runway length before touching down.
4. The landing attempt was continued even after the aircraft touched down well beyond the intended touchdown point.
5. The attempt to stop the aircraft was made at a point where insufficient runway remained to bring it to a stop.
6. The takeoff was attempted with insufficient airspeed and insufficient remaining runway.
7. The aircraft left the runway below a safe flying speed and, once out of ground effect, sank below runway elevation, resulting in its collision with several trees and power lines.

TSB Final Report A17C0147—Collision with terrain

History of the flight

On 15 December 2017, the privately registered Piper PA-23-250 Aztec was conducting a visual flight rules (VFR) flight from Gillam Airport (CYGX), Man. to an unlighted private aerodrome located 5.25 nautical miles (NM) east of Baldur, Man. with only the pilot on board (Figure 1).

On the day of the occurrence, the pilot had departed from the private aerodrome at approximately 11:30 Central daylight time with a full fuel load. His plan was to fly to Dauphin (Lt. Col W.G. (Billy) Barker, VC) Airport (CYDN), Man., and then continue to Gillam Airport (CYGX), Man. Before returning to the private aerodrome later that same day.

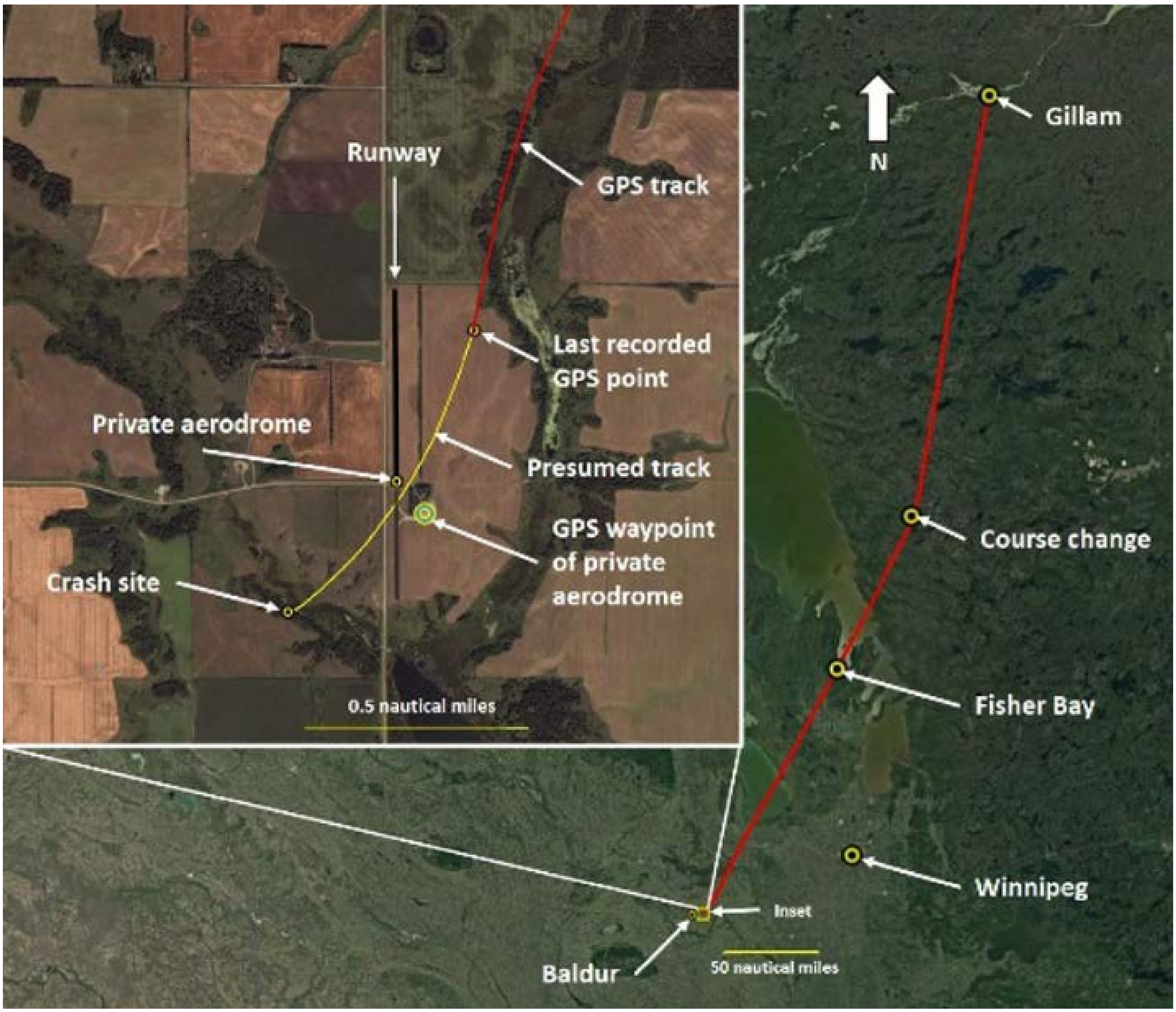


Figure 1. Map overview (Source: Google Earth, with TSB annotations)

Shortly after arrival at Gillam Airport (CYGX), Man., the pilot requested that the wing-tip fuel tanks be filled, taking on 160 L (42 U.S. gallons) of fuel. While the pilot was at CYGX, a family member texted the pilot to inform him that snow was causing poor visibility at the private aerodrome and that an increase in wind speed and gusts was expected at his estimated time of arrival. Consequently, the pilot decided to fly to Winnipeg/James Armstrong Richardson International Airport (CYWG), Man., instead, which is located approximately 78 NM northeast of the private aerodrome and 51 NM closer to CYGX.

The aircraft departed CYGX at 15:50 and climbed to 9 000 feet (ft) above sea level (ASL) on a direct track to CYWG. At 17:15, when the aircraft was approximately 174 NM from CYWG, the pilot altered course to a southwest heading that would take him directly to the private aerodrome.

At approximately 17:45, the pilot received a text message from the same family member indicating that, before dark, the visibility at the private aerodrome had been about ¾ of a statute mile (SM) in snow. About half an hour later, the pilot made arrangements with the family member to make vehicle tracks on the runway and then place the vehicle at the north end of the private aerodrome with the headlights pointing to the south. Shortly thereafter, the pilot was informed that the wind was about 10 to 15 knots (kt) and that the tracks had been made on the runway. Snow was still falling and there was now about 3 inches (in.) of snow on the runway.

At 18:34, the aircraft began to descend from its cruising altitude at a rate of approximately 1 550 ft per min. When it was roughly 0.87 NM northeast of the private aerodrome, the aircraft levelled off briefly at approximately 400 ft above ground level (AGL), before resuming the descent. The aircraft descended through 200 ft AGL immediately prior to crossing over the middle of the private aerodrome, on a southwest heading. As the aircraft passed overhead, the family member drove the vehicle to the north end of the runway, expecting that the pilot would circle to the north before returning to land. However, immediately after overflying the private aerodrome, the aircraft descended into a small valley following sloping terrain.

At 18:38, in the hours of darkness, the aircraft crashed on a frozen marsh at the bottom of the valley. The pilot received fatal injuries.

Search

When the aircraft had not arrived by 19:00, a ground search by vehicle was initiated. The ground search proved unsuccessful and, at 20:00, the Joint Rescue Coordination Centre (JRCC) in Trenton, Ont. was notified of the overdue aircraft. The JRCC contacted the local Royal Canadian Mounted Police (RCMP) and tasked a Royal Canadian Air Force Lockheed C-130 Hercules aircraft to conduct a search, which began at approximately 23:00. The Hercules aircraft detected a weak 406-MHz ELT transmission; however, it was not possible to home in on the signal. Owing to deteriorating weather conditions, the Hercules was forced to abandon the search at 02:00 on 16 December 2017. The Hercules was able resume the search later that morning and again detected a weak 406 MHz ELT signal.

The JRCC contacted the local chapter of the Civil Air Search and Rescue Association (CASARA) at 05:46 and a coordinated ground and air search was initiated. CASARA members detected a strong 121.5-MH ELT signal east of Baldur. The crash site was discovered at 15:00 on 16 December 2017, approximately 0.38 NM southwest of the private aerodrome.

Aircraft information

During the occurrence flight, the aircraft was lightly loaded with only the pilot and miscellaneous aircraft equipment on board.The Piper PA-23-250 Aztec was certified, equipped, and maintained in accordance with existing regulations and approved procedures. It had no known deficiencies and was being operated within its certified weight and centre-of-gravity limits.

Impact and wreckage information

The right wing contacted scrub brush roughly 8 ft from the marsh surface (Figure 2). Damage to the scrub brush indicates that the aircraft was

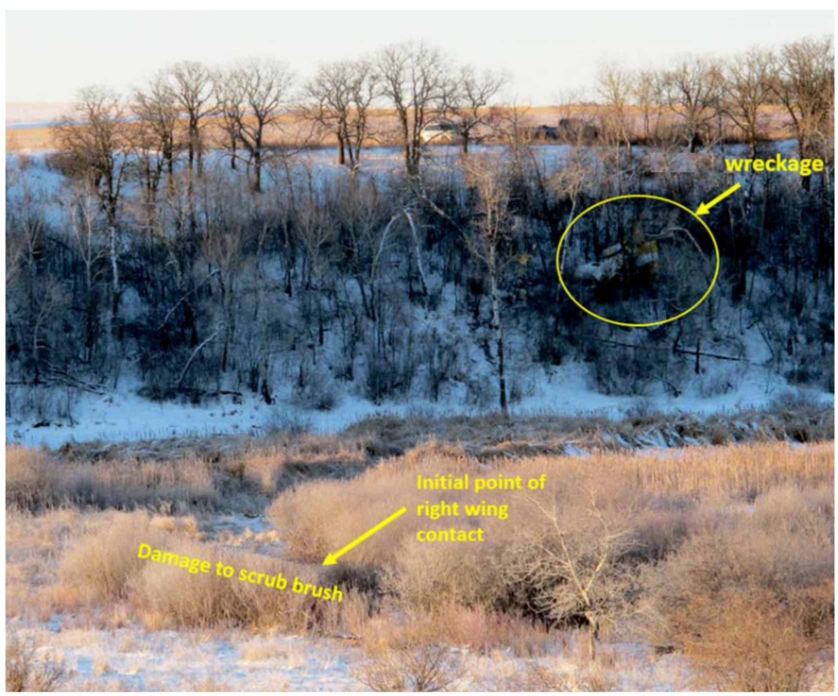


Figure 2. View of the initial impact site and wreckage

in a 5° descent while banking approximately 23° to the right. The right wing-tip and fuel tank were torn away on contact with the frozen marsh. The aircraft travelled across the marsh for about 300 ft before colliding with the steeply rising tree-covered terrain on the southwest side of the valley. The left outer wing-panel had broken away after contacting a tree, at a height of about 15 ft, and lay on the right side of the wreckage trail, near the side of the valley. The aircraft came to rest, inverted, halfway up the side of the valley, approximately 425 ft from the initial point of contact with the marsh surface. The aircraft was destroyed by impact forces.

Calculations indicate that the aircraft would have had approximately 45 min of fuel remaining. Both propellers exhibited damage consistent with substantial power being produced by the engines.

The pilot had been seated in the left-hand seat. The seat had separated from the airframe attachment points. The pilot's seatbelt and shoulder harness had been fastened. The landing gear was down and locked and the flaps were up.

All of the aircraft's components were accounted for within the wreckage trail. Examination of the wreckage did not reveal any pre-existing mechanical conditions that could have contributed to the crash. A portable global positioning system (GPS) unit and a tablet computer were found at the wreckage site and sent to the TSB laboratory for data retrieval.

Weather
The weather at CYGX at the time of the aircraft's departure was reported as clear sky conditions, light winds, temperature of −26°C, and an altimeter setting of 29.92 in. Hg. The forecast weather, available at the time of departure and based on the graphical area forecast, indicated that extensive ceilings of 800 pi AGL with visibility of 2 to 5 SM in light snow with occasional visibility of ½ SM were expected for the Baldur area.

Pilot
The pilot had held a commercial pilot licence since January 1981. He had obtained a multi-engine rating in June 2017 and held a valid Class 1 medical certificate. He did not hold an instrument flight rating. Records indicate that the pilot had accumulated more than 4 000 hours of flying time.

Since October 2016, he had flown the aircraft for a total of 140 hours, 122 of which were as pilot-in-command. In the 30 days prior to the accident flight, the pilot had flown the aircraft for 32 hours.

Private aerodrome
The private aerodrome consists of a north/south, unlighted, gravel runway at an elevation of 1 417 ft ASL. The area has little to no cultural lighting other than that produced by the buildings at the private aerodrome and some scattered farmyards. The *Canadian Aviation Regulations* prohibit aircraft from landing or taking off at night at an aerodrome that does not have the required lighting, unless the flight is being carried out as part of a police operation or to save a human life. A driveway connects the hangar area to the highway and divides the runway into a 2 700-foot-long north section and a 1 500-foot-long south section. The pilot operated the Piper PA-23-250 Aztec from the 2 700-foot-long section of the runway, north of the driveway. △

Cannabis legalization and regulation in Canada

For the Government of Canada, protecting the health and safety of Canadians is an absolute priority. It is illegal to pilot an aircraft while under the influence of cannabis, and doing so will remain a criminal offence after the legalization of cannabis in Canada.

Cannabis can impair a person's capacity to pilot any type of aircraft in a safe manner and can thus endanger lives and lead to property loss.

Transport Canada regulations are in place to prohibit transport-sector workers in safety-related roles from working while impaired. Transport Canada continues to analyze emerging safety factors, such as impairment, in all modes of transportation – aviation, marine, rail, and road – to see which tools exist and which other tools could be necessary. A business could choose to establish internal policies that are stricter than the regulations in effect.

Answers to the 2018 Self-Paced Study Program

1. This abbreviation is initiated by ATS
2. supplement; replacement
3. small; increases in low visibility
4. On the back covers of the *Canada Flight Supplement* (CFS) and the *Canada Water Aerodrome Supplement* (CWAS)
5. A layer of broken cloud based at 800 ft above sea level (ASL) with tops at 1 200 ft ASL over CYUX
6. 5 NM
7. Within the organized area of cloud, broken (BKN) cumulus clouds based at 2 000 ft ASL with tops at 8 000 ft ASL
8. Isolated towering cumulus topped at 12 000 ft ASL. Visibility 5 SM with light rain showers and mist mainly over and in the vicinity of James Bay and northern Ontario. Local ½ SM visibility in fog. Ceilings at 200 ft above ground level (AGL).
9. 4 SM; 1500Z on the 5th
10. 300° true at 15 kt becoming 310° at 8 kt
11. The wind is varying in direction between 320º and 050º true.
12. 200
13. Declare an emergency.
14. 2 000 ft AGL
15. at prescribed locations
16. 1 mi; 3 mi; 2 000 ft; 500 ft
17. establish two-way communication; prior to
18. 15 NM
19. 2000Z on December 14, 2018
20. 5 years
21. At the end of the length of time specified in TC AIM – LRA 1.9 or CAR 404.04, which is calculated from the first day of the month following the date of your medical examination or declaration
22. insufficient rest; lack of sleep; overexertion
23. as per the *AIP Canada* (ICAO) Part 5
24. underestimate
25. 122.75 MHz
26. By a NOTAM
27. Transmission Line and Cranes—Edmonton to Fort McMurray, Alberta
28. 126.7 MHz
29. In the procedures (PRO) section of each Aerodromes and Facilities listing
30. As per the chart and the legend
31. Aircraft Radio Control of Aerodrome Lighting; 7 times initially; 123.2 MHz
32. "Cleared for the option" is an expression used to indicate ATC authorization for an aircraft to make a touch-and-go, low approach, missed approach, stop-and-go, or full-stop landing, at the discretion of the pilot.
33. Straight ahead on the runway heading until they reach the circuit traffic altitude; 500
34. cultural lighting
35. less inherent; spatial disorientation
36. Deflation
37. the ambient temperature, actual and forecast winds
38. 1. Yaw the glider away from the bow in the rope until the rope becomes taught;

    2. Extend spoilers until the rope becomes taught.
39. Not less than 500 ft vertically from cloud.
40. Because of the high rate of descent and lack of speed for a flare
41. Mast bumping and possible contact with the propeller or the vertical tail surfaces.△

General Aviation Safety Survey

To understand the challenges and safety risks that the general aviation community is facing, we first need to gather information on the sector.

We are using our targeted inspection process to conduct this survey.

The survey will help us to:

- establish baseline regulatory compliance;
- determine, where possible, how compliance is or is not achieved;
- understand how the sector generally operates and applies regulations.

Through these interactions, we are seeking:

- opportunities to inform and promote safety;
- to uncover why non-compliances may occur;
- opportunities to further educate your general aviation community.

Have more questions? Contact us at: TC.GeneralAviation-AviationGenerale.TC@tc.gc.ca.

For more information, refer to the article published in ASL 1/2018 titled *General Aviation Targeted Inspections—What to Know*. △

How to Stay Current as Well as Proficient

The *Canadian Aviation Regulations* outline the requirements for staying current. However, staying current doesn't always mean that you're staying proficient as a pilot. By staying proficient, you're keeping your overall knowledge and skills up to date.

For example:

- When was the last time you practised a forced approach, stall or full-flap overshoot?
- When did you work on your cross-wind land technique?
- When did you last fly with an instructor?
- How prepared are you if a **real emergency** happens?

To improve your proficiency, practise your skills. Do this with an instructor or on your own. One way is to become current, then practise by yourself until you feel you're fully competent.

Stay proficient by **regularly**:

- reading about changes to the Aeronautical Information Manual
- reviewing your pilot operating handbook;
- practising emergency procedures and flight exercises;
- attending Transport Canada and certified industry seminars.

Contact your local flight school or qualified flight instructor to schedule a flight review at least once every 2 years.

Watch a video on staying proficient: How to remain proficient, as well as current

To meet the 2-year requirement, you can complete the Transport Canada self-paced study program on page 26. Attending a Transport Canada aviation safety seminar in your region is also a way to meet the 2-year requirement. △

INCORRECT LOADING

Can have an IMPACT!

canada.ca/general-aviation-safety

TP 5905E

Transport Canada / Transports Canada

Canada

2018 Flight Crew Recency Requirements
Self-Paced Study Program

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 31. In addition, aeroplane and ultra-light aeroplane pilots are to answer questions 32 and 33; helicopter pilots are to answer questions 34 and 35; balloon pilots are to answer questions 36 and 37; glider pilots are to answer questions 38 and 39; gyroplane pilots are to answer questions 40 and 41.

References are listed at the end of each question. Many answers may be found in the Transport Canada Aeronautical Information Manual *(TC AIM). Other answers can be found in the* AIP Canada (ICAO). *Amendments to these publications may result in changes to answers and/or references. The TC AIM is available online at:* https://www.tc.gc.ca/eng/civilaviation/publications/tp14371-menu-3092.htm.

The AIP Canada (ICAO) *is available online at:* http://www.navcanada.ca/EN/products-and-services/Pages/AIP.aspx.

The CARs are available online at: http://laws-lois.justice.gc.ca/eng/regulations/SOR-96-433/FullText.html

1. When a civil aircraft uses its registration marks as its call sign after the initial contact with air traffic services (ATS), the call sign may be abbreviated to the last three characters of the registration, as long as ______________________________________.

   (TC AIM - COM 1.9.1.2)

2. Pilots should use VFR Global Navigation Satellite System (GNSS) receivers only to __________ map reading in visual conditions, not as a ___________ for current charts.

   (TC AIM - COM 5.11 (f))

3. In the proper use of GNSS, pilots should resist the urge to fly into marginal weather when navigating VFR. The risk of getting lost is _____ when using GNSS, but the risk of controlled flight into terrain (CFIT) ____________________________.

   (TC AIM - COM 5.11 (h))

4. Where can pilots find the suggested format for pilot weather reports (PIREPs)?

   ____
   ____

   (TC AIM - MET 1.1.6 and MET 2.1)

   UACN10 CYEG 081353
   EG
   UA /OV CYUX /TM 1346 /FLDURD /TP AT43 /SK 008BKN012

5. In the above PIREP, what is the reported weather condition?

   ____
   ____

   (TC AIM-MET 2.1)

6. TAFs are intended to relate to weather conditions for flight operations within _____ of the centre of the runway complex, depending on local terrain.

(TC AIM - MET 3.1 and 7.2)

7. What does the following mean if seen on a Graphic Area Forecast (GFA)?

BKN CU $\frac{80}{20}$

(TC AIM - MET 4.11)

ISOLD TCU 120
5SM –SHRA BR
MNLY OVR VC JMSBA/
NRN ON
LCL 1/2 SM FG
CIG 2 AGL

8. Decode the above GFA clouds and weather chart information.

(TC AIM - MET 4.11)

TAF CYAM 051339Z 0514/0602 VRB03KT P6SM SCT010 BKN030 TEMPO 0514/0515 BKN009
FM051500 30012G22KT 4SM -SHRA BR BKN020 OVC030 TEMPO 0515/0518 P6SM NSW SCT020 BKN040
FM051800 30015KT P6SM -SHRA FEW020 BKN040
BECMG 0522/0524 31008KT
RMK NXT FCST BY 052000Z=

9. In the above aerodrome forecast (TAF), what is the lowest visibility forecast for CYAM? __________. At what time is this visibility forecast to commence? ___________.

(TC AIM - MET 7.4)

10. In the above TAF, what is the wind direction and speed expected at 2300Z? _____________________.

(TC AIM - MET 7.4)

METAR CYXX 041700Z 34004KT 320V050 20SM SCT050 OVC060 07/03 A3007 RMK SC4SC4 SLP187=

11. What does 320V050 mean in the above METAR?

(TC AIM - MET 8.3 (f))

12. In the remarks section of a METAR, density altitude will be indicated after sea level pressure when the density altitude is ______ ft or more than the aerodrome elevation.

(TC AIM - MET 8.3(o))

13. A VFR flight encountering instrument meteorological conditions (IMC) is not normally given VHF direction finder (VDF) headings. What should a pilot do to receive navigation assistance to the VDF site?

____

(TC AIM - RAC 1.6)

14. In the interest of conserving wildlife, pilots must not fly at an altitude of less than ______________ when in the vicinity of herds of wildlife or above wildlife refuges/bird sanctuaries depicted on affected aeronautical charts.

(TC AIM - RAC 1.11.2)

15. The landing or takeoff of aircraft in national parks and national park reserves may only take place _______________________ in accordance with *National Parks of Canada Aircraft Access Regulations* which can be found at http://laws-lois.justice.gc.ca/eng/regulations/SOR-97-150/.

(TC AIM - RAC 1.11.3)

16. VFR weather minimum in uncontrolled airspace at or above 1 000 ft AGL requires a visibility of ____ by day and ____ by night, and a distance from cloud not less than _________ horizontally and ______ vertically.

(TC AIM - RAC 2.7.3 and CAR 602.115)

17. VFR flights must ________________________________ with the appropriate air traffic control (ATC) agency ________ entering Class D airspace.

(TC AIM - RAC 2.8.4)

18. In Canada, the area covered in a Search and Rescue visual search will typically extend to a maximum of _____ on either side of the flight-planned route.

(TC AIM - SAR 2.1)

180139 CYTS TIMMINS
REMOTELY PILOTED AIRCRAFT ACT RADIUS 0.7 NM CENTRE 482818N 811833W (APRX 7 NM S AD) SFC TO 300 FT AGL 1350 MSL
TYPE SENSEFLY EBEE. WINGSPAN 38 INS. WEIGHT 1.5 LB. COLOUR BLACK YELLOW.
1400-2000 DLY
1809141400 TIL APRX 1812142000

19. In the above NOTAM, when is the remotely piloted aircraft system activity expected to end?

____

(TC AIM - MAP 3.6.1)

20. A licence holder with an operational level of language proficiency must be retested every ________.

(TC AIM - LRA 1.3)

21. On what date does the validity period of your medical certificate come to an end? (specify date) ____________________

(TC AIM - LRA 1.9 & 1.9.1 and CAR 404.04)

22. The most common causes of fatigue are ________________, _____________, and ____________.

(TC AIM - AIR 3.8)

23. Go to the NAV CANADA Web site and familiarize yourself with the AICs and AIP Canada (ICAO) Supplements available at www.navcanada.ca/EN/products-and-services/Pages/AIP-current.aspx. Record the most recent AIC number here: _____

24. Pilots unfamiliar with the potential dangers and problems associated with navigating an aircraft in sparsely settled areas of Canada tend to _____________ the difficulties involved in surviving on the ground.

(AIP Canada (ICAO) Part 1 - GEN 1.5.1)

25. What is the correct frequency to use in the Southern Domestic Airspace (SDA) for air-to-air communication? ___________

(AIP Canada (ICAO) Part 1 - GEN 3.4.3.2)

26. How is the temporary occurrence of a potential hazard announced in the Canadian Domestic Airspace (CDA)?

(AIP Canada (ICAO) Part 2 - ENR 5.3.2)

27. AIP Canada (ICAO) Supplements are published at www.navcanada.ca/EN/products-and-services/Pages/AIP-part-4-current.aspx
What is the title of AIP Canada (ICAO) Supplement 7/18?
____

(AIP Canada (ICAO) Part 4)

Nav Canada publishes the Canadian Airport Chart Diagrams at www.navcanada.ca/EN/products-and-services/Documents/CanadianAirportCharts_Current.pdf

28. What is the Aerodrome Traffic Frequency at Alert (ATF), Nunavut (CYLT)? _________

(Canadian Airport Chart Diagrams)

29. In the CFS, where would you find the mandatory circuit patterns and heights, specific VFR routes within zones, restrictions to certain types of traffic, other aerial activities within zones, specific helicopter procedures, and Noise Operating Criteria?

____

(CFS Aerodromes and Facilities Legend)

30. Refer to the CFS and locate the Ottawa VFR Terminal Procedures Chart. Draw and name any 2 symbols found on the chart. _____________ and _____________.

(CFS Section A General, VTPC Legend and CFS Section B Aerodrome/Facility Directory)

31. Refer to the CFS and the Hinton/Jasper-Hinton Alberta (CEC4) aerodrome “Lighting” section. What does ARCAL stand for? ______________________________________ To turn on the aerodrome lights at this aerodrome, you should key the transmitter ________________ on frequency _________

(CFS Section B, Aerodrome/Facilities and Section A, General, Aerodromes and Facilities Legend)

Aeroplanes including ultra-light aeroplanes:

32. You are in the circuit at a controlled airport and the tower tells the aircraft ahead of you that it is "Cleared for the option". What does that mean?

(TC AIM - GEN 5.1)

33. Aircraft departing an uncontrolled aerodrome should climb ____ before commencing a turn in any direction to an en route heading. Turns back toward the circuit or airport should not be initiated until at least ____ ft above the circuit altitude.

(TC AIM - RAC 4.5.2)

Helicopters:

Visit the Transportation Safety Board of Canada (TSB) website at www.bst-tsb.gc.ca/eng/rapports-reports/aviation/index.asp.

34. TSB Aviation Investigation Report A15P0217 states "Therefore, using TC's interpretation of the Night VFR requirements, a flight conducted over an area away from _________________ and where there is inadequate ambient light to clearly discern a horizon (i.e. to continue flight solely by reference to the surface) does not meet the requirements for operation under VFR."

(TSB Aviation Investigation Report A15P0217 – 1.18.3.1)

Visit the Transportation Safety Board of Canada (TSB) website at www.bst-tsb.gc.ca/eng/rapports-reports/aviation/index.asp

35. TSB Aviation Investigation Report A11Q0168 states that "According to Robinson Helicopter Company Safety Notices SN-18 and SN-26, helicopters have ________________________ stability and much faster roll rates than aeroplanes. Loss of the pilot's outside visual references, even for a moment, can result in ________________________________, wrong control inputs, and loss of control.

(TSB Aviation Investigation Report A11Q0168 – 2.3)

Balloons:

36. Should power line contact become inevitable, what is the best action for a balloonist to take? _________

(Use balloon references.)

37. 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 the _________________________, and possible variations of those factors.

(CAR 602.18)

Gliders

38. Identify two methods to reduce slack in a towrope while a glider is being aerotowed?
____
____

(Use glider references)

39. If your aircraft is above 1 000 ft AGL and the cloud base can easily be reached, how high are you permitted to fly? ____

(CAR 602.114 and 602.115)

Gyroplanes

40. Name the reasons why, while flying in the shaded area of the Height vs Velocity diagram, a landing, following an engine failure, has the potential to be unsuccessful?
____

(Use Rotorcraft references.)

41. What are the potential dangers of excessive flapping of the rotor blades during a zero-g flight manoeuvre?
____
____

(Use Gyroplane References.)

Signature: ____________________ Date: ________________________

Answers to this quiz are found on page 23 of ASL 3/2018