Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A07Q0063

LOSS OF CONTROL AND COLLISION WITH TERRAIN

AÉROPRO
PIPER PA31-350 C-FTIW
GRAND LAC GERMAIN, QUEBEC
01 APRIL 2007

Canada

Aviation Investigation Report

Loss of Control and Collision with Terrain

Aéropro
Piper PA31-350 C-FTIW
Grand lac Germain, Quebec
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Report Number A07Q0063

Summary

A Piper PA31-350 (registration C-FTIW, serial number 31-7752123), operated by Aéropro, was on a visual flight rules (VFR) flight from Sept-Îles, Quebec, to Wabush, Newfoundland and Labrador. The pilot, who was the sole occupant, took off around 0630 eastern daylight time. Shortly before 0700, the aircraft turned off its route and proceeded to Grand lac Germain to fly over the cottage of friends. Around 0700, the aircraft overflew the southeast bay of Grand lac Germain. The pilot then overflew a second time. The aircraft proceeded northeast and disappeared behind the trees. A few seconds later, the twin-engine aircraft crashed on the frozen surface of the lake. The pilot was fatally injured; the aircraft was destroyed by impact forces.

Ce rapport est également disponible en français.

Other Factual Information

History of the Flight

About a week before the accident, the pilot planned to fly over the cottage of friends on Grand lac Germain, Quebec, if he had an opportunity. At approximately 2200 eastern daylight time [1] the night before the accident, the company advised the pilot that he was required to do a medical evacuation (MEDEVAC) flight that was scheduled for the next morning.

The aircraft was to fly to Wabush, Newfoundland and Labrador, and bring an ambulatory patient and a passenger back to Sept-Îles, Quebec. The pilot arrived at the company office at Sept-Îles Airport around 0500 to do the external inspection of the aircraft and prepare for the flight. At 0601, he filed a flight plan according to visual flight rules, which indicated that the pilot planned to take off at 0630 for a direct flight to Wabush at an altitude of 5500 feet above sea level (ASL). At 0630, the aircraft took off as planned, with the pilot as sole occupant, and set a direct heading for the destination. The winds were calm, the skies were clear, visibility was 30 miles and the outside temperature was -13°C.

At 0635, the pilot reported five miles north of the airport at 2200 feet climbing to 5500 feet. That was the last message received from the pilot. Radar data indicate that, at 0637, the aircraft was on a heading for Wabush in level flight at 3500 feet ASL. At 0647, the aircraft disappeared from the radar screen. Around 0700, the aircraft arrived at Grand lac Germain, which is about 60 miles north of Sept-Îles, 107 miles south of Wabush and some 9 miles to the west of the planned route.

The aircraft flew over the area twice. The aircraft was not observed the first time it overflew the area. The second time it overflew the area, it flew a northeast heading and followed the downward slope of the terrain on the south side of the bay, passing about 500 feet to the east of the cottage. When it was over the lake, the aircraft arrested its descent at a height of approximately 100 to 300 feet. The aircraft's speed could not be determined. The landing gear was up and no anomalies were observed. The engine noise seemed constant and normal.

Over the north shore of the bay, the aircraft initiated a gentle climb followed by a steep bank, then disappeared behind the trees. The aircraft roughly followed the west shore of the lake as it moved farther away from the cottage. The noise of an impact was heard a few seconds later. A few minutes after that, the aircraft was found broken up on the frozen surface of the lake.

Pilot

The pilot started flying PA31s for Aéropro in March 2006. He held a valid commercial pilot licence issued in June 1994 and a Group 1 instrument rating. Examination of the pilot's logbook, Transport Canada records and the company records revealed that the pilot had about

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[1] All times are eastern daylight time (Coordinated Universal Time minus four hours).

790 flying hours on PA31s. His total flying hours were approximately 5475, including 90 hours in the last 30 days before the accident. The pilot was considered by his peers and the instructor pilots as a competent and professional pilot.

On the day of the accident, the pilot was based at Sept-Îles. His last previous flight was on 30 March 2007. The day before the accident, the pilot got up around 0700; he spent the day doing family activities and went to bed around 2230. On the day of the accident, he got up around 0430 and left the house to go to the company office.

According to the company operations manual, pilots are required to inform the operations manager of the number of hours they fly. The operations manager must ensure that the pilots' hours meet the regulatory requirements for flight time and flight duty time prescribed in Section 700.15 of the *Canadian Aviation Regulations* (CARs). Since Transport Canada had issued an operating specification to the company to extend the flight time limitations, the company was required to ensure that pilots did not exceed the times specified in Section 720.15.

At the time of the accident, the last update on the form used to record the pilot's flight time, flight duty time, and rest periods was made on 23 February 2007. To determine the pilot's flight time from 23 February 2007 to the day of the accident, the logbooks for the aircraft operated by the company were used. The pilot's calculated flight time indicated that he did not exceed the limitations prescribed in Section 720.15 of the CARs. Based on the information gathered, there is no evidence that fatigue was a factor in the accident. Test results for the presence of common drugs were negative. The autopsy report indicates that the pilot died as a result of the accident.

Aircraft

The Piper PA31-350 is a low-wing, twin-engine aircraft that can carry two pilots and up to eight passengers, depending on configuration. The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. Its last inspection was on 29 March 2007. The number 2 cylinder of the left engine was replaced. At the time of the accident, the aircraft had no outstanding maintenance items. No deficiencies had been reported or entered in the aircraft logbook. The pilot who flew the aircraft the day before the accident reported no particular problems.

The aircraft was equipped for instrument flight. It was fitted with an autopilot and a radar altimeter. The aircraft was not equipped with a flight data recorder (FDR) or cockpit voice recorder (CVR), nor were they required under existing regulations.

The aircraft had been modified to increase the maximum allowable take-off weight from 7000 to 7368 pounds. The Super Chieftain modification from Boundary Layer Research Inc. (Supplementary Type Certificate [STC] SA00192SE) consisted of four engine nacelle strakes and 88 vortex generators affixed to the wings and vertical tail. The vortex generators improve the stall characteristics and lower the stall speed by about 8 knots by controlling boundary layer airflow.

Stall

The stall speed of the aircraft at its estimated weight at the time of the accident—5800 pounds—was 67 knots with the wings level, flaps retracted and no applied power. The aircraft weight and load factor have an effect on stall speed. For example, in a turn, the load factor increases according to the angle of bank. Consequently, the greater the bank angle, the higher the speed at which the aircraft will stall (see Table 1). Also, to maintain constant altitude in a turn without applying more power, some speed must be sacrificed. In a climbing turn, the outer (high) wing will be the first to stall and sink. The manufacturer and owner of the STC state that the maximum loss of altitude when recovering from a stall is 500 feet.

Gross weight 5800 pounds	Angle of bank					
	0°	30°	40°	50°	60°	70°
Stall speed in knots	67 knots	72 knots	77 knots	83 knots	95 knots	115 knots

Table 1. Stall speed with vortex generators and no power

The symptoms of an impending stall include sluggish control surfaces (loss of effectiveness), airframe vibration, and activation of the stall warning system. Pilots must decrease the angle of attack and minimize the loss of altitude. To do so, they must apply full throttle and take an attitude close to cruising attitude.

The aircraft's stall warning system consists of a lift transducer vane and a backing plate located on the right-wing leading edge. The vane is able to move up or down within a range of motion afforded by a gap in the backing plate in which it is mounted. Aerodynamic pressure on the lift transducer vane varies with the wing's angle of attack. When an angle of attack approaches that of an imminent stall, the vane changes position, and the sensor unit produces a signal that activates the stall warning horn in the cockpit, 4 to 10 knots before the stall.

The walk-around checklist in the aircraft operating manual does not require that the stall warning system be checked for serviceability. The investigation revealed that the company pilots did not routinely check the system for serviceability.

Company

The company's operations are governed by Section 703, Air Taxi Operations, and Section 704, Commuter Operations, of the CARs. The Aéropro head office is in Québec, Quebec, and it has auxiliary bases in Saint-Hubert and Sept-Îles. C-FTIW operated out of Sept-Îles. At the time of the occurrence, Aéropro was operating a fleet of about 14 aircraft (Cessna 310 and 337, Piper Navajo, Beech King Air 90 and 100, and Embraer 110).

Aéropro uses a pilot self-dispatch system. The pilot is fully responsible for preparing, planning and conducting the flight. He is also required to ensure that the flight is conducted in accordance with existing regulations and company procedures as published in the company operations manual. The company operations manual states that the pilot-in-command is responsible for monitoring the flight. The pilot-in-command is required to advise the person

who authorized the flight or the qualified person on duty as soon as the itinerary or schedule is changed. The company has no particular requirements for MEDEVAC flights. Aéropro did, however, use two pilots on MEDEVAC flights to facilitate patient boarding. Since there were no requirements to that effect, the presence of a co-pilot was left to the discretion of the pilot-in-command. The pilot was not able to make contact with another pilot before the flight for undetermined reasons; he decided to carry out the flight on his own. The pilot did not advise the company that he was going to complete the flight alone. When the aircraft was reported missing, the company advised the search and rescue centre that there were two pilots on board, since the aircraft was on a MEDEVAC flight.

Accident Site

The accident occurred on the frozen surface of the southeast bay of Grand lac Germain, at an elevation of 1780 feet ASL. The aircraft struck the frozen surface of the lake 525 feet east of the shoreline it was flying over and 275 feet west of an island in the middle of the bay. The aircraft crashed approximately 2300 feet northeast of the cottage and 1600 feet after disappearing behind the trees. The aircraft broke through the top layer of ice, which was about two inches thick, then bounced off the second layer of ice. The impact produced a crater 30 feet in circumference.

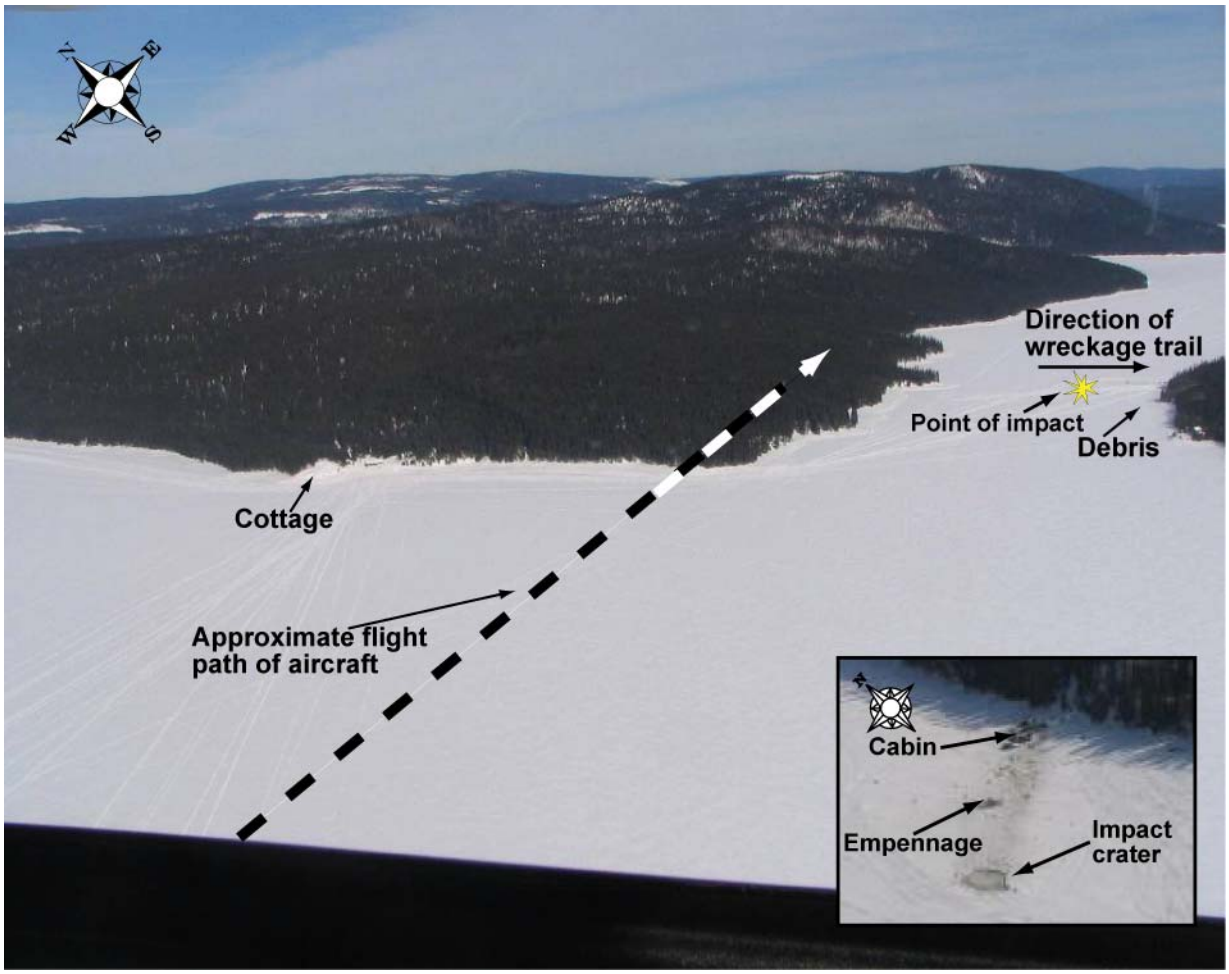

Figure 1. Aerial view of accident site

The aircraft heading was 117°M at the time of impact, which is 14° off the breakup trajectory. Photogrammetric analysis of the crater established that the aircraft struck the ice surface in a low right bank attitude with the nose slightly up. The slope of the flight path was approximately 18° downward.

From the point of impact, the sun was at 115°M and at 8° above the horizon.

Wreckage

The wreckage was examined to the extent possible. The aircraft broke into several pieces. The breakup trajectory was on a heading of 103°M. The wreckage trail was approximately 250 feet long and an average 40 feet wide. The wing tips were found 50 feet from the point of impact. The cabin roof was completely torn off. The cockpit and cabin were so damaged by impact forces that the occupant space was almost completely reduced. The accident was not survivable.

The landing gear was up. Both engines separated from the aircraft under impact forces. Examination of the propellers established that, at the time of impact, they were at low pitch, which is consistent with cruise engine power. It was also determined that the two engines were at the same throttle setting. The engine rpm could not be determined.

The two flap actuators were examined at the TSB Engineering Laboratory, and it was confirmed that they were in the retracted position at the time of impact. Readings were taken from the needle marks imprinted on the faces of the two airspeed indicators and one vertical speed indicator at the time of impact. The marks indicated that both airspeed indicators read 67 knots and that the vertical speed indicator showed a rate of descent of 1900 feet per minute.

There was a significant dent in the right wing tip that was approximately five inches in diameter. No debris was found in this imprint or inside the wing that could be used to identify the object that was struck. The imprint of a blade was observed in the dent. The investigation did not determine whether the right wing struck a tree in flight or another object during the breakup sequence. Bird strike was ruled out because no bird remains were found.

Due to the extent of impact damage, it was not possible to establish flight control continuity at the time of the accident. However, none of the components examined revealed any deficiencies that would have impeded control of the aircraft. No signs of in-flight fire were found.

The fuel system console was retrieved and sent to the TSB Engineering Laboratory for analysis. The fuel tank selector for the left engine was found in the closed position; examination revealed that it moved freely. Normally, the lever must be lifted in order to move it. The incandescent filament in the indicator light was found intact, indicating that it was not illuminated at the time of impact and that fuel was being supplied to both engines.

VFR Flight Obstacle Clearance Requirements

The operation of Aéropro's PA31 was subject to Part VII, Subpart 3, of the CARs. Section 703.27 of the CARs requires that companies governed by Subpart 703 that conduct daytime VFR flights not operate the aircraft at less than 300 feet above ground level (AGL) or at a horizontal distance of less than 300 feet from any obstacle. At the time of the accident, the Aéropro company operations manual did not make provision for the restrictions on daytime VFR flights prescribed in Section 703.27 of the CARs.

Illusion Created by Low-Altitude Flight

When flying at normal altitude, an aircraft seems to be moving slowly relative to the ground. The proximity of the ground tends to capture the pilot's attention and create the illusion of higher speed relative to the ground, to the point where the pilot may be tempted to reduce speed.

Analysis

There is no indication that weather contributed to the accident.

The flight path of C-FTIW could not be accurately determined. However, the information available reveals that the aircraft was heading northeast at an altitude between 100 and 300 feet before initiating a climb and a right turn. A few seconds later, the aircraft stalled and crashed after travelling approximately another 600 feet, in a slight nose-up attitude and banked slightly right.

The information gathered did not reveal the direction the aircraft banked before it crashed. However, analysis eliminated that ambiguity. If the aircraft had been banked steeply to the left, aerodynamic forces would have pushed it to the left of its flight path, that is, to the west of the lake, and it would have crashed in the trees. The attitude of the aircraft on impact and the marks on the ground indicate that the forces acting on the aircraft were directed toward the right. For that reason, it was concluded that the aircraft was banked right before it disappeared behind the trees. Therefore, it is reasonable to think that the pilot made a right turn after the low-altitude pass in order to continue on his route to Wabush.

Aircraft

It is possible that an unidentified mechanical problem increased the pilot's workload and distracted him before the impact. However, the aircraft maintenance records and the physical evidence at the accident site suggest that the accident was not caused by a mechanical failure. Examination of the propellers established that they were being driven by the engines and they were rotating at the same speed. Since the flaps were retracted, it was concluded that the aircraft did not experience an asymmetrical flap problem. No anomalies were observed by the witnesses or noted on previous flights that could have caused a loss of control.

The wings and the vertical tail of the aircraft were equipped with vortex generators in accordance with STC SA00192SE. This modification altered the lift characteristics of the wing by increasing the stall angle of attack. To determine the effect of the vortex generators on the stall angle of attack, the modified wings had to be compared with the original wings. The results showed that the difference between the two stall angles of attack was about 2°. This difference did not have a crucial effect on the lift conditions in this occurrence and it can be concluded that the aircraft was in a stall condition at the time of impact.

Obstacle Clearance Margin

The altitude of the aircraft the second time it overflew the area could not be determined with precision. However, it is possible that the aircraft was below the minimum obstacle clearance altitude before it stalled. To prevent CFIT accidents, [2] CARs require that commercial flights operating under Subpart 703 maintain a minimum obstacle clearance altitude. The rules for obstacle clearance are independent of the VFR weather minima.

Plausible Scenarios

Three scenarios were examined as plausible explanations for the loss of control of the aircraft before impact.

Flight Control Failure

Failure of the ailerons, rudder, or elevator was considered. In this occurrence, failure of the ailerons or rudder would not have resulted in loss of control of the aircraft. However, if the elevator failed, the result would be a nose-down attitude and an increase in speed. This would have caused the aircraft to strike the frozen surface of the lake at high speed with a steep angle of descent. If that had happened, most debris would be close to the point of impact. However, instead, the aircraft was in a slightly nose-up attitude, and the wreckage trail was over 250 feet long. Consequently, failure of a flight control is not very plausible.

Collision with a Tree

The altitude of the aircraft during the pass and the cylindrical imprint near the right wing tip suggest that the aircraft might have struck a tree before crashing. If that had happened, the tree impact would have caused the aircraft to yaw right and pitch down. Given the altitude at which the collision would have occurred, it is reasonable to think that the pilot would not have had time to regain control of the aircraft before it struck the frozen surface of the lake. Moreover, a collision with a tree would have reduced the aircraft speed below the stall speed.

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[2] Controlled flight into terrain

However, no wood residue was found in the wing, the right wing tip remained attached to the wing until the final impact, and the imprint could be the result of a propeller blade impact during the aircraft breakup. Consequently, it is not possible to conclude with certainty that the aircraft struck a tree.

Aerodynamic Stall

Analysis of the impact marks, the wreckage pattern and the imprints on the aircraft's instruments [3] indicates that the aircraft struck the frozen surface of the lake at a speed near the stall speed at an angle of descent consistent with the stall angle of attack of the aircraft. For these reasons, it can be concluded that the aircraft was in a stall condition at the time of impact.

It is possible that the aircraft stalled during the climbing turn to the right. Several factors may have contributed to reducing the margin between the aircraft's speed and its stall speed. Since the pilot's aim was to fly over the cottage of his friends, it is reasonable to think that the aircraft was flying below normal cruising speed. Furthermore, the aircraft proximity to the ground could create an illusion of high speed, which may have induced the pilot to reduce speed. In addition, the throttle setting during the climb may have been the same as in the level flight segment, since the engine noise did not increase; if that were the case, the aircraft would have experienced a loss of speed during the climb. Finally, the observed steep bank turn substantially raised the stall speed. If the bank angle of the aircraft was 70°, as was reported by one witness, the stall speed would have increased from 67 knots to 115 knots.

Because the stall occurred during the climb, the left wing stalled before the right wing. Since the stall warning system is on the leading edge of the right wing, it is plausible that the audible signal alerted the pilot to the imminent stall less rapidly than if the stall had occurred in level flight. There was insufficient altitude for the aircraft to effect a recovery and the pilot did not have enough time to regain control of the aircraft.

The following TSB Engineering Branch Laboratory reports were completed:

LP 034/2007 – Propeller Analysis
LP 035/2007 – Flap Actuator & Analysis
LP 036/2007 – Instruments & GPS Analysis
LP 055/2007 – Performance & Flight Analysis

These reports are available from the Transportation Safety Board of Canada upon request.

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[3] Examination of the airspeed indicator and vertical speed indicator revealed that the aircraft struck the frozen surface of the lake at 67 knots with a rate of descent of 1900 feet per minute.

Finding as to Causes and Contributing Factors

1. The aircraft stalled at an altitude that was too low for the pilot to recover.

Findings as to Risk

1. The aircraft was flying at an altitude that could lead to a collision with an obstacle and that did not allow time for recovery.

2. The steep right bank of the aircraft considerably increased the aircraft's stall speed.

3. The form used to record the pilot's flight time, flight duty time, and rest periods had not been updated for over a month; this did not allow the company manager to monitor the pilot's hours.

4. At the time of the occurrence, the Aéropro company operations manual did not make provision for the restrictions on daytime VFR flights prescribed in Section 703.27 of the *Canadian Aviation Regulations.*

Other Findings

1. The fact that the aircraft was not equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR) limited the information available for the investigation and limited the scope of the investigation.

2. Since the aircraft was on a medical evacuation (MEDEVAC) flight, the company mistakenly advised the search and rescue centre that there were two pilots on board the aircraft when it was reported missing.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 10 September 2008.

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Appendix A – Approximate Flight Path of Aircraft