

Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

**AVIATION INVESTIGATION REPORT
A07W0003**



LOSS OF CONTROL - MARGINAL WEATHER

**ARCTIC SUNWEST CHARTERS
CESSNA A185F C-GSDJ
YELLOWKNIFE, NORTHWEST TERRITORIES, 53 nm SE
03 JANUARY 2007**

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Aviation Investigation Report

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Summary

The Cessna A185F (registration C-GSDJ, serial number 18504212) operated by Arctic Sunwest Charters departed Yellowknife, Northwest Territories, at 1019 mountain standard time, with a pilot and three passengers on board, for a round trip flight to Blatchford Lake Lodge, approximately 53 nautical miles southeast. The aircraft was on a company flight itinerary with an estimated time of arrival of 1100. When there was no contact from the pilot by 1300, a communication search and track crawl was conducted by company aircraft, but this was unsuccessful in locating the aircraft. No emergency locator transmitter signal was detected at any time. At 1513, the company reported the aircraft overdue to the Flight Service Station. An active search by the Rescue Coordination Centre was conducted using a number of aircraft. The wreckage of the aircraft was found at 1215, 04 January 2007, on the ice at Blatchford Lake. The pilot and two passengers had sustained fatal injuries, one passenger had sustained serious injuries, and the aircraft was substantially damaged.

Ce rapport est également disponible en français.

Other Factual Information

History of Flight

The ski-equipped Cessna A185F had been chartered to transport three employees of the Blatchford Lake Lodge, with their gear and supplies, to the lodge to prepare for the January 20 opening. Due to load considerations, the pilot ensured that the passengers donned their winter clothing to create more room in the cargo area, and to determine their actual weights before calculating the amount of baggage and cargo that could be loaded. Before departure, the pilot advised dispatch that, if he encountered marginal conditions and icing en route to the lodge, he would probably stay at the lodge until conditions improved.

The pilot had not previously been to the lodge and was briefed by the chief pilot as to the location of the lodge relative to Blatchford Lake. He also entered coordinates for the lodge into a hand-held global positioning system (GPS); however, this waypoint was approximately one nautical mile (nm) east of the lodge.

The last NAV CANADA radar return on the aircraft was at 1036 mountain standard time¹ about 30 nm east of Yellowknife at approximately 500 to 600 feet above ground level (agl).²

The hand-held GPS was recovered from the accident site, and the track log data were extracted by the TSB Engineering Laboratory. Data consisted of ground speed, track, latitude and longitude, leg segment distance, and GPS altitude. The data points were recorded every 30 seconds by the GPS over a 41-minute time period.

The cruise ground speed of the flight was as high as 130 knots 6 minutes into the flight, and steadily decreased to 100 knots 24 minutes later. Altitudes reached 1417 feet above sea level (asl) 5 minutes after take-off and decreased to an average of 1050 feet asl over the next 12 minutes. The aircraft then commenced a gradual descent to 893 feet asl (193 feet agl) over the next 7 minutes before returning to an average of 1050 feet asl 2 minutes later. Average terrain elevation over the entire track was approximately 700 feet asl.

Slight deviations left and right from the direct track were recorded while en route to the destination waypoint, with the aircraft arriving at the north shore of Blatchford Lake approximately 0.9 nm east of the lodge. The aircraft then took up a northeasterly heading (away from the lodge) and slowed to 78 knots. There was one more track point recorded 0.6 nm west of the accident site on a track of 071° magnetic (M), with a ground speed of 90 knots, before the unit ceased recording (see Figure 1). The aircraft was in a left turn when it began to shake just before a sudden descent and impact.

¹ All times are mountain standard time (Coordinated Universal Time minus seven hours).

² Units are consistent with official manuals, documents, and instructions used by or issued to the crew.

Search and Rescue and Survivability

The pilot was conducting the flight on a flight itinerary, with the company being the responsible agency for activating search and rescue (SAR) if the aircraft became overdue.

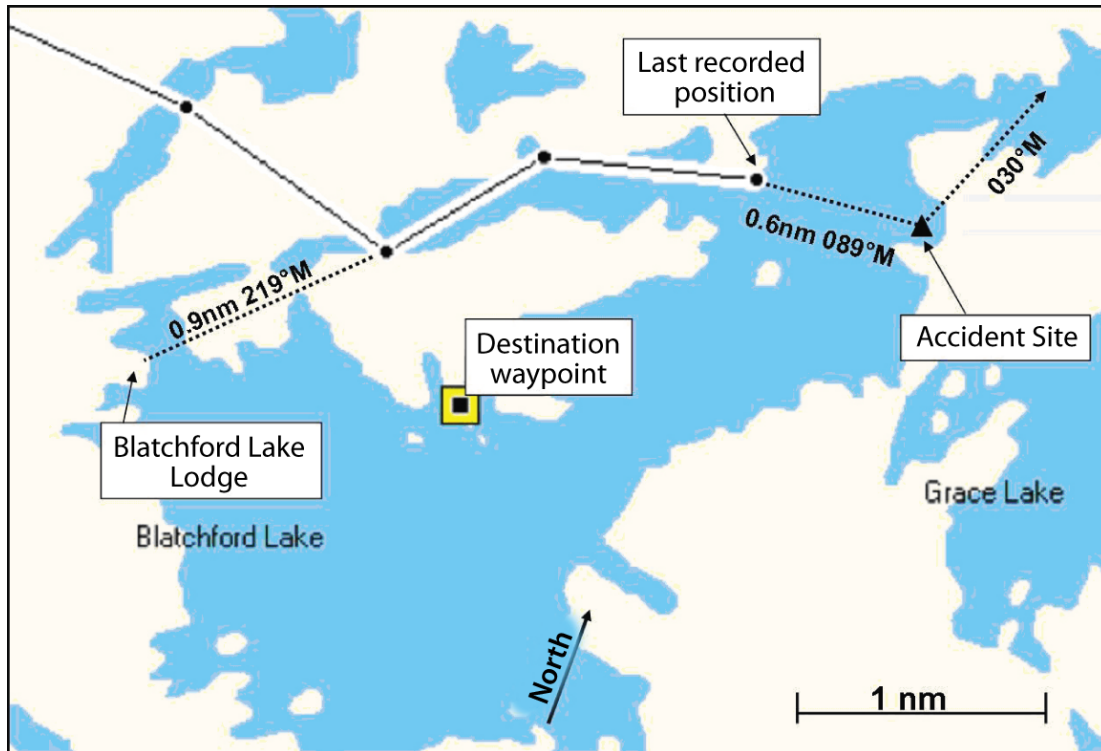


Figure 1. Map of area

The company began a communications search for the aircraft at approximately 1300, and a Turbo Beaver was deployed at 1435 to search along the proposed route. The Beaver made it out to the lodge and reported that nothing was seen, and no emergency locator transmitter (ELT) signal was heard. The Beaver encountered cloud ceilings as low as 200 feet agl and icing conditions along the route. NAV CANADA and the Rescue Coordination Centre (RCC) were notified at 1513.

In total, the RCC tasked one Griffon, one Twin Otter, and two Hercules on the search. It also tasked a ground SAR team, two Beavers from the company, and a locally operated Bell 212.

The first SAR aircraft, a military Twin Otter from Yellowknife, was on scene at 1830 followed by a Hercules from Winnipeg, Manitoba, at 1905. Both aircraft encountered darkness, low cloud, and in-flight icing, which made searching difficult. Airborne search activities ceased at approximately 2200. SAR activities recommenced at 0745 on 04 January 2007, when a second Hercules arrived from Winnipeg.

The downed aircraft was spotted at 1214 and SAR technicians were on scene at approximately 1245. The technicians confirmed three dead and one survivor. The Beaver 212 picked up the survivor at 1415 and landed at the Yellowknife hospital at 1457.

All occupants were wearing the provided lap seat-belts and shoulder harnesses where available. Seat deformation and injury pattern were consistent with the aircraft hitting the ice in a right-wing-low, slightly nose-low attitude with a high vertical deceleration. Autopsy examination of the pilot and two passengers showed that their injuries were not survivable. The passengers were wearing several layers of winter clothing, and the survivor's injuries, although serious, did not include any external or internal bleeding. The survivor remained trapped within the aircraft the entire time while awaiting rescue. The lowest temperature reached was -15°C.

Accident Site and Wreckage Description

The aircraft struck the snow-covered surface of Blatchford Lake 2.75 nm east of the lodge and came to rest at 62°10.383' N, 112°35.192' W. The wreckage trail was approximately 255 feet long on a track of 030°M. The first ground scars were about 40 feet long and included marks from the fuselage, followed by the right and left wing tips. The aircraft bounced, became airborne, and travelled for about 55 feet before contacting the surface of the lake again. The aircraft remained on the lake, yawing to the right and skidding for an additional 160 feet. The aircraft came to rest on a heading of 144°M.

The fuselage and empennage were distorted and leaning to the right, with significant crushing of the bottom of the aircraft such that the floor was almost level with the seat bottoms. Damage to the propeller was consistent with considerable engine power being produced at the time of impact. Throttle, propeller pitch, and mixture controls were found in the FULL FORWARD position. The flaps were in the UP position and the wheel skis were in the skis DOWN/wheels UP position. Elevator trim was positioned FULL FORWARD/NOSE DOWN. The control column broke on impact positioned fully aft, with a medium right bank input.

The leading edges of the wings, horizontal stabilizer, vertical fin, and wing struts were covered with approximately 3 to 4 mm ($\frac{1}{8}$ inch) of rime ice, as were the windscreen and propeller spinner. The pitot head was clear of ice. The stall horn opening in the left-wing leading edge was clear of ice; however, it appeared to have been covered with ice that was dislodged at impact. The stall warning horn did not sound before impact.

Cargo retrieved from the cargo compartment was found in sections 1 and 2, and partway into the tail cone. None of the cargo was secured, nor was there a cargo net or ropes attached to the two tie-down rings in cargo area 1. The SAR technicians who attended the scene removed one bag that was found on the floor in the front right seat, wedged between the seat and the panel, and a second bag that was loose in the rear seat area. The right front seat passenger and the left rear seat passenger had been holding baggage in their laps, which is not allowed by Section 602.86 of the *Canadian Aviation Regulations (CARs)*.

After the cargo was removed, the ELT was found detached and lying in the tail section. It had torn loose from its mounting bracket in a downward direction, and the antenna had detached. The switch was found in the ARM position. At the site, when the ELT was jolted in the forward direction with a helicopter radio tuned to 121.5 MHz, the ELT immediately activated. Installation and maintenance of the ELT was in accordance with regulations.

Weight and Balance

The weight and balance report completed for the operational flight plan reflected a weight of 227 pounds for the pilot, 390 pounds for the three passengers, 150 pounds of cargo, and 378 pounds of fuel for a gross take-off weight (GTOW) of 3265 pounds. There was concern about the load, and many items were left behind to be taken out to the lodge at a later date.

A new, calibrated bathroom scale was used at the accident site to weigh the items removed from the aircraft. Of the items removed, 176 pounds was attributed to cargo. Another 104 pounds was attributed to aircraft equipment. Pilot and passenger weights were obtained from weighing at autopsy fully clothed, and the survivor supplied his fully clothed weight, for a total of 468 pounds of passenger weight. The aircraft weight at the time of the occurrence was calculated to be 3316 pounds, with the centre of gravity (C of G) at 46.88 inches aft of the datum. Maximum allowable gross weight was 3350 pounds with the C of G limits of +41.9 to +46.5 inches aft of the datum.

Weather

The pilot retrieved weather information from the NAV CANADA website at 0815 and discussed some of the weather with the company chief pilot. The dominant weather feature in the Yukon and Northwest Territories was two low-pressure areas; one over the Yukon and the other over the northern border of Alberta and Saskatchewan. The *Clouds and Weather* chart issued at 1141Z (Zulu time) for use from 12Z to 24Z forecast the following for the vicinity of Great Slave Lake:

North of the lake, broken layers based at 8000 asl with tops at 12 000 asl. Broken layers based at 1500 to 2500 asl, tops 4000 asl, with visibilities of 6 sm [statute miles] and patchy visibilities of 2 to 5 sm in light snow and mist. In the vicinity of Great Slave Lake and over higher terrain, expect extensive ceilings of 300 to 600 agl with local visibilities of ¼ sm in freezing fog.

The weather described above would be conducive to white-out conditions.

The *Icing Turbulence and Freezing Level* chart issued at 1142Z valid from 12Z to 24Z forecast the following conditions in the area of intended flight:

An area of patchy moderate mixed icing based at 1500 asl with tops at 4000 asl.

From 0800, the Yellowknife airport weather trend was towards higher ceilings and increased visibilities throughout the morning. An aviation routine weather report (METAR) at the Yellowknife airport was issued at 1000, and a special at 1022, three minutes after departure.

1000 – Wind 290°T at 2 knots, visibility 15 sm in light snow, ceiling 800 feet agl broken, 1400 feet agl overcast, temperature -13°C, dew point -14°C, altimeter setting 29.16" Hg [inches of mercury], remarks, stratus ⁶/₈, stratocumulus ²/₈.

1022 – Wind 310°T at 5 knots, visibility 15 sm, ceiling 900 feet agl broken, 1400 feet agl overcast remarks, stratus ⁶/₈, stratocumulus ²/₈.

When the pilot retrieved the weather, there was only one pilot report for the Yellowknife (YZF) area, which was issued at 0651. There were two more pilot reports collected after 0900. It is not known whether the pilot had received the latter two reports.

At 0651, a Dash 7 had departed Yellowknife and reported that in the climb they entered cloud at 1100 feet asl and encountered moderate rime ice. The tops were at 2400 feet asl and it was clear above. Temperature at 3600 feet asl was -10°C.

At 0916, a Beech 200 reported in the descent for YZF that the cloud tops were at 3500 feet asl and the bases at 1400 asl. There was no icing and the braking action was good on Runway 33.

At 0920, a Dash 7 reported in the descent for YZF that the cloud tops were 2600 feet asl and the bases at 1400 feet asl. There was light rime ice in cloud.

Pilot Information

The pilot held a commercial pilot licence valid for all single-pilot, non-high performance, single- and multi-engine land and sea aeroplanes. He did not have an instrument rating. His total time was approximately 1750 hours, of which 150 hours were on Cessna 185 aircraft. He had accumulated about 755 hours on floats and 50 hours on skis. His previous job was flying a privately operated Cessna 185 on wheels, skis, and floats for a surveying company. The survey flying was done primarily at low level with no passengers and in fairly good weather conditions, since good weather was critical to the collection of accurate data. Before the survey job, the pilot had flown a Piper PA18 Super Cub for a wilderness lodge.

The pilot was described as conscientious and skilled, but self assured, and reluctant to seek assistance.

The pilot joined Arctic Sunwest Charters on 20 November 2006, his first job flying under Section 700 of the CARs. He completed his training, including low-visibility training, for the Cessna 185 on 07 December 2006. The pilot completed two local flights totalling about five hours late in December in the Cessna 185 before the occurrence trip. He was also trained to fly the Turbo Beaver, having flown as an extra crew member and as captain on several flights, for a total of about 11 hours.

Company Information

At the time of the occurrence, Arctic Sunwest Charters operated 13 aircraft comprising 9 different types, and was certified by Transport Canada to operate under Sections 702, 703, 704, and 705 of the CARs. For the 703 operations, the company used a pilot self-dispatch system, and operational control and flight release was delegated to the pilot-in-command (PIC) by the operations manager. A flight release was deemed to have been given when the PIC determined that:

- the flight was to be conducted in accordance with the operating certificate, specifications issued to the company, and all CARs and standards;
- the validity of all required licences, permits, and certificates had been verified;
- all required aircraft maintenance work had been completed, and that there was sufficient time left on the aircraft to complete the job before the next maintenance interval; and
- an operations flight plan, a flight plan, or flight itinerary had been completed.

The operations manager retained the authority to cancel or delay a flight as necessary.

The company obtained an operations specification in order to operate under visual flight rules (VFR) in uncontrolled airspace below 1000 feet agl with less than two miles of flight visibility (Sections 3.5.4 and 5.35 (4) of the company operations manual). This required the aircraft to be fitted with and the pilot to be trained (initially and annual recurrent) on the use of an artificial horizon, a directional gyroscope, a GPS receiver, and visual navigational charts. There is no record of the pilot having received the required instruction regarding the GPS.

The pilot had to have a minimum of 500 hours in operations under Section 700 of the CARs or equivalent and have completed flight and ground training on low-level flying. When encountering low visibility below 1000 feet agl, the aircraft was to be operated at 80 knots indicated airspeed (KIAS) and configured with 10° of flap.

The company operations manual (Section 2.5) identified the PIC as the person responsible for proper load security, weight, and distribution for the aircraft, and stated that the weight and C of G do not exceed the limitations in the aircraft flight manual. Subsection 602.86 (b) of the CARs identified that any cargo carried on board an aircraft be restrained so as to prevent the cargo from shifting during movement of the aircraft on the surface and during take-off, landing, and in-flight turbulence.

The company operations manual (Section 3.10.1 (D, E)) specified that the Cessna 185 will not depart into or operate in icing conditions, and that no aircraft shall be flown in known or forecast icing conditions unless the aircraft is equipped and approved to operate safely in such conditions.

Analysis

It was determined that the aircraft stalled while in a left turn at low level. With the forward visibility through the windshield obscured by ice, the pilot was most likely flying with attitude references through his left side window. In a left turn, the descending left wing would have obstructed his visibility, leaving only a view of the snow-covered lake surface below. The conditions would have been conducive to a white-out situation, whereby the snow-covered lake surface would blend with a snowy, obscured ceiling to disorient the pilot by eliminating all horizon references. The pilot's manoeuvring speed was unknown, but entering a turn would have increased the stall speed, as would the effect of the ice on the wings. The use of flaps would have decreased his stall speed, but the flaps had not been deployed. The stall warning had not activated to warn of the impending stall.

The calculated aircraft weight at impact was just below the maximum gross weight; however, the amount of additional weight of the airframe ice was not quantified. The C of G was at or slightly aft of the aft limit. This configuration would not have created a problem under normal flight conditions, but the aft C of G would have increased the difficulty in recovering from a stall.

Under the operator's Transport Canada exemption for operations below 1000 feet agl with less than two miles of flight visibility, the pilot had to be trained in the use of a GPS receiver. There is no record of his having received the required instruction. The coordinates entered for the lodge were about a mile east of the lodge, and the pilot had turned northeast (away from the lodge) before reaching this waypoint. There is a probability that the pilot abandoned the use of the GPS when he reached the north shore of the lake, and turned left to follow the shore of the lake for navigation, since his visual reference was out his left side window with his windshield obscured by ice. His subsequent flight path continued to track eastward away from the GPS waypoint and away from the lodge, until the aircraft crashed.

The pilot was required to have had a minimum of 500 hours in operations under Section 700 of the CARs or equivalent to qualify for low-level/limited visibility flight. He had about 16 hours' commercial (Section 700 of the CARs) flying time with about 1500 hours of non-commercial single-engine flying time. He had completed his low-level flying training, but did not adhere to the operations manual requirements that specified that the aircraft was to be operated at 80 KIAS with 10° of flap. The aircraft airspeeds varied from 130 KIAS to 77 KIAS, and flaps were not deployed.

The company operations manual specified that the Cessna 185 will not depart into forecast icing conditions. Freezing fog and patchy moderate mixed icing was forecast for the destination area when the aircraft departed, and the pilot report from 0651 reported rime ice upon entering clouds at 1100 feet asl. After departure, the pilot had initially climbed to 1400 feet asl, then began a continuous descent to about 1000 feet asl near his destination. He had encountered icing conditions as forecast and reported, as evidenced by the ice remaining on the airframe after the occurrence. The aircraft was not equipped or approved to operate in icing conditions.

The cargo and baggage was not secured, nor was there any means on board for securing the baggage and cargo to the tie-down rings. Because the primary impact was oriented vertically, the unsecured items probably did not project into the cabin and passengers. It could not be determined whether the baggage carried in the passengers' laps contributed to the severity of their injuries. The survivor was the passenger without baggage in his lap.

SAR efforts were delayed for several hours because the ELT did not function. The unit was capable of operating, but the impact activation switch (G switch) was oriented to sense a forward impact, not a vertical (downward) impact.

The following TSB Engineering Laboratory report was completed:

LP 04/07 - GPS Download

This report is available from the Transportation Safety Board of Canada upon request.

Findings as to Causes and Contributing Factors

1. The aircraft stalled at an altitude too low for the pilot to recover.
2. The aircraft's stall speed and stall recovery characteristics were affected by the left turn, airframe icing, and the aft centre of gravity loading.
3. The pilot's visibility was compromised by the marginal weather conditions and an ice-covered windshield, with a probability that the pilot had entered white-out conditions.

Findings as to Risk

1. The pilot self-dispatched on a flight that was not in accordance with the requirements outlined in the company operations manual. He continued the flight after encountering conditions beyond his capabilities in regards to training, equipment, and operating conditions.
2. The baggage and cargo were not secured, and there were no means on board for securing the baggage and cargo to the tie-down rings.
3. Two of the passengers were carrying unsecured baggage in their laps.

Other Finding

1. The pilot had not been trained in the use of the global positioning system as required by regulation for low-level flight/limited visibility flight.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 29 November 2007.

Visit the Transportation Safety Board's Web site (www.tsb.gc.ca) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.