Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A13O0125

LOSS OF CONTROL AND COLLISION WITH WATER

CESSNA 182, C-FIUE
GRIFFITH ISLAND, ONTARIO
04 JULY 2013

Canada

Aviation Investigation Report A13O0125

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Summary

The privately registered Cessna 182 equipped with amphibious floats (registration C-FIUE, serial number 33120) had departed Makada Lake, Ontario, with the pilot and 1 passenger on board to pick up another passenger at Little Panache Lake, and then continued to Griffith Island, located in Georgian Bay on Lake Huron. One pilot and 2 passengers were on board. While conducting a visual approach to Runway 27 at Griffith Island, the aircraft aerodynamically stalled and collided with the water approximately 1000 feet southeast of the runway threshold. The accident occurred during daylight hours, at approximately 1345 Eastern Daylight Time. The aircraft was destroyed by impact forces, and there were no survivors. The aircraft was equipped with an emergency locator transmitter, which activated. However, no signal was received due to submersion of the antenna.

Le présent rapport est également disponible en français.

Factual information

History of the flight

On the day of the occurrence, the privately registered Cessna 182 equipped with amphibious floats (registration C-FIUE, serial no. 33120) was proceeding to Griffith Island to meet with 2 other aircraft. The planned route, from Makada Lake to Little Panache Lake and on to Griffith Island, was approximately 102 nautical miles (nm). This was the pilot's first flight to Griffith Island.

Griffith Island is located on the southwest side of Georgian Bay near the Bruce Peninsula, approximately 10 nautical miles (nm) east of Wiarton, Ontario. The island has a single grass strip runway (09/27), which is 2700 feet long and 130 feet wide, and is located on a hill on the southeast side of the island, at a field elevation of 625 feet above sea level (asl). The approach to Runway 27 is over the water, and the threshold is approximately 460 feet from the water's edge.

The occurrence aircraft was the last of the 3 aircraft to arrive at Griffith Island, and was heard overflying the island in a southbound direction. When the aircraft was spotted, it was floating in the water upside down, just south of the extended centreline of the runway. A 911 call was placed, and a local boat proceeded to the scene of the accident, but its occupants were unable to locate any survivors. When emergency vessels and the Ontario Provincial Police recovery divers arrived on scene, they confirmed that all occupants were deceased and trapped in the aircraft.

The accident occurred at approximately 1345.[1]

Pilot

The pilot held a private pilot licence (aeroplane, valid for single-engine, land and sea aircraft), along with a valid Category 3 medical certificate. The pilot had accumulated approximately 140 hours of total flight time, including 75 hours on the accident aircraft.

Weather and environment

There was no aviation routine weather report (METAR) for Griffith Island; however, the 1400 METAR for Wiarton Airport (CYVV), located 10 nm to the west, was as follows: wind 260 ºT at 5 knots, visibility 6 statute miles (sm) in haze, scattered cloud at 2000 feet above ground level (agl), broken clouds at 25 000 feet agl, temperature 24 °C, dewpoint 21 °C, and altimeter 30.10 inches of mercury; remarks: 3 oktas[2] cumulus clouds, 2 oktas cirrus clouds, and embedded towering cumulus (TCU) to the east.

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1 All times are Eastern Daylight Time (Coordinated Universal Time minus 4 hours).

2 Cloud layer amounts are reported in eighths (oktas) of sky coverage.

According to weather radar data, the TCU moved through the area from 1250 to 1350, and remnants of the TCU could be seen just east of the island at the time of the accident.

Aircraft

C-FIUE was originally manufactured in the United States by Cessna in 1956, with airframe serial no. 33120. In 2004, the aircraft was involved in a serious accident and required extensive repair work. During the repairs, the fuselage was replaced with the fuselage from serial no. 33464, which had been involved in an accident in the United States in 1996 (National Transportation Safety Board [NTSB] docket no. MIA96LA151). The original data plate from serial no. 33120 was transferred to the replacement fuselage.

The aircraft was equipped with a Teledyne Continental IO-550-F13B engine (serial no. 284911-R) converted to an O550-F/TS as per Texas Skyways Inc. supplemental type certificate (STC) SA09131SC. Attached to the engine was a McCauley 3-bladed D3A34C401/90DFA-10 constant speed propeller as per STC SA09133SC. The aircraft was also equipped with a Horton Inc. short take-off and landing (STOL) kit (STC SA950CE) and Air Research Technology Inc. (ART) wing extensions (STC SA00276NY), which increased the maximum allowable gross take-off weight from 2550 pounds to 2950 pounds. The Wipaire Inc. Wipline Model 3000 amphibious floats were not originally approved for installation on this model of the Cessna 182; however, due to airframe modifications, a limited STC O-LSA05-041/D was approved for this installation.

The aircraft was privately registered and had accumulated approximately 2500 hours of total flight time since new. The last maintenance had involved removing the tricycle landing gear, installing the amphibious floats, and performing an oil change on 15 May 2013.

The original Cessna 182 rear-seat bench has only a centre leg, which is attached to the floor at the front and back of the seat. The seat is also attached to each side of the fuselage with 2 more bolts. All 4 seat belts attach to the seat structure.

The rear-seat bench that was installed in C-FIUE was not the original Cessna 182 seat but a split back design from a Cessna 172. Airframe modifications had to be made to mount this type of seat. The process involved utilizing two existing anchor nuts in the airframe that were originally meant to be used for cargo tie points as the rear-seat forward leg attachments. Doubler plates and anchor nuts were added to the floor for attachment of the rear-seat legs.

In the original Cessna 182 configuration, the rear seat belts would normally attach to the steel frame of the rear-seat bench. However, there are only outboard attachment points on the Cessna 172 rear-seat bench, and the inboard seat belts were mounted to the airframe in the Cessna 172. Instead of being mounted to the seat, the rear outboard seat belts were mounted to eyebolts threaded into anchor nuts in the cabin floor, which were originally intended for cargo tie-down rings. The existing anchor nut in the floor from the original Cessna 182 seat bench rear-centre leg attachment point would have been utilized for attachment of the centre belts. A hinge bracket on one of the seat belt ends suggests that the centre belts may have been bolted to the floor in this configuration at one time.

The front-seat shoulder-harness installation was neither the original Cessna design nor an approved STC, and there was no record of the installation change.

The Canadian Aviation Regulations (CARs) state in 551.406 (d):

> Seat belt and shoulder harness installations are classified as major modifications and must be accomplished in accordance with approved or specified data, as required by CAR Part V, Subpart 71 and Standard 571 of this manual.[3]

Neither the rear-seat modification nor the seat belt installation was recorded in any of the aircraft's documentation. The changes were most likely done in 2000, when the aircraft was rebuilt after initial purchase by the previous owner. The aircraft was operated for 11 years by the previous owner; although it had been inspected and maintained regularly as required by regulation, the discrepancy was never noted.

Wreckage information

The following relevant facts were noted during the wreckage examination:

- There was fuel on the water surrounding the aircraft.
- The wing leading edges were compressed rearward and down, which is indicative of a steep nose-down inverted impact.
- There were no anomalies with respect to the aircraft flight controls.
- The flaps were in the up or fully retracted position.
- The front ends of both floats had only minor compression damage, but both floats were attached to the aircraft by only the flying wires and the water rudder cables.
- The wheels were extended.
- The propeller was completely detached from the engine, which is indicative of an engine operating at high power at impact.
- The engine was detached from the mounts but suspended from the aircraft firewall by hoses and cables.
- The front right door had been pushed into the cabin and was jammed.
- The front left door was partially open.
- The 2 front-seat occupants were wearing their seat belts and shoulder harnesses, but both front-seat shoulder-harness attachments were pulled out of the damaged ceiling structure.
- The front seats were detached from the floor rails.
- The rear-seat occupant was wearing a lap seat belt, but the right outboard seat belt attachment had pulled out of the airframe, and neither of the 2 rear inboard seat belts

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[3] Transport Canada, SOR/96-433, *Canadian Aviation Regulations* (CARs), Part V: Airworthiness Manual, Chapter 551: Aircraft Equipment and Installation, 406: Seat Belt and Shoulder Harness, *(d)* Installation.

were attached to the aircraft structure. They were, however, jammed between the 2 seat backs in such a manner that they were usable.

- All 4 rear-seat mounting flanges were broken, and the seat bench was freely movable and was blocking the exit.
- There was cargo on the rear left seat, which was also blocking the exit.
- The aircraft was equipped with a stall warning system, but its functionality could not be determined due to the extent of damage.

There were only 2 personal flotation devices found on the aircraft, neither of which was worn by occupants.

Aircraft weight and fuel calculations

As equipped, the aircraft had a maximum gross take-off weight of 2950 pounds and a basic empty weight of 2327 pounds. This gave the aircraft a useful load capacity of 623 pounds for pilot, passengers, baggage, and usable fuel.

It was not possible to determine how much fuel was on the aircraft when it departed Makada Lake, nor was it possible to determine the amount of fuel on the aircraft at the time of the accident. CARs 602.88 requires that 30 minutes of reserve fuel remain when the aircraft reaches its destination. Information obtained from Texas Skyways Inc. indicated that the aircraft would burn approximately 16 U.S. gallons per hour (gph) at 75% power and 25 gph at full power. Based on these numbers, the aircraft should have arrived with a minimum of 8 gallons of usable fuel, or 48 pounds at 6 pounds per U.S. gallon. The occupants' weights were provided by the coroner and equalled 526 pounds; an additional 5 pounds for clothing was added for each passenger. The estimated take-off weight of the baggage and cargo was 80 pounds. Based on these weights, the aircraft was approximately 46 pounds over its maximum gross weight of 2950 pounds on arrival.

Aerodynamic stall

The following is stated in the publication *From the Ground Up*:

> A stall occurs when the wing is no longer capable of producing sufficient lift to counteract the weight of the airplane. A smooth laminar flow of air over the wing is necessary to produce lift.
>
> Factors Affecting Stall
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> Weight: Weight affects the stalling speed of an airplane. Weight added to an airplane requires that it be operated at a higher angle of attack to produce the lift necessary to support that weight. Therefore the critical angle of attack will be reached at a higher airspeed.
>
> Turbulence: Turbulence affects stall speed. An upward vertical gust causes an abrupt increase in angle of attack because of the change in direction of the air relative to the wing and could result in a stall if the airspeed of the airplane is at the same time relatively low.

> Turns: As the angle of bank increases, the amount of lift required to sustain level flight also increases because of the increasing load factor that is integral to the action of banking the airplane. To increase lift, the pilot must increase the angle of attack of the airfoils. Therefore, in a turn, the stall angle is reached at a higher airspeed than in level flight.[4]

According to the various limitations listed in the STC flight manual supplements, when operating at 2950 pounds, the aircraft would have stall characteristics similar to those stated in the *Cessna 182 Owner's Manual* for an aircraft weighing 2550 pounds. According to the *Cessna 182 Owner's Manual*, the stall speeds for an aircraft at 2550 pounds and power off for this particular model of Cessna 182 are as listed in Table 1.

Table 1. Stall speeds of the Cessna 182

Condition	Stall speed*		
	0° angle of bank	30° angle of bank	60° angle of bank
Flaps up (0°)	62	67	88
Flaps down 10°	60	64	85
Flaps down 40°	55	59	78

* Note: mph true indicated air speed, at 2550 pounds and power off

Survivability

Both front-seat occupants were wearing the installed 4-point safety belt. Impact forces and damage to the ceiling structure caused the shoulder-harness attachments to pull out of the ceiling. Damage to the floor structure caused the seats to come off of the attachment tracks. The only thing securing the front seats and front occupants were the lap belts, which remained attached to the floor. The failed upper-body restraints allowed both of the front-seat occupants to contact the aircraft structure, which was determined to be the cause of their fatal injuries.

The rear-seat occupant was wearing the installed lap safety belt, which was still fastened after the accident. The inboard portion remained jammed between the seat backs, but the outboard attachment to the airframe had failed. The 4 rear-seat attachments had also failed, allowing the seat to move freely. The investigation determined that the rear-seat occupant sustained non-life–threatening injuries and drowned.

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4 Sandy A.F. MacDonald, *From the Ground Up*, 29th Edition (Aviation Publishers, 2012).

The NTSB defines a survivable accident as:

> […] one in which the forces transmitted to the occupant through the seat and restraint system do not exceed the limits of human tolerance to abrupt accelerations and in which the structure in the occupant's immediate environment remains substantially intact to the extent that a livable volume is provided throughout the crash sequence.[5]

Based on this definition, the accident was survivable.

TSB Aviation Investigation Report A12O0071 states:

> According to past research into accidents with helicopters submerged in water, typically only 10% to 15% of people are able to carry out the required egress actions effectively.[6] Another 10% to 15% of people typically fail to act from the extreme stress, greatly reducing their chance of survival. The remaining 75% may be stunned or shocked by the event; however, most are able to escape successfully if they are well trained and have rehearsed for such an event. Restrictions to normal exits, water temperature, darkness and disorientation following water impact further reduce the ability to egress. Escape training and passenger briefings emphasize the importance of memorizing exit locations. Exits are clearly indicated in the passenger briefing cards…[7]

As a private operation, the aircraft was not equipped with any passenger briefing cards, nor was this required by regulation. It is not known whether any of the occupants had received egress training, and there currently is no regulatory requirement for this type of training in private or commercial floatplane operations. It is not known whether the passengers received any safety briefing. The aircraft was not equipped with the required number of life vests.

CARs 602.62 (1) states the following:

> No person shall conduct a take-off or a landing on water in an aircraft or operate an aircraft over water beyond a point where the aircraft could reach shore in the event of an engine failure, unless a life preserver, individual flotation device (IFD) or personal flotation device (PFD) is carried for each person on board.[8]

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5 United States National Transportation Safety Board (NTSB), Safety Report, NTSB/SR-83/01, *General Aviation Crashworthiness Project, Phase One* (27 June 1983), p. 3.

6 C.J. Brooks, C.V. MacDonald, L. Donati and J.T. Taber, Civilian Helicopter Accidents into Water: Analysis of 46 Cases, 1979–2006, *Aviation, Space, and Environmental Medicine* (2008), 79(10), pp. 935–940.

7 TSB Aviation Investigation Report A12O0071

8 Transport Canada, SOR/96-433, *Canadian Aviation Regulations* (CARs), Part VI, Subpart 2: Operating and Flight Rules, Section 602.62: Life Preservers and Flotation Devices, Subsection (1).

Analysis

The information obtained from examinations of the wreckage, engine, and propeller indicates that the engine was operating at the time of the accident, and there were no flight control anomalies that would have contributed to a loss of control.

The aircraft successfully departed Little Panache Lake overweight, and it was still overweight when it overflew Griffith Island. It crashed in the water just south of the extended centreline of the runway, close to shore. The pilot would have been manoeuvring the aircraft south of Griffith Island to approach from the east, but may have also been trying to avoid the towering cumulus (TCU) that had just passed to the east. Conducting a turn with the flaps retracted would increase the speed at which the aircraft would stall, and the steeper the turn, the higher the stall speed would be. The aircraft's overweight condition and possible turbulence from the nearby TCU would also have increased its stall speed. The fact that the aircraft rolled completely inverted before colliding with the water in a steep nose-down attitude indicates that the aircraft stalled aerodynamically, and that control was lost at an altitude too low to effect a recovery. If an aircraft is operated above its maximum gross weight, then there is an increased risk of stalling.

The rear seat and seat belt installation were major modifications, and were not documented by any means as required by regulation. The aircraft was therefore not in compliance with all applicable standards of airworthiness at the time of the accident. Neither the previous nor the current owners were aware that the aircraft was not in compliance with regulations, and this fact was overlooked or missed during the aircraft's regular maintenance and inspections.

The inboard rear seat belts were not physically attached to the aircraft prior to the occurrence flight. The inboard lap attachments had been unbolted from the floor at some point in time, and for unknown reasons, had not been reattached prior to the accident. If an aircraft is operated with a passenger who is occupying a seat with improperly installed seat belts, then there is an increased risk of serious injury or fatality.

The impact forces were survivable; however, they were sufficient to cause airframe, seat attachment and safety belt attachment failure, which resulted in fatal injuries to the 2 front occupants. The rear-seat occupant was wearing the seat belt and had no life-threatening injuries, but drowned. It was not possible to determine whether there had been any attempt to egress the aircraft. Egress would have been hampered by the right door being jammed, by the left door being partially blocked by cargo and the rear-seat bench, and by the aircraft being upside down, which would have been disorienting. Additionally, the aircraft was not equipped with a life vest for each person on board, as required by the *Canadian Aviation Regulations* (CARs). If an aircraft is operated without the required number of life vests on board, then there is an increased risk of fatality in the event of a survivable accident on water.

Findings

Findings as to causes and contributing factors

1. The aircraft aerodynamically stalled, resulting in a loss of control at an altitude from which recovery was not possible.
2. The 2 front occupants did not survive due to the severity of the impact. The rear-seat passenger survived the impact, but did not exit the aircraft, and drowned.

Findings as to risk

1. If an aircraft is operated above its maximum gross weight, then there is an increased risk of stalling.

2. If an aircraft is operated without the required number of life vests on board, then there is an increased risk of fatality in the event of a survivable accident on water.

3. If an aircraft is operated with a passenger who is occupying a seat with improperly installed seat belts, then there is an increased risk of serious injury or fatality.

Other findings

1. The aircraft had undocumented major modifications. Neither the rear-seat modification nor the seat belt installation had been recorded in any of the aircraft's documentation.

This report concludes the Transportation Safety Board's investigation into this occurrence. The Board authorized the release of this report on 31 July 2014. It was officially released on 10 September 2014.

Visit the Transportation Safety Board's website (www.bst-tsb.gc.ca) for information about the Transportation Safety Board and its products and services. You will also find the Watchlist, which identifies the transportation safety issues that pose the greatest risk to Canadians. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.