Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

Air Transportation Safety Investigation Report A19O0103

WHEELS-DOWN WATER LANDING

Privately registered
Cessna A185E (on amphibious floats), C-GBUI
Upper Raft Lake, Ontario
04 August 2019

History of the flight

At approximately 1225[1] on 04 August 2019, a privately owned and operated amphibious Cessna A185E aircraft (registration C-GBUI, serial number 185-1320) departed for a daytime visual flight rules cross-country flight from Runway 30, a hard surface runway at the Orillia Rama Regional Airport (CNJ4), Ontario. The pilot, 6 family members, and a dog were on board the aircraft bound for a cabin located on the west shore of Upper Raft Lake, Ontario, approximately 48 nautical miles north of CNJ4. The pilot had originally planned to make 2 separate flights; however, because of a previously planned family engagement, he decided to fly a single flight in order to save time.

The cruise portion of the 34-minute flight was flown at an altitude of approximately 2200 feet above sea level. At 1259, the aircraft touched down on the water of Upper Raft Lake with the wheels in the down position and flipped over, coming to rest in an inverted position. The passengers sustained minor injuries from the impact and managed to egress from the right side of the aircraft. The pilot,

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

however, did not egress the aircraft and subsequently drowned. The dog also drowned. The aircraft was equipped with an emergency locator transmitter which activated, but no signal was received.

The passengers, 1 adult and 5 children, climbed onto the aircraft's floats. They paddled the aircraft to the east shore, tied it to a rock, and waited on shore for assistance. The family was unable to call for assistance because their mobile telephones were in the aircraft. They spent the night on the shore near the aircraft. At approximately 0900 the following morning, another family member informed a seaplane operator at CNJ4 that the aircraft had not yet returned. The operator dispatched an aircraft and the seaplane was located at approximately 1000 in Upper Raft Lake. Subsequently, the pilot landed to assist the survivors.

The flight information centre in London, Ontario, and the Joint Rescue Coordination Centre in Trenton, Ontario, were then notified. Shortly after, the Joint Rescue Coordination Centre dispatched 2 aircraft to the site. The survivors were airlifted to hospital.

Pilot information

Records indicate that the pilot was certified and qualified for the flight in accordance with existing regulations. The pilot obtained his commercial pilot licence in March 2005, and obtained his seaplane rating in June 2005. He had accumulated approximately 3100 total flight hours, 300 of which were on type and 150 on amphibious aircraft.

Weather information

The aerodrome routine meteorological report issued at Muskoka Airport (CYQA),[2] indicated that the weather at the time of the accident was as follows:

- Winds variable at 8 knots
- Visibility 9 statute miles
- Clear skies

The weather was not considered a factor in this occurrence.

Aircraft information

The occurrence aircraft was a single-engine, 6-seat aeroplane manufactured by Cessna Aircraft Company in 1968. During the occurrence flight, it was equipped with 4 seats. It was privately registered and was maintained on an annual inspection program as specified in the *Canadian Aviation Regulations* (CARs) Standard 625.[3]

The aircraft had been in a previous accident in 2013.[4] It was completely rebuilt by the occurrence pilot, who was also a licenced aircraft maintenance engineer. During the rebuild, which was completed in February 2019, some modifications were installed, all in conformance with the supplemental type certificates approved for the type and model of the aircraft.

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[2] Muskoka Airport is located 32 nautical miles south-southwest of Upper Raft Lake.

[3] Transport Canada, *Canadian Aviation Regulations* Standard 625, (last revised 30 December 2007), Appendix B, Part I: Scheduled Inspections for Small Aircraft other than Balloons, available at https://www.tc.gc.ca/en/transport-canada/corporate/acts-regulations/regulations/sor-96-433/standard-625/appendix-b.html (last accessed on 17 March 2020).

[4] TSB Air Transportation Occurrence A13O0167.

The aircraft had been flown approximately 23 hours since it had been rebuilt. In July 2019, after approximately 14 hours of air time since the aircraft had been rebuilt, Wipaire 3730 amphibious floats[5] were installed. The floats incorporated a retractable landing-gear assembly that enabled the aircraft to land on runways or on water. The aircraft had then flown approximately 9 hours before the accident.

Wreckage information

The aircraft touched down on the surface of the water with the wheels down, causing it to flip over; the aircraft came to rest inverted, the floats above the water keeping it afloat (Figure 1).

The aircraft was recovered from Upper Raft Lake 5 days after the occurrence. It had sustained substantial damage. All damage to the airframe was attributable to impact forces when the aircraft flipped over.

Figure 1. The occurrence aircraft found the day after the occurrence, tied to the shore (Source: friend of the pilot)

All of the control surfaces were accounted for; the flaps were found set to 30º. The aircraft's flight instruments were intact. A global positioning system (Garmin Aera 660) was removed from the aircraft and sent to the TSB Engineering Laboratory in Ottawa, Ontario, for analysis. The unit provided information pertaining to the occurrence flight, including the flight path.

All of the wheels were found fully extended and the landing-gear selector handle was found in the UP position. It could not be determined if the handle had been selected up by the pilot at some point, or if it had moved to the UP position as part of the impact and egress sequence.

Landing-gear system information

The landing-gear system on the occurrence aircraft was powered by an electro-hydraulic power pack made up of an electrical pump and a hydraulic fluid reservoir mounted as a unit on the forward left-hand side of the engine firewall.

Normally, in this system, the landing-gear selector assembly has a red PUMP ON light that illuminates to indicate that the electro-hydraulic power pack is operating when the landing gear is extending or retracting.

The pump shuts off automatically after the desired gear position is attained. A pressure switch cuts off the electrical power to the pump when hydraulic pressure builds up in the system after the wheels are fully extended or fully retracted.

[5] Wipaire Incorporated, Supplemental Type Certificate SA805CE, originally issued by the Federal Aviation Administration on 03 December 1971, last re-issued on 05 July 1985, last amended on 08 April 1991.

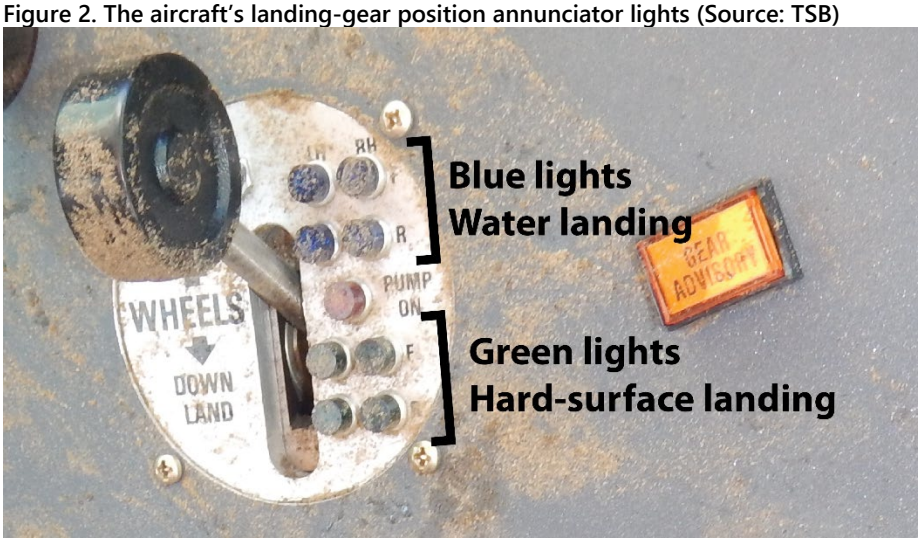
A 40 A circuit breaker for the associated hydraulic pump is located on the front panel under the landing gear selector and protects the electrical circuit to the pump. If it trips at any time prior to or during the selection of the landing gear lever to the UP position, the landing gear is no longer powered and will not retract.

The circuit breaker was found protruding from its normal position, indicating that it had tripped. The investigation could not determine if the circuit breaker was tripped before, during, or after the occurrence flight.

The aircraft was equipped with an emergency hand pump that could be used to operate the landing gear manually in case of an electro-hydraulic power pack failure, or a general electrical failure of the gear system. However, nothing indicated that this backup system had been operated. The aircraft was also equipped with a bubble window on the pilot's side, and a curved mirror located on the underside of the left wing to enable the pilot to check the wheels' position visually.

The aircraft was equipped with 8 independent landing-gear position annunciator lights (Figure 2). These lights are split into 2 groups: 4 blue lights for water landing, and 4 green lights for hard-surface landing. Normally, each light, in each colour grouping, is associated with each of the 4 wheels of the landing gear: 2 lights for the nose gear at the top and 2 lights for the main gear below. When the landing gear is up, the blue lights illuminate; when the landing gear is down, the green lights illuminate.

Figure 2. The aircraft's landing-gear position annunciator lights (Source: TSB)



The aircraft was equipped with an amphibious landing-gear position advisory system, which was meant to provide an aural warning as to the landing gear position when the aircraft decelerated through a specific airspeed. This system was examined to determine the threshold airspeed at which the advisory would activate and to confirm if the aural warnings were serviceable. It was determined that the threshold airspeed setting was set to activate the unit once the airspeed was reduced to 95 mph or below.

The electrical ground connection for the amphibious landing-gear position advisory system was broken. Following the prolonged water immersion of 5 days in the lake, the advisory system could not be repaired and remained defective, providing no aural advisory or warning light. The investigation could not determine if the unit was operational during the occurrence flight.

The hydraulic pump and motor were examined and appeared to have no deficiencies that would have affected normal operation. The landing-gear selector assembly was fully functional and leak-free.

Aircraft checklist information

It could not be determined whether the pilot used a checklist to operate the aircraft during normal operations, including to check if the gear was in the correct position for landing. No checklists or placards were found during the examination of the wreckage and the aircraft contents. However, because the aircraft was subjected to substantial impact forces and was inverted in water for some time, if there had been a checklist on board, it may have become separated from the wreckage.

Section 602.60 of the CARs requires that all power-driven aircraft be equipped with:

> (a) a checklist or placards that enable the aircraft to be operated in accordance with the limitations specified in the aircraft flight manual, aircraft operating manual, pilot operating handbook or any equivalent document provided by the manufacturer.[6]

Furthermore, it states that:

> A checklist or placards […] shall enable the aircraft to be operated in normal, abnormal and emergency conditions, and shall include […]
>
> (d) a pre-landing check […][7]

Weight and balance information

The aircraft had a maximum gross take-off weight of 3350 pounds and a basic empty weight of 2389.5 pounds, which provided a useful-load capacity of 960.5 pounds for the pilot, passengers, baggage, and usable fuel.

Given that the fuel tanks were compromised during the impact sequence, an accurate weight and balance calculation of the occurrence flight could not be completed. To remain below maximum gross take-off weight, considering the weight of the aircraft, passengers, and baggage, it would have been possible to carry 25 gallons of fuel, enough for approximately 90 minutes of flight at a cruise power setting.

Survival aspects

The investigation revealed 3 different survival aspects: safety belts, life preservers, and egress training.

Safety belts

The aircraft was capable of carrying 4 people, including the pilot: there were 4 seats installed, and each was equipped with a restraint system.

Section 605.22 of the CARs stipulates that "no person shall operate an aircraft other than a balloon unless it is equipped with a seat and safety belt for each person on board the aircraft other than an infant."[8]

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[6] Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, paragraph 602.60(1)(a).

[7] Ibid., paragraph 602.60(2)(d).

[8] Ibid., subsection 605.22(1).

Although there were only 4 seats on the aircraft, there were 7 people on the occurrence flight—the pilot, 1 adult passenger, 5 children—and 1 dog. Three children occupied the 2 rear seats: 1 child used a seat and was wearing a safety belt; the other 2 children, who were sharing the 2nd seat, did not wear the safety belt. Another child and the dog occupied the baggage area, which did not have any seats nor safety belts. The adult passenger was sitting in the front, next to the pilot, and was holding a child (not an infant). Both the pilot and the adult passenger only wore the lap strap, neither wore the available shoulder harnesses. The child on the passenger's lap was unrestrained.

Subsection 101.01(1) of the CARs defines a safety belt as "a personal restraint system consisting of **either** [emphasis added] a lap strap or a lap strap combined with a shoulder harness."[9]

From 1990 to 2018, the TSB investigated many accidents involving aircraft that were equipped with detachable shoulder harnesses where it was determined that the harnesses were not being worn at the time of the accident. Of the 62 accidents identified, 33 were fatal, resulting in 68 deaths. Of those 68 deaths, 37 were individuals who had not been wearing the available shoulder harness. Although the survivability of these 62 accidents varied, the use of shoulder harnesses in many cases could have improved the odds of survival and egress.

Transport Canada attempted to clarify the regulations in Aviation Safety Letters 4/2013 and 1/2018, and Advisory Circular 605-004 (November 2014). However, if regulations are not clear in requiring the use of all available components of a safety belt, shoulder harnesses may not be used as intended, increasing the risk of injury or death. Therefore, the Board has recommended that

> the Department of Transport amend the *Canadian Aviation Regulations* to remove any ambiguity associated with the definition of "safety belt."
>
> **TSB Recommendation A19-01**[10]

Life preservers

Although the 6 passengers were able to egress the aircraft, the aircraft was only equipped with 5 personal flotation devices. None of the passengers was wearing a personal flotation device, nor did they egress with one.

Subsection 602.62(1) of the CARs states that:

> 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 or personal flotation device is carried for each person on board.[11]

Egress training

Neither the pilot nor the passengers had received underwater egress training, nor were they required to by regulation.

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[9] Ibid, subsection 101.01(1).

[10] Transportation Safety Board of Canada, Recommendation A19-01 (30 October 2019), at https://www.tsb.gc.ca/eng/medias-media/fiches-facts/a17o0264/a17o0264-20191030-02.html (last accessed on 27 March 2020).

[11] Ibid., subsection 602.62(1).

A TSB study of Canadian seaplane accidents[12] determined that there were challenges for occupants to egress after the aircraft impacted the water. In order to increase survivability, egress training for pilots was deemed essential. In February 2019, proposed amendments to the CARs were published in the *Canada Gazette*, Part II.[13] These amendments, which will come into force in February 2022, will make underwater egress training mandatory for all pilots of commercially operated seaplanes.

Safety messages

There were 2 adults and 5 children on board the aircraft, but only 4 seats and restraint systems. The 2 available shoulder harnesses were not used by the front-seat occupants. One child was held on an adult's lap and was unrestrained; another child was not sitting in a seat at all. Two children were sharing 1 seat and not wearing the available safety belt. It is important that each occupant has their own seat and uses the available restraint system to improve the odds of survival and egress from an aircraft involved in an accident.

The passengers in this occurrence were able to exit the aircraft after the impact. However, there were not enough personal flotation devices for everyone on board. It is important that aircraft have enough personal flotation devices on board for all occupants in case of an accident on water.

The pilot of the occurrence aircraft had not received underwater egress training. This training has been demonstrated to improve the chances of survival in seaplane accidents and should be considered by private seaplane operators.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 18 March 2020. It was officially released on 02 April 2020.

[12] TSB Aviation Safety Study SA9401, *A Safety Study Of Survivability In Seaplane Accidents*, 1994, at http://www.bst-tsb.gc.ca/eng/rapports-reports/aviation/etudes-studies/sa9401/sa9401.html (last accessed 27 March 2020).

[13] Government of Canada, *Canada Gazette*, Part II, Volume 153, No. 5 (25 February 2019), Regulations Amending the Canadian Aviation Regulations (Parts I, VI and VII — Seaplane Operations).

ABOUT THIS INVESTIGATION REPORT

This report is the result of an investigation into a class 4 occurrence. For more information, see the Policy on Occurrence Classification at www.tsb.gc.ca

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.

TERMS OF USE

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