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

Air Transportation Safety Investigation Report A17O0209

COLLISION WITH WATER

Cessna 150J, C-FHPU
Goderich, Ontario
20 September 2017

About the investigation

The Transportation Safety Board of Canada (TSB) conducted a limited-scope, fact-gathering investigation into this occurrence to advance transportation safety through greater awareness of potential safety issues. It is not the function of the Board to assign fault or determine civil or criminal liability.

History of the flight

A privately registered Cessna 150J aircraft (serial number 15070602, registration C-FHPU) departed Brampton-Caledon Airport (CNC3), Ontario, at approximately 1951[1] for a night visual flight rules (VFR) cross-country training flight to Goderich Airport (CYGD), Ontario. Weather was suitable for the flight with light winds, good visibility, and few clouds.

There were 2 pilots on board the aircraft: the owner of the aircraft, who was seated in the left seat, and an instructor from the Brampton Flying Club, who was seated in the right seat.

After departure, the aircraft climbed to an altitude of 3000 feet above sea level, where it remained for the cruise portion of the flight. The aircraft's position was recorded on radar until coverage was lost as the aircraft descended into CYGD. The last radar return, at 2036, showed the aircraft at 1800 feet above sea level, 0.8 nautical miles (nm) east of the airport.

The aircraft was observed flying westbound toward Lake Huron, then in a southeast direction toward the airport, followed by a rapid descent. Tall trees then blocked the aircraft from view, but the sound of the aircraft hitting the water was audible shortly thereafter.

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

Canada

Emergency services were contacted and an extensive search was conducted. The aircraft was located at the bottom of Lake Huron, in 25 feet of water, approximately 0.6 nm from shore. The aircraft was destroyed by the impact forces. Both occupants were fatally injured.

Aircraft and wreckage information

The aircraft was manufactured in 1969 and had accumulated approximately 5896 hours total time since manufacture.

The aircraft wreckage was recovered and transported to the TSB regional facility in Richmond Hill, Ontario, where it was examined in further detail. Damage to the aircraft indicated that it struck the water in a steep (nearly vertical) nose-down attitude. The flaps were found in an asymmetric condition: the right wing flap was in the fully retracted (up) position, whereas the left wing flap was extended (down) more than its physical limit of 40°.

The aircraft systems were examined to the degree possible and all flight control surfaces were accounted for. Damage to the propeller was consistent with considerable power being produced at the time of impact.

The instruments were recovered and examined at the TSB Engineering Laboratory in Ottawa, Ontario. The examination of the turn coordinator, directional gyro, altimeter, and airspeed indicator did not yield any useful information; however, the vertical speed indicator was indicating a rate of descent in excess of 2000 feet per minute. The artificial horizon was tested, and it was determined that it was functional at the time of impact.

Examination of wing flaps and associated components

The wing flaps on the Cessna 150J are electrically driven. The flap actuator assembly is located in the right wing and there are 2 drive pulleys (1 in each wing), which are interconnected by cables. The drive pulleys are connected to the flaps via push-pull rods. A comprehensive examination of the wing-flap system and associated components was conducted.

The left wing flap sustained damage to the inboard end as a result of the impact. The surfaces of the flap were otherwise undamaged.

The forward section of the left wing inboard aft flap track was fractured (Figure 1). As a result, the left flap inboard aft roller, which is normally positioned inside the associated flap track, was located outside of the broken flap track.

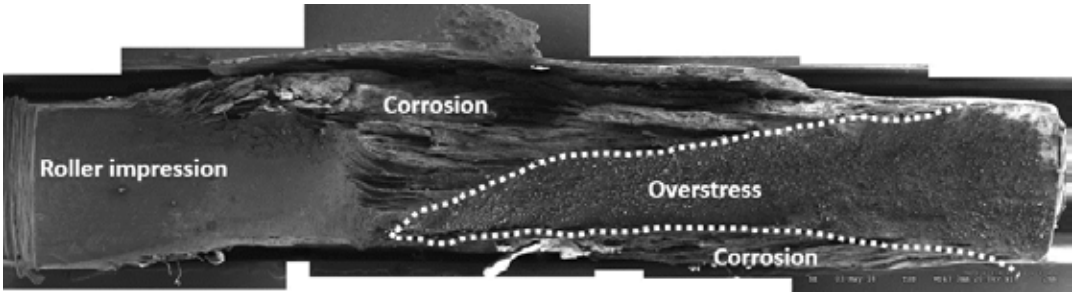
The outboard flap track was still intact and, as a result, it was possible for the left flap to be cocked in position, preventing it from travelling.

Figure 1. The fractured flap track, with an expanded view of the fractured area

The fractured surface of the inboard flap track was examined with a scanning electron microscope. It was determined that the damage was caused by corrosion, which gave the appearance of

delamination (Figure 2). The corrosion had been present prior to the occurrence; however, when or how it began could not be determined. Corrosion has a detrimental effect on the strength of an aluminum component and can significantly diminish the structural integrity and life expectancy of an aircraft component.

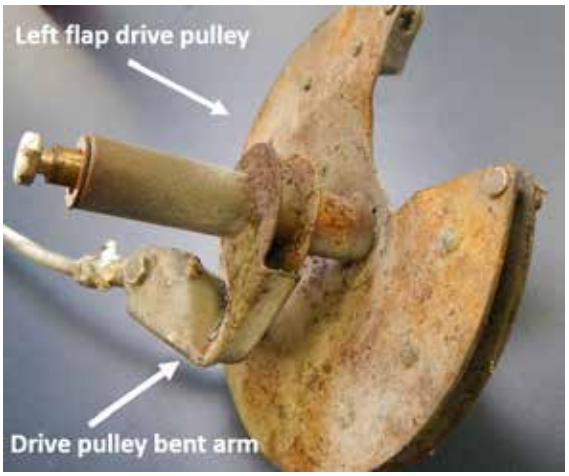
Figure 2. Scanning electron microscope image of the fractured flap track, showing areas of corrosion, overstress, and the flap roller impression on top of corrosion



The fracturing of the non-corroded portion of the flap track was caused by overstress from a combined shear and tension load. However, it could not be determined whether this happened before or during impact.

The arm attached to the flap drive pulley in the left wing was bent almost 90° from its original position as a result of tensile overload (Figure 3). It is possible that this damage occurred during the impact sequence. However, there was no corresponding damage to the left flap, which is connected to the drive pulley arm via a push-pull rod. It is also possible that the bending of the drive pulley arm occurred during operation of the flaps. If the left flap was unable to move, the arm may have been bent from the cable tension produced by the flap actuator.

Figure 3. The left flap drive pulley



The examination of the right wing flap, the flap actuator, and other components indicated that the right flap was fully retracted at the time of impact. The flap direct (down) interconnect cable that drives the left flap down in alignment with the right flap was found broken near the right wing root. An examination of the cable indicated that it had broken due to overstress; there was no sign of metal fatigue or corrosion.

It could not be determined with certainty when the cable broke. The force of the impact may have broken the cable; however, it is also possible that, if the left flap was cocked, extreme tension applied during operation of the flaps may have broken the cable.

Aircraft maintenance and inspection

The aircraft was being maintained under the pre-approved maintenance schedule for privately registered aircraft (*Canadian Aviation Regulations* [CARs] Standard 625, Appendix B, Part I). The Standard 625, Appendix B, Part I inspection must be completed at intervals not exceeding 12 months and includes tasks to inspect the aircraft for corrosion.

The last annual inspection of the aircraft was completed in October 2016; the aircraft had accumulated 32 hours of air time since that inspection. No anomalies or modifications related to the flaps had been recorded in any of the aircraft log books since the aircraft was imported into Canada in 1990.

The Cessna 150 Service Manual provides a supplemental inspection document detailing the following recommended intervals with respect to inspecting the flap tracks for corrosion:

- For aircraft operating in areas where the corrosion severity is rated as mild to moderate, the initial inspection is to be completed after 20 years of operation, then every 10 years.[2]
- For aircraft operating in areas where the corrosion severity is rated as severe, the initial inspection is to be completed after the first 10 years, then every 5 years.[3]

These recommended supplemental inspections are not mandatory for privately registered aircraft in Canada, and there was no record of any such inspections in the aircraft log books since the aircraft was imported to Canada.

Flight crew

Records indicate that both pilots were certified and qualified for the flight in accordance with existing regulations. There was nothing to indicate that their performance was degraded by physiological factors.

The pilot had received his private pilot licence approximately 5 weeks prior to the accident, and had approximately 142 hours total flight time. The occurrence flight was a night cross-country training flight, which is one of the requirements to obtain a night rating.

The instructor held a commercial pilot licence with Class 3 instructor rating and a night rating. She had been employed by the Brampton Flying Club since January 2017 and had approximately 700 hours total flight time, including 42 hours at night and 35 hours with reference to instruments. According to records, the instructor had flown to CYGD at night on 2 previous occasions, once in May 2017 and once in July 2017.

Neither the pilot nor the instructor held an instrument rating.

Brampton Flying Club

The Brampton Flying Club owns and operates a fleet of aircraft primarily used for flight training and rental. However, it also allows students to use their own aircraft for training.

In order for students to obtain realistic night flying experience, the Brampton Flying Club's *Brampton Flight Centre Flight Training Operations Manual* states the following:

> For the night x country requirement, two popular routes are to Muskoka and Goderich. Muskoka gives the student good experience of very little reference points and black hole effect and Goderich will require either a take-off or approach over water which will require some reference to instruments.

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[2] Cessna Aircraft Company, *Model 150 Series (1969 – 1976) Service Manual*, Supplemental Inspection Number: 57-53-01, D971-3-13 Temporary Revision Number 6 (01 December 2011), p. 1.

[3] Ibid.

Both routes take approximately two hours including a couple of circuits. The student should complete the planning for the x country and then fly the route with very little intervention.[4]

At the time of the occurrence, the Brampton Flying Club did not provide its instructors with specific flight training to address the black-hole effect, or provide its non-instrument-rated instructors with proficiency training. In addition, instructors were not tested to ensure they were proficient at operating aircraft during black-hole approaches or at night with limited visual references. This type of flight training is not required by regulation.

No safety reports had been filed in the Brampton Flying Club safety management system regarding the black-hole effect or operating at night with limited visual reference.

Night visual flight rules

There are many risks associated with night flying, given the poor visual cues, especially on takeoff and landing. Few or no visual references at night can lead to various illusions that cause spatial disorientation due to the lack of a discernible horizon. Night flying over featureless terrain, such as bodies of water or wooded terrain—called black-hole conditions—is particularly difficult.

The principle behind VFR flight is that the pilot uses visual cues outside the aircraft (e.g., the horizon or ground references) to determine the aircraft's attitude. Therefore, some basic requirements must be met when conducting VFR flight, no matter whether it is during the day or at night.

According to CARs sections 602.114 and 602.115, an aircraft must be "operated with visual reference to the surface,"[5,6] regardless of whether it is operated in controlled or uncontrolled airspace. The CARs define surface as "any ground or water, including the frozen surface thereof."[7] However, the CARs do not define "visual reference to the surface," which has been widely interpreted by the industry to mean visual meteorological conditions.

Therefore, a flight conducted over an area away from cultural lighting and where there is inadequate ambient illumination to clearly discern a horizon would not likely meet the requirements for operation under VFR (i.e., to continue flight solely by reference to the surface). Instead, such flights would require pilots to rely on their flight instruments to ensure safe operation of the aircraft.

In this occurrence, the pilots could expect to see lights from the town of Goderich, located approximately 1 nm south of the airport, and some cultural lighting (e.g., houses, traffic on the road) to the east and north of the airport. However, to the west of the airport, over Lake Huron, pilots would not generally see any cultural lighting.

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4 Brampton Flying Club, *Brampton Flight Centre Flight Training Operations Manual*, Amendment 6 (25 April 2017), section 6.2.2.15: Night Flying, p. 45.

5 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, paragraph 602.114(a).

6 Ibid., paragraph 602.115(a).

7 Ibid., subsection 101.01(1).

A TSB investigation report[8] on a helicopter that crashed while departing under VFR at night from a remote airport with limited lighting raised the issue of a lack of clarity in the definition of what flight "with visual reference to the surface" means in practice. The TSB recommended that

> the Department of Transport amend the regulations to clearly define the visual references (including lighting considerations and/or alternate means) required to reduce the risks associated with night visual flight rules flight.
>
> **TSB Recommendation A16-08**

In its response, Transport Canada indicated that it will take a two-fold approach to address this recommendation to reduce the risks associated with night VFR flights. In the short term, Transport Canada will conduct safety promotion and education activities, which will be followed by a regulatory amendment project.

The Board has assessed Transport Canada's response to Recommendation A16-08 as showing **Satisfactory Intent**.

Summary

In this accident, an in-flight flap asymmetry could not be ruled out. The broken flap track was heavily corroded, which weakened its structural integrity and life expectancy. The corrosion had been present for some time, but was not noticed in any of the annual inspections that followed standards set out in the CARs. The manufacturer recommends periodic supplemental corrosion inspections; however, these are not required by regulation, and none were documented as having been completed.

Although both pilots had received some instrument training, neither of them had an instrument rating. Nonetheless, the aircraft was being operated at night in an area with limited visual reference to the surface. As detailed in TSB Recommendation A16-08, the CARs do not clearly define the visual references that are required in these situations.

This concludes the TSB's limited-scope investigation into this occurrence. The Board authorized the release of this investigation report on 13 September 2018. It was officially released on 21 September 2018.

[8] TSB Aviation Investigation Report A13H0001.

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