Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A13P0165

LOSS OF CONTROL AND COLLISION WITH TERRAIN

TYLAIR AVIATION LTD.
CESSNA 172L, C-FQTR
KAMLOOPS, BRITISH COLUMBIA, 30 NM WEST
06 AUGUST 2013

Canada

Aviation Investigation Report A13P0165

Loss of control and collision with terrain

TylAir Aviation Ltd.
Cessna 172L, C-FQTR
Kamloops, British Columbia, 30 nm west
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Summary

The Cessna 172L (registration C-FQTR, serial number 17259371) departed the Kamloops Airport, British Columbia, at about 1016 Pacific Daylight Time. The student pilot was the sole occupant of the aircraft for the 2-hour local training flight. When the aircraft did not return at the expected time, the Joint Rescue Coordination Centre Victoria was notified of the overdue aircraft by TylAir Aviation Ltd., and a search was started. No emergency locator transmitter signal was received by the Canadian Mission Control Centre or reported by anyone else. The search and rescue team located the aircraft wreckage and the fatally injured pilot the following day. There was no post-impact fire.

Le présent rapport est également disponible en français.

Factual information

History of the flight

Student pilots who reach a demonstrated level of basic flight proficiency are required to practice flight exercises on their own as part of the training process for licensing. This flight was operated on a company visual flight rules (VFR) flight itinerary and supervised by an instructor. For a solo student flight, supervision involves a pre-flight briefing during which the instructor outlines the manoeuvres the student is to practise and relays any restrictions that apply to the flight. The plan was for the pilot to fly to the TylAir Aviation Ltd. (TylAir) practice area over the western section of Kamloops Lake, British Columbia. The pilot was familiar with this area, located about 15 nautical miles (nm) west of the Kamloops Airport, British Columbia.

The aircraft was fuelled to full capacity before the flight. The total fuel endurance, without reserves, should have been about 4 hours and 40 minutes. The actual flight duration was estimated to be approximately 1 hour and 34 minutes.

It was not expected that the aircraft would leave the practice area or be operated higher than 5500 feet above sea level (asl), as described in the TylAir *Student/Renter Policy and Procedures* manual.[1]

Air traffic services (ATS) radar data indicated that the aircraft initially appeared at 3000 feet asl about 3 nm west of the Kamloops Airport. The recorded flight path exhibited a direct climbing route to the designated company practice area, with some manoeuvres conducted within the area at 4500 feet asl, which was consistent with the training plan for the day (Figure 1). Subsequently, the flight moved away from the practice area to an area about 6 nm north of Kamloops Lake (15 to 20 nm west-northwest of the Kamloops Airport) over higher terrain, and further manoeuvres took place there between 5000 and 7000 feet asl. At about 1057,[2] a prolonged climb started, combined with manoeuvres. At 1105, radar data showed that C-FQTR was 18 nm west of the Kamloops Airport (about 13 nm east of the accident site) and had reached 9000 feet asl (its highest radar-recorded altitude). C-FQTR then disappeared from the radar display and did not reappear. There were no reports of anomalies with the radar equipment, and no further responses to radar were received from the aircraft transponder. When the aircraft did not return at the scheduled time, the instructor, who was supervising the flight, notified search and rescue services. In the interim, 2 company employees commenced an air search in their private aircraft.

Communications

VFR aircraft operating in uncontrolled airspace outside of the Kamloops Airport mandatory frequency area (5 nm radius to 4100 feet asl) are not required to be monitored by ATS personnel.

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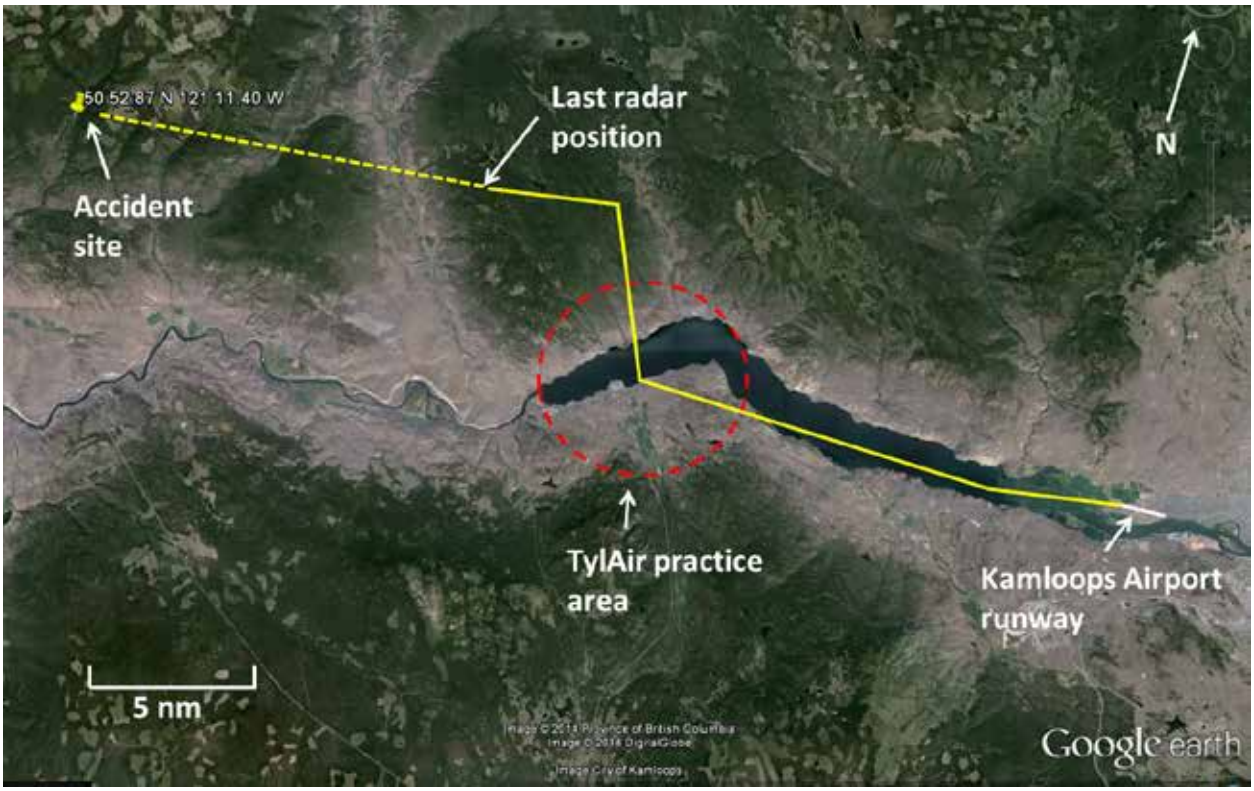
1 TylAir Aviation Ltd., *Student/Renter Policy and Procedures*, 22 June 2013.

2 All times are Pacific Daylight Time (Coordinated Universal Time minus 7 hours).

Figure 1. Area map showing the approximate route of the occurrence aircraft



The aircraft was equipped with 2 communication radios, and the following 2 frequencies were displayed: 121.5 megahertz (MHz) and 124.72 MHz. No distress call was transmitted. The policy of the school is to monitor 121.5 MHz (very high frequency [VHF] emergency frequency) and 125.7 MHz (Kamloops mandatory frequency [MF]).

The pilot carried a mobile telephone. The telephone location is verified by the service provider at 18-minute intervals. The last verification occurred at 1143. The telephone did not reply to the next verification at 1201. The accident is believed to have occurred between these times. Wireless service coverage by the service provider was confirmed at the accident site by investigators. It is not known what the pilot did between the time of the last radar target and the estimated time of the accident. The damaged telephone was examined at the TSB Laboratory; no data could be extracted.

Weather

The 1000 aerodrome routine meteorological report (METAR) issued for the Kamloops Airport on the morning of the accident was as follows: winds light and variable, visibility 40 statute miles (sm), clouds few[3] at 16 000 feet above ground level (agl), ceiling broken at 23 000 feet agl, temperature 22 °C, dew point 9 °C. By 1200, the only notable differences were that some clouds (few) had developed at 5500 feet agl, and that the temperature had increased to 27 °C. Search

[3] The layer amounts are reported in eighths (oktas) of sky coverage. “Few” amounts to 0 to 2/8 summation amount. (*Transport Canada Aeronautical Information Manual*)

aircraft did not encounter any conditions of turbulence during the afternoon following the accident. The weather was suitable for the planned VFR flight.

Accident site

The site was located 30 nm west of Kamloops, on the westerly side of a large valley within Arrowstone Provincial Park. The valley is oriented in a magnetic direction of 020° / 200° (north-northeast to south-southwest). The aircraft's direction at impact paralleled the valley on a south-southwest heading. The accident site was at an elevation of 4500 feet asl (about 220 feet lower than the height of the adjacent terrain), in forested terrain with ground consisting of grass-covered, hard, dry soil. This location is well beyond the company practice area over Kamloops Lake.

The propeller and front parts of the engine were found in a crater about 24 inches deep. The engine crankshaft was sheared off behind the propeller, and the crankcase had been broken open at the front end. The oil pan was completely separated from the engine. The propeller was missing a few inches of 1 blade tip; the balance remained in 1 piece, but was severely distorted.

The fuel tanks ruptured on impact; the weather conditions at the time and following the accident allowed for a high rate of evaporation, and there was no sign or smell of fuel when investigators arrived at the site. The aircraft battery, which was located on the lower left portion of the firewall behind and below the engine, was crushed and broken apart.

The left wing and the front half of the fuselage exhibited extensive accordion-type crushing damage. This type of damage is indicative of a hard frontal impact, which compromised the livable cabin space. The right wing exhibited damage created by tree contact, in addition to accordion-type damage resulting from subsequent ground impact. The tree damage was consistent with a descent angle of about 55° below horizontal. The tree scarring did not allow for the determination of the bank angle.

The aircraft was not equipped with an autopilot or an electric elevator trim. Wing flaps were electrically operated. The flap drive motor indicated that the flaps were retracted. All flight control surfaces, including their mass balance weights, were present at the site. The elevator trim appeared to be in a slightly nose-down position, which was within expectations for the loading condition of the aircraft. The rudder and ailerons had no pilot-adjustable trim tab mechanism. The flight control systems were examined at the site, and again once the wreckage was recovered; there were no indications of any pre-impact damage or condition that would have adversely affected the controllability of the aircraft.

Flight instruments were destroyed; however, remnants of the airspeed indicator, altimeter, engine tachometer and Hobbs meter,[4] turn coordinator, and flap position indicator were recovered and evaluated by the TSB Laboratory. The examination of the airspeed indicator dial face and pointer did not reveal any witness marks; however, it was noted that the pointer, due to the bends in the dial face, was trapped in the region past the 200 mph indication (Photo 1).

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[4] The Hobbs meter is the registered trade name of an operating-time indicator used with reciprocating engines to show the number of hours the engine has operated. (Dale Crane, ed., *Dictionary of Aeronautical Terms*, 3rd ed. [Newcastle, Washington, Aviation Supplies & Academics, Inc.: 1997]).

The normal operating speed range is 59 to 140 mph (manoeuvring speed). The caution range is 140 to 174 mph (the never exceed speed and red line). The highest graduation speed mark on the gauge is 210 mph. The dial face of the engine tachometer revealed witness marks indicating approximately 2550 rpm. The maximum operating speed for the engine at 5000 feet asl is 2600 rpm. The position of the throttle at the time of the accident could not be determined.

Photo 1. Occurrence airspeed indicator showing trapped pointer position

Pilot

Records indicate that the student pilot held a student pilot permit – aeroplane, validated with a current medical certificate. The pilot began flight training in 2012 at a different flight training unit located at the Kamloops Airport. The pilot changed flight training units in the summer of 2013. The pilot had accumulated about 80 hours of total flight time. While at TylAir, the pilot accumulated 13 hours with an instructor and 3 hours solo. The pilot was at the final preparation stage to take the private pilot flight test. Although the flight dispatch sheet signed off by the student and instructor listed exercises 9 to 18,[5] the pre-departure briefing with the instructor discussed the following training exercises which were to be practised: power-on and power-off stalls, slow flight, and steep turns, concluded by circuits at the airport. The pilot had conducted all of these exercises with the same instructor at TylAir prior to the accident flight. The instructor was satisfied with the student's proficiency in executing all exercises, including the ability to recover from a spin or a spiral dive,[6] should a manoeuvre develop into either of these

5 Exercises 9a: Turns, 9b: Steep Turns (> 30° bank) (private pilot licence flight test requirements 45° bank, 360° turn), 10: Flight for Range and Endurance, 11: Slow Flight, 12: Stalls, 13: Spinning, 14: Spiral Dives, 15: Slipping, 16a: Normal Take-Off, 16b: Crosswind Take-Off, 16c: Short Field Take-Off, 16d: Soft / Rough Field Take-Off, 17: The Circuit, and 18: Approach & Normal Landings.

6 A spiral dive is a steep descending turn with the aircraft in an excessively nose-down attitude. A spiral dive may be recognized by an excessive angle of bank, rapidly increasing airspeed, and a rapidly increasing rate of descent.

flight conditions. Student pilots are instructed to recover from a spiral dive before reaching 130 mph, 10 mph below the manoeuvring speed limit of 140 mph, which is the top of the green arc on the indicated airspeed (IAS) dial face.

By all accounts, the pilot was regarded as a responsible person who was progressing well with the flight training program. The pilot had not been known to diverge from the parameters of a solo training flight, as briefed beforehand with the flight instructor.

Since there were no recorded flight data or witnesses to the accident, all possible explanations for this accident were considered. This included the possibility of an intentional crash. Information gathered about the pilot did not identify any symptoms or behavioural characteristics consistent with this possibility.

The investigation determined that the pilot was wearing the 3-point safety harness.

Flight training unit

TylAir Aviation Ltd. operates under *Canadian Aviation Regulations* (CARs) Part IV, Subpart 6 – Flight Training Units (FTU). The company was a start-up, and the operating certificate (OC) was issued by Transport Canada (TC) on 07 May 2013. Authorized training services included the private pilot licence (PPL). The operator used 1 C172 aircraft for flight training and rentals. One of the company's principals served as the base manager. The company employed 1 person as the chief flying instructor (CFI) and 1 Class 3 instructor. Maintenance was carried out by an external aircraft maintenance organization.

The TylAir *Student/Renter Policy and Procedures* manual identified company practice areas. In all of these areas, the maximum altitude is specified as being 5500 feet asl, which, in the practice area over Kamloops Lake, is about 4300 feet agl. The manual also describes the use of practice areas as suitable for steep turns, slow flight, stalls, spirals, and spins, as well as for precautionary and forced landings (limited to recovery above 1000 feet agl). There was an informal policy that students on solo flights were not authorized to carry out spiral dives or spins. The manual did not include such a policy.

Aircraft

The aircraft was equipped with a normally aspirated Lycoming engine (model O-320-E2D, serial number L4233927A) with a fixed pitch metal propeller. The aircraft was manufactured in 1971 and was registered to TylAir Aviation Ltd. on 22 May 2013. The airframe total time since new (TTSN) was recorded as 7804 hours. The maximum allowable take-off weight was 2300 pounds for operations in the normal category, and 2000 pounds for operations in the utility category.

A review of the recent aircraft maintenance records showed that the aircraft maintenance was carried out to meet the regulations and standards set out by TC. There were no reported or recorded defects. The aircraft was equipped with a transponder, and there were no previous maintenance issues with this unit. Due to extensive damage to the unit, the transponder was not examined to determine whether it functioned correctly.

Performance charts in the Cessna *Model 172 and Skyhawk Owner's Manual* indicate that, at 2300 pounds, with flaps retracted and wings level, the aerodynamic stall speed would be 47 mph IAS. At 60° angle of bank, the stall speed would increase to 80 mph IAS. C-FQTR was operating at a take-off weight of 1768 pounds, which would result in a lower stall speed in both circumstances.

The Cessna *Model 172 and Skyhawk Owner's Manual* states:

> "[…] in the acquisition of various certificates such as commercial pilot, instrument pilot and flight instructor, certain maneuvers are required […] All of these maneuvers are permitted in this airplane when operated in the utility category."[7]

These include: chandelles, lazy eights, steep turns, spins, and stalls (except whip stalls). The owner's manual cautions readers that, ". . . the airplane is clean in aerodynamic design and will build up speed quickly with the nose down. Proper speed control is an essential requirement for execution of any manoeuvre."[8]

The C172 is a very docile and stable aircraft, and a good spin entry requires some technique. TC provides the following information on stall and spin awareness regarding inadvertent spiral dives: "Aircraft that are difficult to spin can quickly build up speed during a failed spin entry. It is important for students to recognize this entry to a spiral dive and immediately apply the correct spiral dive recovery procedure."[9] This TC publication indicates that in the absence of recommendations from the manufacturer, for most aircraft, the first step to recover from a spin is to close the throttle. In this regard, the emergency procedures section of the owner's manual indicates that the first step to recover from a spiral dive is also to close the throttle.

Weight and Balance

The pilot had completed a company dispatch form, which included the aircraft weight and balance calculation. At the actual take-off weight of 1768 pounds, the aircraft centre of gravity (CG) was located within the utility category moment envelope of the CG graph. The calculations were reviewed and confirmed that the CG was, and would remain, within the allowable moment envelope for operations in the utility and normal categories.

Emergency locator transmitter

By regulation,[10] an aircraft operated by a flight training unit conducting training operations within 25 nm of the aerodrome of departure is not required to carry an emergency locator transmitter (ELT). Current ELTs operate on 406 MHz as well as 121.5 MHz. The 406 model incorporates several advantages, such as satellite communications coverage, which provides for much quicker and more accurate position and alerting capabilities, including aircraft and owner

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7 Cessna Aircraft Company, *Model 172 and Skyhawk Owner's Manual* (1971), page 4-2.

8 Ibid.

9 Transport Canada Safety and Security, Civil Aviation, TP 13747, *Guidance Notes: Private and Commercial Pilot Training*, 2nd ed., Stall/Spin Awareness (October, 2003).

10 *Canadian Aviation Regulation* 605.38 (1), (3)(*d*)

identification. This information can substantially reduce the search and rescue (SAR) efforts to locate a missing aircraft which, in the event of survivable impact forces, increases the likelihood of rescue and survival of the occupants.

No ELT signal was received by the Canadian Mission Control Centre (CMCC) or reported by anyone else. Logbook entries indicate that the aircraft was equipped with a 406 MHz ELT. However, no ELT was found at the accident site or in the aircraft wreckage during subsequent examinations. Investigators noted that an ELT antenna was mounted on an upper surface of the aircraft and was installed in accordance with regulations. The cable between the ELT and the antenna had been unfastened at the antenna connection. There was no documentation indicating when the ELT was removed from the aircraft. No placards indicating removal of the ELT were found in the aircraft wreckage. Such placards are required to supplement any maintenance action and records when removing an ELT.

Data related to the flight path and other characteristics of a flight can be recorded by devices such as flight data recorders, cockpit voice recorders, portable global positioning systems (GPS) or GPS tracking devices installed for this purpose. The operator did not equip the aircraft with any of these devices. GPS tracking can substantially reduce the SAR efforts to locate a missing aircraft, and recorded data may be an aid to future safety improvements through the identification of safety deficiencies during an investigation. The aircraft was not required, by regulation, to be equipped with any of these devices.

TSB Laboratory reports

The following TSB Laboratory reports were completed, and are available on request:

- LP155/2013 - Cell Phone Data Extraction
- LP177/2013 - Instrument Analysis

Analysis

It is not known what manoeuvres the pilot may have been conducting, but a nose-drop during a steep turn or an improper stall recovery can lead to a spiral dive if not corrected in time. The primary reason why an aircraft would achieve speeds near or greater than the never exceed speed of 174 mph is a spiral dive. Both steep turns and stalls were planned as part of the training flight, and recovery skills had previously been demonstrated by the student pilot with the instructor on board.

The damage to the terrain and to the aircraft is indicative of a high impact speed in a nose-low attitude. If the aircraft had been in an aerodynamic stall at the time of impact, there would have been significantly less damage. A spiral dive is a flight regime that can produce such impact damage, but there was no indication of bank angle at impact. It is possible that the pilot had initiated recovery from a spiral dive and had achieved a wings-level attitude, but did not have sufficient altitude to recover from the dive. Although the pilot was wearing the 3-point safety harness, the livable cabin space was severely compromised at impact, making this accident unsurvivable.

It was uncharacteristic for this pilot to be practising in areas beyond the practice area agreed upon in the pre-flight briefing. The location of the accident site was 15 nautical miles (nm) beyond the practice area; the fact that the pilot was flying the aircraft in this location could only be intentional, since it is highly unlikely that the pilot was lost. While the area overflown outside the assigned practice area required flight at higher altitudes to stay clear of the terrain, it could not be determined what the pilot's intentions were by climbing to 9000 feet or higher.

The air traffic services (ATS) radar equipment was functioning properly. Failure of the transponder itself, or of its individual electrical power supply, could not be determined. Although unlikely, it is possible that the transponder was switched off by the pilot. The investigation could not ascertain the cause for the disappearance of the aircraft transponder target from the ATS radar.

The lack of fuel at the accident site was likely due to the evaporation of the remaining fuel that was released from the tanks once ruptured. The aircraft battery was mounted on the lower left front side of the engine firewall and was crushed on impact, removing the possibility of arcing wires. Also, given the crater that was formed in the dry dirt on impact, it is likely that a significant amount of dust or particulate matter formed a cloud, which may have acted in the manner of a fire extinguishing agent; this may have prevented a post-impact fire from igniting if any other sources of heat were still present.

The aircraft was not carrying an emergency locator transmitter (ELT). Since there was no known intention for this flight to travel beyond 25 nm from Kamloops, British Columbia, the *Canadian Aviation Regulations* (CARs) do not require an ELT to be on board. However, the removal of the ELT should have been documented and the aircraft placarded. Although the company flight following for this flight worked well with regards to quick notification to search and rescue services, the absence of an ELT resulted in considerable time and resources being expended to locate the accident site. This, in turn, dramatically decreases the chance of survival for any potential survivors of an accident.

Findings

Findings as to causes and contributing factors

1. The pilot entered a flight regime from which recovery was not effected prior to collision with terrain.

Findings as to risk

1. If an aircraft is not equipped with an emergency locator transmitter or other tracking device, there is an increased risk that the rescue of accident survivors will be delayed and their survival compromised.

This report concludes the Transportation Safety Board's investigation into this occurrence. The Board authorized the release of this report on 24 September 2014. It was officially released on 30 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.