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

Air Transportation Safety Investigation Report A18O0150

MID-AIR COLLISION

Cessna 150G, C-FGMZ (privately owned)
and
NLG Air Inc.
Piper PA-42 Cheyenne III, C-FCSL
Ottawa/Carp Airport, Ontario, 1.3 nm S
04 November 2018

History of the flight

At 0944[1] on 04 November 2018, a privately operated Piper PA-42 Cheyenne III aircraft (registration C-FCSL, serial number 42-8001017) departed Ottawa/Carp Airport (CYRP), Ontario, with the pilot and 1 passenger on board. The purpose of the flight was to verify the aircraft pressurization system. Because the aircraft would be flying at an altitude above 18 000 feet above sea level (ASL), an instrument flight rules (IFR) flight plan was required and had been filed. The flight plan indicated that the estimated time of arrival back at CYRP was 1011.

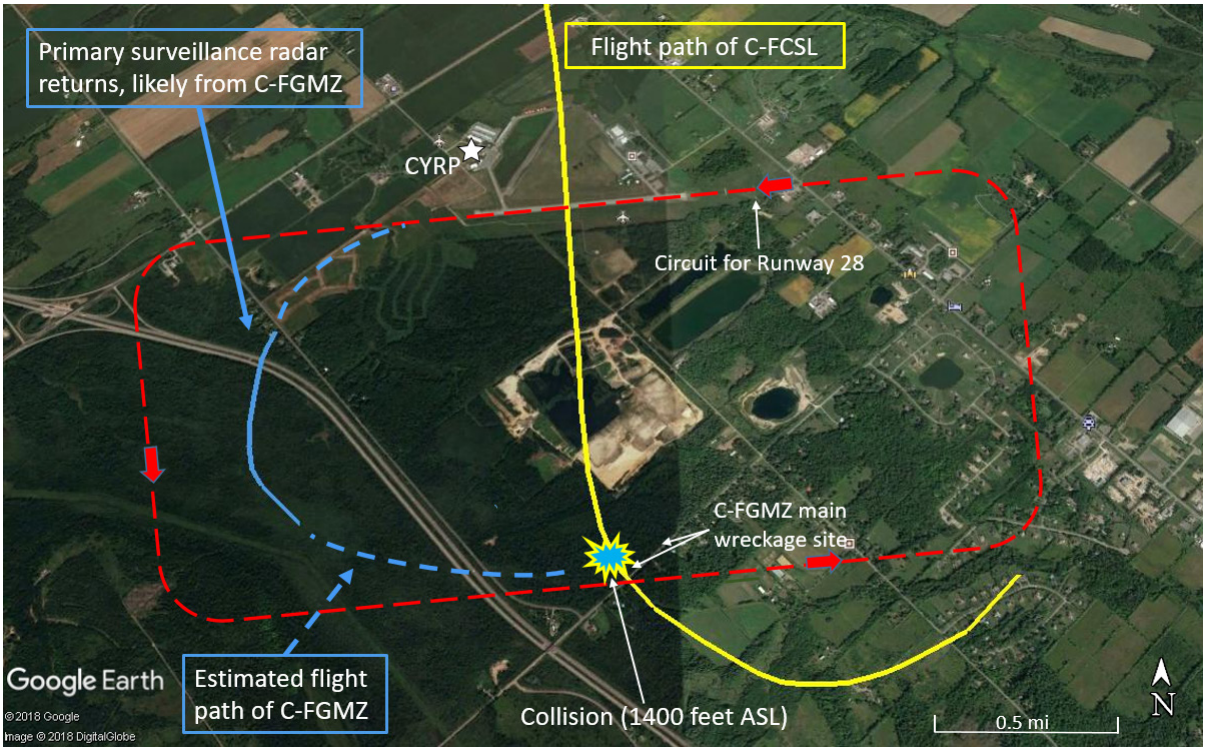
Once the pressurization verifications were complete, the pilot cancelled the IFR flight plan for the return flight once below 18 000 feet ASL, flying instead under visual flight rules (VFR).

While the Piper was returning to the airport, a privately owned Cessna 150G aircraft (registration C-FGMZ, serial number 15066473) was conducting circuits at CYRP under VFR. Only the pilot was on board. The investigation was unable to determine the precise time at which the Cessna departed or its exact flight path.

[1] All times are Eastern Standard Time (Coordinated Universal Time minus 5 hours).

At 1010, the Piper was on approach to the airport from the north. It had flown over Runway 10/28 at circuit altitude to join the circuit at the midpoint of the downwind leg for Runway 28, when the 2 aircraft collided at approximately 1400 feet ASL, about 1.3 nautical miles (nm) south of the airport (Figure 1). The pilot of the Piper did not see the Cessna while crossing over the airport. The investigation was unable to determine whether the pilot of the Cessna saw the Piper or took evasive action prior to the collision.

Figure 1. Flight paths of the Piper (C-FCSL) and the Cessna (C-FGMZ). The left-wing outboard section of C-FGMZ was found 635 feet southwest of the main wreckage site. (Source: Google Earth, with TSB annotations)



A section of the Cessna's left wing was severed as a result of the impact, and the aircraft entered a steep dive with no possibility of recovery. The aircraft was destroyed by impact forces and a post-impact fire. The pilot received fatal injuries.

The Piper sustained substantial damage from the collision; however, control of the aircraft was maintained. The pilot diverted to the Ottawa/Macdonald-Cartier International Airport (CYOW), Ontario, and landed without incident. Neither the pilot nor the passenger was injured.

Pilot information

Records indicate that the pilot of the Piper was certified and qualified for the flight in accordance with existing regulations. He obtained a Canadian commercial pilot licence – aeroplane in 2000 and had a valid Category 1 medical certificate. He had both single- and multi-engine ratings, as well as a valid Group 1 instrument rating and a Class 1 instructor rating. He also held a high-performance endorsement for the PA-42 series aircraft (Cheyenne III/IV/400LS). He had accumulated approximately 10 200 total flight hours, including about 200 hours as pilot-in-command on the occurrence aircraft.

Records indicate that the pilot of the Cessna was certified and qualified for the flight in accordance with existing regulations. He obtained a Canadian private pilot licence – aeroplane in 1981 and held a valid Category 3 medical certificate. He held a single-engine – land rating as well as a night and VFR

over-the-top rating. He had accumulated approximately 1000 total flight hours, of which approximately 150 hours had been completed as pilot-in-command over the past 10 years.

The investigation found no evidence to indicate that either pilot's performance was degraded by pre-existing physiological factors, nor was there evidence to suggest that fatigue was a factor.

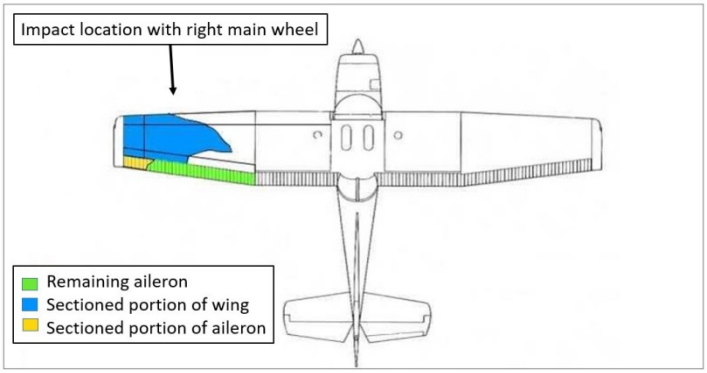
Collision and wreckage information

A review of the radar data indicates that the collision occurred at approximately 1400 feet ASL, as the Piper was initiating a left turn to join the midpoint of the downwind leg of the circuit. Details of the Piper's flight path were recorded by NAV CANADA's secondary surveillance radar (SSR)[2] system, but the data did not include any information pertaining to the Cessna. However, there were poor[3] primary surveillance radar (PSR)[4] returns available that depicted an aircraft near the crosswind leg just prior to the collision. A comparison of the aircraft's converging path and speed with the Piper's track confirmed that these were most likely the Cessna's PSR returns; however, it was not possible to determine the Cessna's entire track.

The investigation determined that, as the 2 aircraft collided, the Cessna's left wing struck the Piper's extended right main-wheel assembly at a point 5.75 feet from the Cessna's outer left-wing rib. The impact damage to the leading edge of the wing indicates that it struck the outboard face of the Piper's wheel assembly, nearly perpendicular with the Piper's longitudinal axis.

The damage sustained by the wing structure caused the failure and subsequent separation of the outer section of the wing and aileron (Figure 2). The aircraft became uncontrollable and rapidly entered a steep dive, striking the ground in a near-vertical attitude. The aircraft was destroyed by the impact forces and post-impact fire.

Figure 2. The Cessna's in-flight damage (Source: Cessna Aircraft Company, with TSB annotations)



The Piper sustained damage to the right main landing gear, right-side aft and lower fuselage, rudder, and left-side flap. Although the damage was substantial, none of it critically affected the aircraft's primary flight controls.

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2 "Secondary surveillance radar (SSR) determines aircraft range by measuring the interval between transmitting an interrogation to and receiving a reply from an airborne transponder." (Source: Transport Canada, TP 14371, *Transport Canada Aeronautical Information Manual* [TC AIM], COM—Communications, navigation and surveillance [11 October 2018], section 7.2.)

3 "Poor PSR targets are reported by the radar with less than a threshold number of replies (low *Track Quality*)." (Source: NAV CANADA, *WinRad User Manual*, Version 17.0.1, Feature Selection, Display Feature Selection.)

4 "Primary surveillance radar (PSR) computes target positions by determining the range and azimuth of transmitted and reflected radio frequency energy. It is a passive surveillance system and therefore does not rely on information transmitted from the aircraft." (Source: Transport Canada, TP 14371, *Transport Canada Aeronautical Information Manual* [TC AIM], COM—Communications, navigation and surveillance [11 October 2018], section 7.1.)

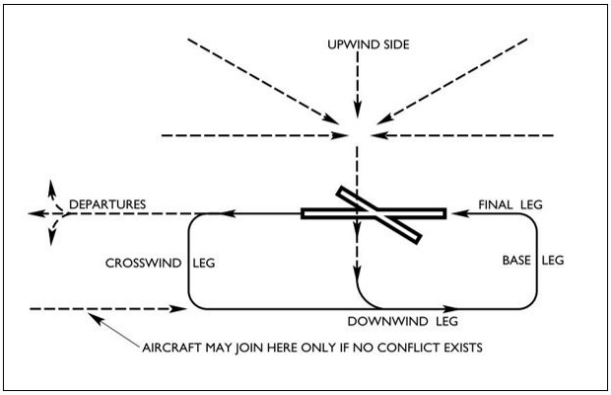
Airport information

CYRP is an uncontrolled airport located 1.2 nm south of the village of Carp. It is owned and operated by West Capital Developments. CYRP has 1 paved runway (Runway 10/28) and 1 gravel runway (Runway 04/22). At the time of the occurrence, Runway 28 was in use, with a standard left-hand circuit pattern (Figure 3). The circuit altitude for Runway 28 is 1400 feet ASL.[5] The airport lies within an aerodrome traffic frequency (ATF) area with a radius of 5 nm that is centred on the airport and extends vertically up to and including 1800 feet ASL. Transport Canada (TC) establishes an ATF "to ensure that all radio-equipped aircraft operating on the ground or within the area are listening on a common frequency and following common reporting procedures."[6]

Circuit pattern at an uncontrolled airport

All pilots "operating at or in the vicinity of an aerodrome shall observe the aerodrome traffic for the purpose of avoiding a collision"[7] and "are expected to approach and land on the active runway."[8] In addition, at aerodromes that are not within a mandatory frequency (MF) area,[9] aircraft "should approach the traffic circuit from the upwind side"[10] (Figure 3).

Figure 3. Standard left-hand circuit pattern at an uncontrolled aerodrome (Source: Transport Canada, TP 14371E, Transport Canada Aeronautical Information Manual [TC AIM], RAC—Rules of the Air and Air Traffic Services [11 October 2018], Figure 4.6.)



Radio communications

The *Transport Canada Aeronautical Information Manual* (TC AIM) provides the communication procedures for VFR aircraft at uncontrolled aerodromes with an ATF or an MF area.[11] The TC AIM states, in part, that VFR pilots should maintain a listening watch and be aware of local flying. They should also state their intentions before entering the manoeuvring area, during departure or arrival, and while completing continuous circuits.[12] Although strongly encouraged by TC and considered good airmanship, communication on an ATF is not mandatory by regulation while operating under VFR.

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5 "The circuit is normally flown at 1 000 [feet above airport elevation]." (Source: Ibid., RAC—Rules of the Air and Air Traffic Services [11 October 2018], section 4.5.2.)

6 Ibid., section 4.5.5.

7 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, paragraph 602.96(3)(a).

8 Transport Canada, TP 14371E, *Transport Canada Aeronautical Information Manual* (TC AIM), RAC—Rules of the Air and Air Traffic Services (11 October 2018), section 4.5.2.

9 "*MF area* means an area in the vicinity of an uncontrolled aerodrome for which an MF has been designated." (Source: Ibid., section 4.5.1.)

10 Ibid., paragraph 4.5.2(d)(v).

11 Ibid., section 4.5.7.

12 Ibid.

CYRP's ATF frequency is a privately operated UNICOM[13] and is not recorded. In this occurrence, the pilot of the Piper had broadcasted his intentions on the ATF frequency on at least 3 occasions: while entering the ATF area (5 nm), while overflying the village of Carp, and before joining the midpoint of the downwind leg of the Runway 28 circuit. During this sequence, no radio transmissions from the Cessna were heard by the pilot of the Piper or other pilots in the area at the time.

The Cessna was equipped with a navigation/communication (NAV/COM) very high frequency (VHF) transmitter/receiver, which was examined at the TSB Engineering Laboratory in Ottawa. The extent of heat-related damage sustained by the unit prevented any conclusion to be made regarding its settings or serviceability.

There was no indication of any malfunction with the Piper's VHF transmitter/receiver.

The see-and-avoid principle

The see-and-avoid principle has been examined in a number of other TSB investigation reports.[14] It is the basic method of collision avoidance for VFR flights that is based on active scanning and the ability to detect conflicting aircraft and take appropriate measures to avoid them. An advisory circular published by the U.S. Federal Aviation Administration states, "Pilots should remain constantly alert to all traffic movement within their field of vision, as well as periodically scanning the entire visual field outside of their aircraft to ensure detection of conflicting traffic."[15] The most effective method of identifying potential conflicting traffic is to quickly scan small segments of the visual field (approximately 10° to 15° wide) to detect movement.[16]

Obstructions such as door frames and window posts can obscure the pilot's view. This requires pilots to move their head and look around the obstruction.[17] The large engine nacelles of the twin-engine Piper PA-42 aircraft cover a considerable area on both sides of the aircraft, and may create obstructions.

Wing configuration and the altitude of each aircraft in relation to the other may have created a challenge for the pilots to detect potential threats. The Cessna is a high-wing aircraft and was at a slightly lower altitude than the Piper, which is a low-wing aircraft. These wing configurations would have created an obstruction for both pilots and made direct visual detection of the other aircraft difficult.

The collision occurred in clear conditions and good visibility. The weather at the time was not considered a factor in the accident.

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[13] "Universal Communications (UNICOM) is an air-ground communications facility operated by a private agency to provide Private Advisory Station (PAS) service at uncontrolled aerodromes." (Source: NAV CANADA, *Canada Flight Supplement* [effective 24 May 2018], General, p. A91.)

[14] TSB aviation investigation reports A99P0056, A99P0108, A99P0168, A00O0164, A06O0206, A09C0114, A12H0001, A12C0053, A13P0127, A15W0087, and A17Q0030.

[15] U.S. Federal Aviation Administration, Advisory Circular 90-48D: Pilots' Role in Collision Avoidance (28 June 2016), paragraph 4.2.1.

[16] U.S. Federal Aviation Administration, Midair Collision Avoidance: Your role in collision avoidance, p. 2.

[17] U.S. Federal Aviation Administration, Advisory Circular 90-48D: Pilots' Role in Collision Avoidance (28 June 2016), paragraph 4.2.7.

Airborne collision avoidance systems

Many of the commonly available integrated avionics equipment (all-in-one global positioning system [GPS]/NAV/COM) can be configured with traffic advisory system (TAS), traffic information system (TIS), or traffic alert and collision avoidance system (TCAS) capability, which provide cues of nearby traffic and collision alerts to pilots. However, several of these systems depend on receiving nearby transponder information to detect the traffic; therefore, it is important for pilots to turn their transponder on when flying.

Furthermore, Mode C transponders[18] provide air traffic controllers with aircraft position and altitude information. Having this information available allows air traffic controllers to provide pilots who are leaving their airspace and entering adjacent uncontrolled airspace with information about the traffic to be expected or the position of an aircraft in the circuit. TC published a reminder for pilots to "turn it on for safety,"[19] recommending that pilots always use the transponder to enhance detectability. Altitude-reporting transponders are required in order to activate the traffic alert and collision avoidance functions of a TCAS-equipped aircraft.

The Cessna was equipped with a Mode C transponder, but no SSR return was observed during the occurrence flight. A review of the aircraft technical documents indicates that an encoding and altitude correlation check had been completed successfully on the transponder approximately 1 month before the occurrence. The transponder was examined at the TSB Engineering Laboratory in Ottawa but the extent of heat-related damage sustained prevented any conclusion from being made regarding its settings or serviceability. The investigation could not determine if the Cessna's lack of transponder signal was due to a malfunctioning unit or if it had not been turned on for the occurrence flight.

The Piper avionics equipment was capable of displaying traffic advisory (TIS-A) information to the pilot. TIS-A data is provided by ground-based radars through the Mode S transponder data link; however, this service is not currently available in Canada. Therefore, the Piper's instrumentation would not have been able to display the presence of the Cessna, whether or not its Mode C transponder had been emitting a signal.

Flight recorders

The Piper was a privately operated aircraft under *Canadian Aviation Regulations* (CARs) Subpart 604 (Private Operators), and the Cessna was a private aircraft used for recreational purposes. Neither of the 2 aircraft was equipped with a flight data recorder or cockpit voice recorder, nor were these required by regulation.

Although the TSB has formally recommended[20] the mandatory installation of lightweight flight recording systems by commercial and private operators not currently required to carry these systems, there has been no recent progress for implementation by TC.

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[18] A Mode C transponder is a "type of transponder with altitude-encoding capability." (Source: Transport Canada, Advisory Circular 100-001: Glossary for Pilots and Air Traffic Services Personnel [effective date 11 October 2018].)

[19] Transport Canada, TP 2228-17, *Take Five…for safety*, "Turn it on for safety: using transponders on aircraft," at https://www.tc.gc.ca/en/services/aviation/general-operating-flight-rules/best-practices/safety-transponders-aircraft.html (last accessed on 15 April 2019).

[20] TSB Recommendation A18-01.

Emergency locator transmitter

The Cessna was equipped with a 121.5 MHz emergency locator transmitter (ELT). As of 01 February 2009, Cospas-Sarsat satellites no longer detect 121.5 MHz distress beacons.

In 2016, following its investigation into the May 2013 occurrence in Moosonee, Ontario,[21] the TSB found that more than half of all Canadian-registered aircraft that require an ELT are being operated with an ELT whose signal is not detectable by Cospas-Sarsat. It further concluded that if the regulations are not amended to reflect the International Civil Aviation Organization's standards, it is highly likely that non–406 MHz ELTs will continue to be used on Canadian-registered aircraft and foreign aircraft flying in Canada. As a result, flight crews and passengers will continue to be exposed to potentially life-threatening delays in search-and-rescue service following an occurrence.

Although the TSB has formally recommended[22] that all Canadian-registered aircraft and foreign aircraft operating in Canada be equipped with a 406 Mhz ELT, the regulatory action undertaken by TC is not sufficiently advanced to reduce the risks to transportation safety.

Safety messages

The 2 aircraft in this occurrence were operating under VFR in uncontrolled airspace. Neither pilot saw the other aircraft in time to avoid a mid-air collision, partly owing to the inherent limitations of the see-and-avoid principle. Relying solely on visual detection increases the risk of collision while in uncontrolled airspace. Pilots are strongly encouraged to broadcast their intentions while in an ATF area in accordance with TC's VFR communications procedures, even though they are not mandatory.

A number of viable and economical airborne collision avoidance systems exist, some of which are specifically designed for general aviation. These technologies offer the potential to significantly reduce the risk of mid-air collisions.

Transponders can also provide an additional layer of defence by allowing other aircraft that are equipped with airborne collision avoidance systems to detect conflicting traffic. It is important for pilots to turn their transponder on when flying.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 10 April 2019. It was officially released on 02 May 2019.

[21] TSB Aviation Investigation Report A13H0001.

[22] TSB Recommendation A16-01.

ABOUT THIS INVESTIGATION REPORT

This report is the result of an investigation into a class 4 occurrence. For more information, see the Occurrence Classification Policy 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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