

AVIATION INVESTIGATION REPORT

A99P0056

MID-AIR COLLISION

BETWEEN

CESSNA 172D C-FBVW

AND

CESSNA 172 C-GWAC

108 MILE AIRPORT, BRITISH COLUMBIA

16 MAY 1999

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.

## Aviation Investigation Report

### Mid-air Collision

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and

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### *Summary*

The pilot of a Cessna 172D, C-FBVW, with one passenger on board, was conducting left-hand circuits to runway 32 at 108 Mile Airport. Shortly after C-FBVW turned onto final and descended toward the runway, the aircraft collided with a second Cessna 172, C-GWAC, which was inbound to the airport from the south on an established straight-in approach to the same runway. The collision took place at about 300 feet above ground level. Both aircraft were locked together by the collision and became uncontrollable. They descended at a steep angle and crashed into the corner of a warehouse building at the south end of the 108 Mile shopping centre. The shopping centre is about 2 000 feet south of the approach end of the runway and about 500 feet east of the runway's extended centre-line. The three people involved in this in-flight collision were seriously injured by impact forces but were rescued by first responders. There was no fire.

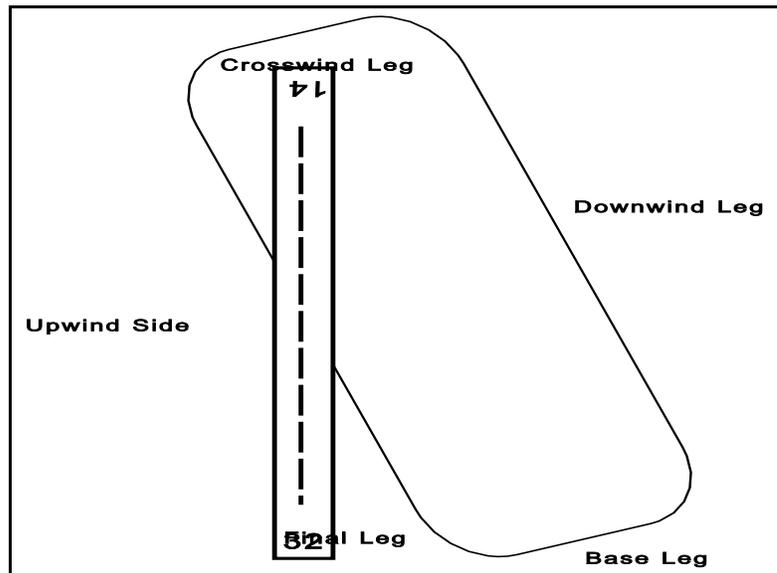
*Ce rapport est également disponible en français.*

## *Other Factual Information*

The pilots of both aircraft were certified and qualified, and there was no evidence that any physiological factors affected their ability to conduct the flights safely. There were no mechanical discrepancies found with either aircraft that would have contributed to the occurrence.

The 108 Mile Airport is a registered, uncontrolled aerodrome, at an elevation of 3 127 feet above sea level (asl), operated by the Caribou Regional District. The aerodrome has a single, asphalt runway 4 877 feet long by 75 feet wide, oriented on a 320/140 degree magnetic heading. The aerodrome traffic frequency (ATF) is 123.2 megahertz and is used within a radius of 5 nautical miles and to an altitude of 6 100 feet asl.

*A.I.P. Canada*, published by Transport Canada (TC), prescribes the procedures that pilots should follow when operating at an uncontrolled airport. These procedures are widely distributed and establish a fundamental basis for safe aircraft operations in Canada. Prior to joining a traffic circuit, all pilots should announce their intentions. Where no mandatory frequency (MF) procedures are in effect, aircraft should approach the traffic circuit from the upwind side or, once having ascertained without any doubt that there will be no conflict with other traffic entering the circuit or established within the circuit, the aircraft may join the circuit on the downwind leg. There are no MF procedures in effect at 108 Mile Airport. Designation of an ATF is aimed at ensuring that all radio-equipped aircraft operating on the ground or within the specified ATF area are listening on a common frequency and following common reporting procedures.



*Canadian Aviation Regulations* require that all turns be to the left while operating in the circuit, unless a right-hand circuit has been specified in the *Canada Flight Supplement* (CFS). The CFS specifies right-hand circuits for runway 32 at 108 Mile Airport during daylight hours.

The pilot of C-FBVW had flown to 108 Mile Airport from Prince George on the day before the accident and had remained in the area overnight. He planned to continue his trip to Vernon on the morning of the accident and had called the Kamloops Flight Service Station for a weather briefing. Based on the content of that briefing, he concluded that the en route weather in the vicinity of Bonaparte Lake was below the minimum required for visual flight rules (VFR) flight and he decided to delay his departure until the weather improved

later in the day. At 1100 Pacific daylight time (PDT),<sup>1</sup> he decided to do some local flying while waiting for an improvement in the weather to the south. The wind at 108 Mile Airport was light out of the northwest, and the pilot and his one passenger (who also held a valid private pilot's licence) took off from runway 14 with a slight tail wind. The pilot was flying the aircraft from the right-hand seat. His passenger was wearing the only available headset and was handling the radio work associated with the flight. This assignment of work was required because the headset connected to the aircraft dash on the left side of the aircraft. The aircraft was equipped with navigation lights and a landing light, neither of which were on at the time of the accident.

The pilot did several left-hand circuits on runway 14 and then proceeded to 100 Mile House, about eight miles to the south. He overflew that aerodrome, assessed that the runway and wind conditions were unsuitable for a landing, and completed a left turn back toward 108 Mile Airport. That turn placed the aircraft to the east of Highway 97, as well as to the east of the extended centre-line of runway 32 at 108 Mile Airport. He approached 108 Mile Airport from the southeast and crossed the aerodrome at midfield about 1 000 feet above the aerodrome elevation. After he crossed the airfield, he turned left to join downwind, left-hand for runway 32. His passenger made radio calls before entering the ATF area, when crossing midfield, and when established on final for runway 32 and did not hear any radio calls from any other aircraft in the vicinity.

The pilot of C-FBVW completed a touch-and-go landing from this first circuit, then entered into a second left-hand circuit for runway 32. His passenger reportedly made radio calls downwind and on turning final; again she heard no response from any other aircraft. It was following the completion of the final turn on this second circuit that C-FBVW was involved in a mid-air collision. C-FBVW descended onto C-GWAC, which was completing a straight-in approach to runway 32.

The pilot of C-GWAC had filed a VFR flight plan from Merritt to his destination of 100 Mile House. When he reached 100 Mile House, the pilot decided to overfly that aerodrome and to continue on to 108 Mile Airport. He reportedly made a radio call prior to entering the 108 Mile Airport ATF area, using a handheld radio that he carried in the breast pocket of his shirt. He reported that he was setting up for a straight-in approach to runway 32. He did not hear any response from any other aircraft in the area and continued inbound to the airport. During the straight-in approach, the pilot concentrated his lookout upwards and to the right, in anticipation of any unannounced traffic that may have been operating in a right-hand traffic pattern. While on short final to runway 32, C-GWAC was involved in a mid-air collision when it was struck from above by C-FBVW. C-GWAC was equipped with navigation lights, a rotating anticollision light, and a landing light. The first two of these lighting systems were operating at the time of the collision, but the landing light was selected off. A post-crash examination of the handheld radio showed that the correct ATF was not selected in either the active or memory locations of the radio. The radio is equipped with a keyed entry pad for frequency selection, as well as two SCAN buttons which are used to scan either up or down the available frequency spectrum. These buttons protrude from the face of the radio and are activated by pressure contact. Safe VFR flight is predicated on the "see and avoid" principle. The effectiveness of this procedure in collision avoidance is dependent on flight crew detecting other aircraft on collision courses and on the pilots' abilities to take evasive action in time to avoid an in-flight collision.

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<sup>1</sup> All times are PDT (coordinated universal time [UTC] minus 7 hours).

A pilot's ability to visually detect another aircraft is affected by many factors, including, the pilot's awareness of the presence of another aircraft, the pilot's available field of view, obstructions to that field of view, aircraft conspicuousness, pilot scanning techniques, and normal physiological limitations of the human visual and motor-response systems.

In general terms, assuming that a pilot is looking in the correct direction, general aviation aircraft similar to the ones involved in this occurrence should, under good conditions, be detectable at an approximate range of 1 to 1.5 nautical miles. Contrast with the background, aircraft attitude, and the relative flight path of an aircraft can affect this detection range, often reducing it significantly.

The human visual system has physical limitations that can reduce its performance. For example, the human eye is particularly attuned to detect movement but is less effective at detecting stationary objects. However, because of the geometry of collision flight paths, an aircraft on a collision course will appear to be a stationary object in the pilot's field of view. The use of high intensity strobe lights, anticollision lights, landing lights, and navigation lights, as well as high contrast paint schemes all help in making an aircraft more visible to others.

Aircraft and cockpit designs can affect a pilot's ability to see effectively. Airframe structures such as wings, window posts, and engine cowls, as well as crew or passenger seating locations may mask certain areas around the aircraft from the pilot's view.

It is generally recognized that traffic advisories will improve a pilot's ability to visually acquire another aircraft. First, the advisory provides advance warning of a potential conflict and will tend to increase the time that the crew will devote to the visual search for the traffic. Second, the advisory will aid the pilot in concentrating the visual search in the proper direction. Research indicates that, if alerted to the presence of another aircraft, a pilot is eight times more likely to acquire the target.<sup>2</sup>

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<sup>2</sup> J.W. Andrews, *Modeling of Air-to-Air Visual Acquisition*, The Lincoln Laboratory Journal, Volume 2, Number 3 (1989) p 478.

## *Analysis*

In this occurrence, the pilot of C-FBVW had given the only available radio headset to his passenger and had delegated the operation of the aircraft radio to her. By doing so, the pilot gave up any ability he had to monitor the ATF directly, and, by doing so, he reduced the effectiveness of the established radio protocols as a defence to support the see and avoid principle.

The pilot of C-GWAC used a handheld radio to transmit his position and intention when he entered the ATF area. Based on a post-crash examination of that radio, it was determined that the radio (as found) was not on the appropriate ATF. Although this examination cannot confirm what frequency was selected at the time the aircraft entered the ATF area, it is known that neither the pilot of C-GWAC nor the passenger of C-FBVW heard any radio transmissions from the other aircraft. The cause for the incorrect frequency selection is not known, but it is possible that a frequency selection or scan button may have inadvertently activated after the pilot put the radio in his shirt pocket. Once the radio was de-tuned from the correct ATF, then any transmission made by the pilot of C-GWAC would have been ineffective in alerting other aircraft in the area of his presence. Similarly, any transmissions made by other aircraft in the area would not have been received by the pilot of C-GWAC.

The pilot of C-FBVW was conducting left-hand traffic patterns to runway 32 at 108 Mile Airport, whereas the CFS states right-hand circuits should be flown to runway 32. By not following the published circuit procedure, this pilot increased the risk of an in-flight collision. Additionally, while in the downwind leg, and during the final turn, his ability to see the conflicting traffic would have been impaired by visual interference from the cockpit dash, the aircraft's engine section, and the passenger. The result was that the visual search procedure used by the occupants of C-FBVW was ineffective.

The pilot of C-GWAC had made a radio call prior to entering the ATF area and had not heard any response from other aircraft. He therefore concluded no other aircraft were in the area and continued to the airport for a straight-in approach to runway 32. This circuit-joining procedure is not recommended when operating in an ATF area. During the approach, the pilot of C-GWAC concentrated his lookout upward and to the right in anticipation of any unannounced traffic operating in a right-hand traffic pattern. This visual search procedure was ineffective because the opposing traffic was operating in a left-hand pattern and approached from above and to the pilot's left side.

C-FBVW was equipped with navigation lights and a landing light, neither of which were selected on at the time of the collision. The non-use of available lighting systems reduces the visual conspicuousness of an aircraft and thereby increases the risk of it not being seen by other pilots.

C-GWAC was equipped with navigation lights, a rotating anticollision beacon, and a landing light. The navigation lights and rotating anticollision beacon were on at the time of the collision, but the landing light was off.

Because neither pilot detected the potential collision, neither took avoidance action prior to the collision.

### *Findings as to Causes and Contributing Factors*

1. The see and avoid principle was ineffective as a method of separating aircraft because neither pilot saw the other aircraft prior to the in-flight collision.
2. The pilot of C-FBVW was conducting left-hand traffic patterns to runway 32 at 108 Mile Airport whereas right-hand traffic patterns were published.
3. The pilot of C-GWAC conducted a straight-in approach to runway 32 rather than using the recommended circuit joining procedure, thereby reducing the opportunity to be seen by other traffic.
4. The pilot of C-GWAC used a handheld radio to transmit his position and intention prior to entering the ATF area. However, based on a post-crash examination of that radio, it appears likely that the radio was not on the appropriate ATF.

### *Findings as to Risk*

1. The pilot of C-FBVW had given the only available radio headset to his passenger and had delegated the operation of the aircraft's radio to her. By doing so, the pilot gave up any ability he had to monitor the ATF directly.
2. Neither pilot was using all available aircraft lighting systems to increase the visual conspicuousness of his aircraft.

### *Safety Action*

A review of mid-air collisions occurring between August 1989 and August 1999 indicates that there were 17 accidents of this type in Canada during this 10-year period. Of these accidents, 8 involved some form of formation flight. Of the remaining 9 accidents, 3 occurred in practice training areas and 6 occurred in the vicinity of uncontrolled airports between aircraft that were not associated with each other.

Following a mid-air collision on 01 May 1995, to improve safety in this area of flight the TSB recommended that:

The Department of Transport ensure that aircraft are flown at reduced airspeeds, consistent with safe manoeuvring, in the vicinity of aerodromes where separation relies primarily on the see-and-avoid concept.

(A96-05)

and that

The Department of Transport take both long- and short-term action to increase the ability of pilots to recognize in-flight collision geometry and optimize avoidance manoeuvring.

(A96-06)

TC responded positively to both recommendations. In 1996, TC published four articles about collision avoidance in issue 2/96 of the *Aviation Safety Newsletter*. Additionally, TC has provided relevant information in *A.I.P. Canada* and has produced and distributed a poster entitled "MF/ATF Communications Requirements" to highlight and review applicable pilot reporting and communication requirements within MF and ATF areas. More recently, TC has published a series of *Human Factors in Aviation* manuals, developed a video on procedures to be used at uncontrolled aerodromes, and amended the *Flight Instructor Guide* to provide more comprehensive training and education in related issues.

Recently, there have been three in-flight collisions in British Columbia involving a total of six aircraft and 12 people. All but three of the involved people died in the accidents. With the increasing concerns brought on by these accidents, NAV CANADA developed, and recently began conducting, pilot education sessions on air traffic procedures that are used at controlled and uncontrolled aerodromes. Both the TSB and TC have participated in these sessions to provide information on recent mid-air collisions and on the limitations of human recognition and response. This active program is expected to raise the awareness of operators, owners, and pilots of the importance of using all available equipment and procedures to reduce the risk of an in-flight collision.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 01 November 2000.*