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

Air Transportation Safety Investigation Report A19P0187

COLLISION WITH TERRAIN

Cessna 172H, C-GECG
Tofino/Long Beach Airport, British Columbia, 31 NM NW
21 December 2019

Background

The occurrence flight was conducted on behalf of the United States Department of Commerce National Oceanic and Atmospheric Administration (NOAA) as part of the Global Greenhouse Gas Reference Network's aircraft program.[1] The program collects air samples at specified altitudes and locations across North America and stores them for later analysis.

The occurrence pilot had been conducting these NOAA air-sampling flights near the Estevan Point Lighthouse, British Columbia (BC), at his discretion approximately every 12 days since 2002. These flights would normally begin with a climb to 17 500 feet above sea level (ASL), where the first air sample would be taken. The pilot would then descend to and level off at 15 500 feet ASL to take the next sample. He would continue to descend and level off at 8 more pre-determined altitudes to take samples. The last air sample would be taken at 1000 feet ASL in the vicinity of Estevan Point. For these flights the aircraft did not enter airspace for which 2-way radio communication with air traffic services was required.

History of the flight

On 21 December 2019, the privately registered Cessna 172H aircraft (registration C-GECG, serial number 172-55070) was conducting a visual flight rules (VFR) flight from Courtenay Airpark (CAH3),

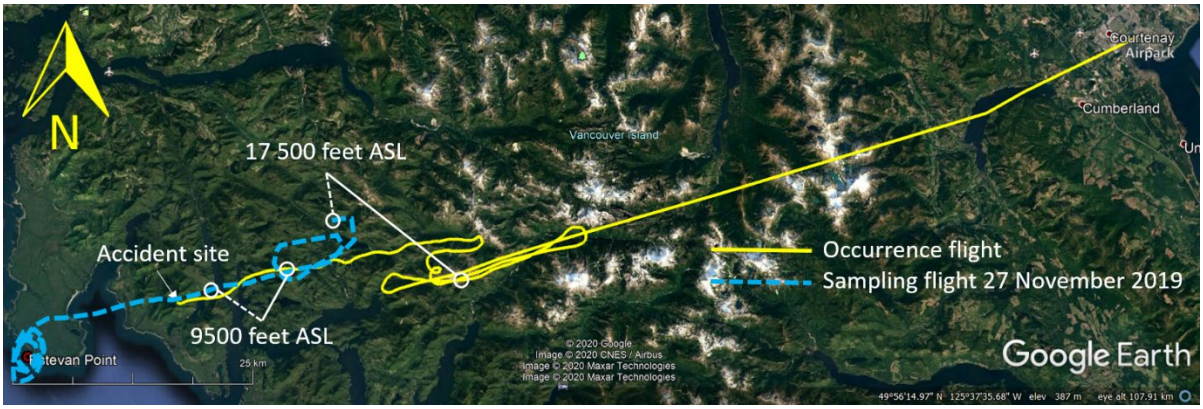
[1] National Oceanic and Atmospheric Administration, Global Greenhouse Gas Reference Network, Aircraft Program, at https://www.esrl.noaa.gov/gmd/ccgg/aircraft/index.html (last accessed 08 June 2020).

BC, with only the pilot on board. Shortly after departing CAH3, the aircraft appeared on radar at 1132[2] climbing through 1900 feet ASL. At 1203, the aircraft levelled off at 17 400 feet ASL. For the next 15 minutes, it followed the planned flight path for the air-sampling mission with a pattern of flight consistent with previous air-sampling flights, including a transponder code change at 1214.

When the aircraft reached 9500 feet ASL at 1217, it did not level off to conduct a sampling as planned. Instead, it descended through 9500 feet ASL on a steady track heading southwest and continued its descent for 4 minutes at 80 to 100 knots groundspeed and an average rate of 1800 fpm, until it was no longer visible on radar. The last radar return was at 2800 feet ASL. There was no record of any radio communications from the aircraft.

The on-board NOAA sampling equipment's GPS (global positioning system) indicated that the aircraft came to rest at 1222 (Figure 1). It had struck trees and collided with the ground near Stewardson Inlet, BC. The pilot was fatally injured. The aircraft was destroyed. There was no post-impact fire.

Figure 1. Flight paths of the occurrence flight and the previous sampling flight, based on NAV CANADA radar and National Oceanic and Atmospheric Administration GPS data (Source: Google Earth, with TSB annotations)



Note: Flight data for the 27 November flight comes from the NOAA GPS, which only captures data from the 1st to the last sample.

When the pilot did not return to his home at the expected time, a ground and air search was initiated. The local police were contacted just less than 4 hours after the accident, and approximately 5½ hours elapsed between the time of the accident and the time that the Joint Rescue Coordination Centre in Victoria was notified of a possible missing aircraft. The aircraft's 121.5 MHz emergency locator transmitter (ELT) emitted a signal, which assisted the search-and-rescue (SAR) aircraft in finding the occurrence location at approximately 2000. Due to poor visibility, cloud, and heavy rain, SAR personnel could not get to the scene until the following morning.

Pilot information

The pilot held a recreational pilot permit with a valid Category 4 medical certificate. The permit was valid for single-engine, land- and seaplanes, in daytime VFR conditions. Additionally, the pilot held a glider licence originally issued in 1995. The investigation could not determine the pilot's total flying hours.

[2] All times are Pacific Standard Time (Coordinated Universal Time minus 8 hours).

Wreckage and impact information

The wreckage was found at approximately 2600 feet ASL on a steep, densely wooded mountainside, 31 nautical miles (NM) northwest of Tofino/Long Beach Airport (CYAZ), BC. The damage was consistent with a low-energy impact (Figure 2).

Few tree tops and tree limbs were broken. The average height of the trees at the occurrence site was approximately 150 feet and those nearest the aircraft had bark scarring on the lower 60 feet, primarily on the sides facing east-southeast; the aircraft's flight path to the occurrence site from CAH3 was from the east-northeast. The scarring is consistent with the NOAA GPS track, which showed the aircraft made a right turn in the last 20 seconds of flight.

Figure 2. Occurrence site on 12 February 2020, looking west (Source: TSB)

The fuel tank caps on both wing tanks were secured; both wing tanks were damaged, and no fuel was found in the tanks. The odour that remained in the fuel tanks was consistent with automotive gasoline. The fuel selector was set to BOTH. A note found on the pilot's kneeboard at the occurrence site indicated the aircraft had departed CAH3 with 87 litres (23 US gallons) of fuel. A typical air sampling flight would consume about 50 litres (13 US gallons) of fuel.

The aluminum fixed-pitch propeller remained attached to the engine crankshaft. Both propeller blades exhibited S–shaped bending and 1 blade had significant leading edge damage. The spinner was crushed. These indications are consistent with the propeller turning and the engine producing power at impact. However, precisely how much power was being produced could not be determined. During the engine examination, nothing was observed that would have prevented the engine from producing power.

A handheld GPS was recovered from the site, but the internal battery voltage no longer supported internal memory and no flight track information could be recovered.

The aircraft had an oxygen tank[3] installed with an attached nasal cannula.[4] The oxygen tank valve was in the OFF position and there was approximately 500 psi remaining.

Both the left and right control yoke tubes were broken 6 inches from their respective control yoke, which is consistent with them being fully out, or in nose-up, elevator position. The pilot and co-pilot seats and seat rails were undamaged.

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[3] The 2015 psi capacity oxygen tank was a Luxfer D tank stamped TC-3AL 139 DOT-3AL2015 BW173867 LUXFER O2△02.

[4] The nasal cannula was an Oxysaver model, connected through an Aerox flow meter.

The wing flaps were found fully retracted and the elevator trim was found in the neutral position. Because the engine had partially pulled away from the airframe, the positions of the engine controls, carburetor heat, throttle, and mixture at the time of impact could not be determined. The aircraft was equipped with a pitot heat system; however, due to the nature of the impact, the position of the switch prior to the accident could not be determined.

Aircraft information

The occurrence aircraft was a Cessna 172H manufactured by the Cessna Aircraft Corporation in 1967. It had originally been equipped with a 145-hp Continental O-300D engine. The engine was upgraded in February 2006 to a 180-hp Lycoming O-360-A4M in accordance with supplemental type certificate (STC)[5] SA4428SW. The aircraft was not certified for flight in instrument meteorological conditions nor in known icing conditions.

The fuel used in the aircraft was a mixture of 100LL aviation fuel and automotive gasoline. The investigation determined that this fuel mixture had been used by the pilot for many years. There is an available STC for automotive gasoline for this airframe and engine; however, the aircraft's technical records did not indicate that this STC had been completed.

The aircraft's last annual inspection was completed on 29 January 2019. At the time of the occurrence, the aircraft had accumulated approximately 4324 hours of total airtime.

Records indicate that the aircraft was equipped and maintained in accordance with existing regulations. Nothing was found to indicate that an airframe failure or system malfunction had occurred before or during the flight.

Meteorological information

The closest aviation weather reporting station to the occurrence site is located at CYAZ, 31 NM to the southeast. An aerodrome special meteorological report (SPECI) was issued at 1225 and indicated the following:

- winds calm;
- visibility 10 statute miles (SM) in rain showers;
- scattered clouds at 2500 feet above ground level (AGL), a broken ceiling at 3000 feet AGL including cumulonimbus clouds, and an overcast layer at 4700 feet AGL;
- temperature 6 °C, dew point 5 °C;
- altimeter setting 29.75 inHg.

According to the upper winds forecast valid at the time of the occurrence, for the altitudes between 6000 and 12 000 feet ASL, the winds were forecast to be from 280° true (T) to 230°T at 13 knots, increasing steadily to 28 knots, with temperatures decreasing from −5 °C to −17 °C. At 18 000 feet ASL, the wind was forecast to be from 220°T at 61 knots with a temperature of −28 °C.

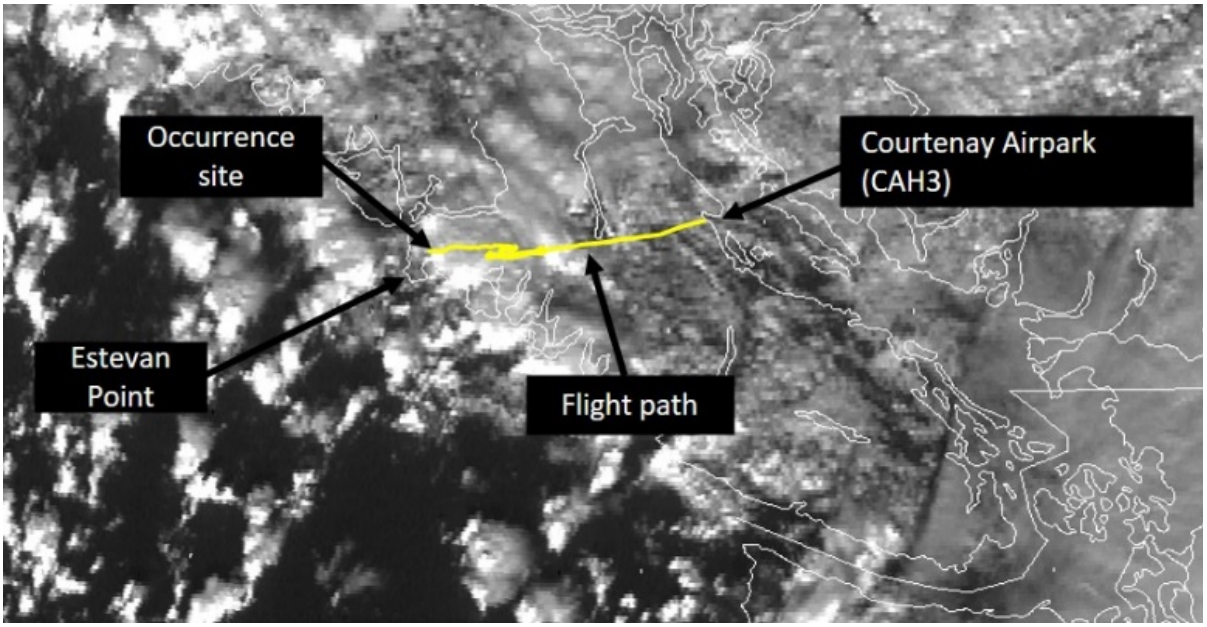
The local graphic forecast (LGF) issued on 21 December at 0946 and valid at 1000 depicted, in the area of the occurrence, broken ceilings of cumulus clouds based at 2000 to 4000 feet ASL, with tops at 12 000 feet ASL and visibility expected to be greater than 6 SM. The forecast included an expectation of occasional towering cumulus clouds with tops at 22 000 feet ASL and visibilities from 4 to greater

[5] A supplemental type certificate (STC) is a document issued by the head of a national aviation authority to record the approval of a change to the type design of an aeronautical product.

than 6 SM in light rain showers and mist. Patchy ceilings were expected from 800 to 1500 feet AGL with local visibility of 2 SM in light rain showers and mist. In addition, the LGF for the occurrence area included towering cumulus clouds with frequent isolated cumulonimbus clouds with tops at 26 000 feet ASL and visibility of 2 SM in thunderstorms and rain with wind gusts up to 30 knots. The freezing level was forecast to be at 2500 feet ASL.

Lightning strikes were recorded near the occurrence site between 1000 and 1300[6] and clouds of vertical development were observed on satellite weather imagery[7] just south of the accident site (Figure 3).

Figure 3. GOES 15 visible satellite image of clouds taken approximately 15 minutes after the accident (Source: Environment Canada, with TSB annotations)



The hazards associated with towering cumulus and cumulonimbus clouds are: tornadoes, turbulence, squall lines, microbursts, heavy updrafts and downdrafts, icing, hail, lightning, precipitation static, heavy precipitation, low ceilings and visibilities.[8]

The *Transport Canada Aeronautical Information Manual* (TC AIM)[9] describes several performance decrements when ice builds up on various areas of the aircraft. Ice on the wings can reduce lift, increase drag and reduce the angle at which the wing stalls. Ice on the propeller can reduce efficiency and create vibrations due to an imbalance. Ice on the windshield can reduce or completely block forward vision.

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6 Lightning detection daily summary issued by Environment and Climate Change Canada for the period from 2200 on 20 December 2019 to 2200 on 21 December 2019.

7 Geostationary Operational Environmental Satellite 15 (GOES 15) imagery at 1230 on 21 December 2019.

8 Transport Canada, TP 14371, *Transport Canada Aeronautical Information Manual* (TC AIM), AIR – Airmanship (26 March 2020), section 2.7.1, at https://www.tc.gc.ca/ca-publications/AIM_2020-1_E_AIR.pdf (last accessed on 08 June 2020).

9 Ibid., section 2.12.3.

Emergency locator transmitter

The aircraft was equipped with a 121.5 MHz 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 controlled flight into terrain of a Sikorsky S-76A helicopter in Moosonee, Ontario,[10] 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.

As a result, the Board recommended that:

> the Department of Transport require all Canadian-registered aircraft and foreign aircraft operating in Canada that require installation of an emergency locator transmitter (ELT) to be equipped with a 406 MHz ELT in accordance with International Civil Aviation Organization standards.
>
> **TSB Recommendation A16-01**

In its latest response, Transport Canada indicated that the regulatory process to mandate the carriage of 406 MHz–capable ELTs for Canadian registered aircraft and foreign aircraft operating in Canada continues to progress. Publication of the final amendment in the *Canada Gazette*, Part II, is expected for late spring 2020.

Provided the new requirements remain as published in the *Canada Gazette*, Part I, when fully implemented, this regulatory change will substantially reduce or eliminate the safety deficiency associated with Recommendation A16-01. However, until the regulations come into effect mandating the carriage of 406MHz–capable ELTs, the risks to transportation safety remain.

Safety messages

In this occurrence, the aircraft was flying in an area of forecasted convective cloud activity, icing, and instrument meteorological conditions. While the investigation could not determine if any of these affected the occurrence flight, it is important that pilots assess all available weather information before departure, plan alternate routes, and operate within the limitations of their aircraft and the privileges of their licenses or permits.

The Cospas-Sarsat satellite system only detects signals emitted by 406 MHz ELTs. As a result, occupants in aircraft equipped only with 121.5 MHz ELTs may be exposed to life-threatening delays in SAR service following an occurrence.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 17 June 2020. It was officially released on 30 June 2020.Visit the Transportation Safety Board of Canada's website (www.tsb.gc.ca) for information about the TSB and its products and services. You will also find the Watchlist, which identifies the key safety issues that need to be addressed to make Canada's transportation system even safer. 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.

[10] TSB Aviation Investigation Report A13H0001.

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

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