Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A06Q0157

ENGINE FAILURE

CESSNA 172M C-FFRV
MONTRÉAL, QUEBEC
10 SEPTEMBER 2006

Canada

Aviation Investigation Report

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Summary

A Cessna 172M, registration C-FFRV, serial number 17262394, with the pilot and two passengers on board, took off at 1545 eastern daylight time from Saint-Hubert Airport, Quebec, for a flight according to visual flight rules over Montréal, Quebec. About 15 minutes after take-off, when the aircraft was over the city, the engine (Lycoming O320-H2AD) lost power and stopped. The pilot tried to restart it, but without success. The pilot transmitted a distress message and quickly reported the situation to the control tower. The aircraft was approximately 1250 feet above ground level at the time. The pilot landed the aircraft on the northbound side of Parc Avenue, in Montréal. On landing, the left wing tip struck a traffic light post before the aircraft came to rest. The aircraft was substantially damaged, but there were no injuries.

Ce rapport est également disponible en français.

Other Factual Information

The pilot was certified and qualified for the flight in accordance with existing regulations. He had over 30 years of flying experience, including 22 years on this aircraft, and had about 5000 flying hours. The weather observation taken at 1600 eastern daylight time[1] was as follows: visibility 9 statute miles, light winds and a few scattered clouds.

The aircraft is registered for commercial operation and is owned by Publicité Aéro-Gramme Inc., which specializes in towing advertising banners. The company uses the Cessna 172M C-FFRV and a Piper Cub in accordance with Part VII, Subpart 2 of the *Canadian Aviation Regulations* (CARs), which applies to aerial work. However, the occurrence flight was a private flight.

The pilot did a preflight inspection before the flight. He used a transparent pipette to drain the wing fuel tanks. No contamination was observed. He then drained the gascolator. To do this on the Cessna 172, the pilot must open an inspection door on the upper right part of the engine cowling and pull the linkage. This opens the gascolator drain valve in the lower part of the engine cowling near the nosewheel strut. Due to the location of the gascolator drain valve, it was hard for the pilot to collect the fuel flowing out of it to assess its condition. Therefore, he pulled the linkage, and the fuel spilled on the ground and could not be examined.

The aircraft was built in 1974 and was fitted with long-range fuel tanks. Review of the occurrence aircraft technical maintenance records revealed that, for several years, the aircraft had been serviced by Air Quasar, an approved maintenance organization (AMO). In November 2005, the upper wing skin panels were removed so the fuel tanks could be inspected. To remove these panels, the tether chains for the fuel filler caps had to be unhooked. With the exception of a defective left tank fuel quantity indicator, no defects were noted concerning the fuel system or the condition of the fuel system components.

The most recent inspection, done on 01 May 2006, was a 100-hour overhaul. At the time of the inspection, the aircraft had accumulated 3393.3 flight hours. Examination of the aircraft technical logs indicated that the gascolator and carburetor filter screens were inspected and no defects were found.

The aircraft was examined at the accident site, and a few water droplets were initially collected from the right wing tank drain valve. The left tank could not be drained because the dented wing skin obstructed the access to the drain valve. The gascolator bowl in the engine compartment was drained, and 5 to 6 ounces of yellowish water was collected (see Photo 1).

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1 All times are eastern daylight time (Coordinated Universal Time minus five hours).

When the draining was done, the engine was started and allowed to run normally for a few minutes, then shut down. The engine test showed no problems. After the engine test, the aircraft was moved onto the sidewalk to restore vehicle traffic flow. The right fuel tank was drained again and about 2 ounces of yellowish water was collected.

Photo 1. Water from gascolator

The day after the accident, the aircraft was examined at the Saint-Hubert Airport, Quebec, and the following observations were made:

- the seals on the two fuel filler caps showed no defects;
- the left wing tank showed no evidence of water and the fuel filler cap installation was in accordance with manufacturer specifications;
- the chain used to tether the cap to the right fuel tank filler pipe was found at the bottom of the fuel tank;
- the two S-hooks on the chain showed signs of corrosion;
- debris was observed on the surface of the gascolator filter screen;
- the bottom of the gascolator bowl had stains from yellowish water;
- debris was observed on the surface of the carburetor filter screen;
- the area where the aircraft was usually parked was not level. The aircraft was always parked with a right bank angle. The right wing was about 1.5 inches lower over a distance of about 48 inches (see Photo 2).

The TSB Engineering Laboratory did an analysis of the gascolator and carburetor filter screens, the gascolator bowl and the right fuel filler cap chain. The following observations were made:

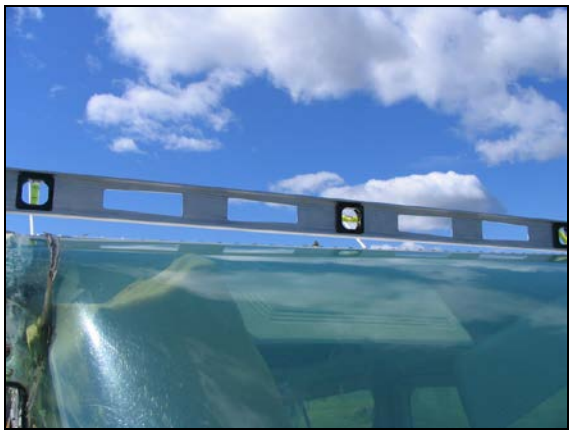

Photo 2. Aircraft out of level

- The tether chain for the fuel filler cap was in the tank long enough, perhaps several months, to allow the untreated steel hooks to corrode. This corrosion resulted in iron ions becoming dissolved in the water at the bottom of the fuel tank and on the surface of the gascolator bowl.
- The presence of a substantial layer of aluminium oxide on the inner surface of the gascolator bowl indicates that surface was in contact with water for a considerable period, probably several years.
- The aluminium gel that formed as a result of the corrosion of the gascolator bowl deposited on the mesh of the gascolator and carburetor filter screens, partially clogging them.

The aircraft's last flight was on 19 July 2006, about seven weeks before the accident. During that flight, the pilot refuelled at three locations—Saint-Hubert Airport, Rimouski, and Montmagny, Quebec. The fuel came from refuelling sources equipped with a filtration system that included water separators. No occurrences involving fuel contamination were reported during that period. After that flight, the aircraft stayed in its parking spot with its fuel tanks half-full until the day of the accident.

In October 1985, Cessna, the aircraft manufacturer, published a manual entitled *Pilot Safety and Warning Supplements*. The manual is intended for pilots as a supplement to the owner's manual or pilot's operating handbook. Section 10 of the *Pilot Safety and Warning Supplements* deals with fuel system contamination, and specifies that a full preflight inspection is recommended before each flight. It also states that the pilot must visually check the quantity of fuel with the aircraft on level ground and make sure that all of the fuel filler caps are installed and secured properly. The pilot must also ensure that the aircraft is on level ground before draining a generous sample of fuel into a transparent container. This allows any contaminants to move to the drain point. Section 10 also states that the condition of the fuel filler caps must be checked periodically. The pilot's operating handbook for more recent models advises the owner to keep the fuel tanks full between flights to reduce the possibility of condensation forming on the inside surfaces of a partly full fuel tank.

In 1992, Cessna put in place its Safety Enhancement Program for all Cessna single-engine models, including the Cessna 172. The program consisted of a series of service bulletins and was intended to modify the fuel tanks on these aircraft. Service bulletin SEB 92-26 applicable to the occurrence aircraft (C-FFRV) required that four drain valves be added to each of the long-range fuel tanks installed on C-FFRV. This service bulletin was not completed on C-FFRV. CARs do not require aircraft owners to comply with service bulletins unless they address airworthiness limitations or maintenance requirements that would become a condition for the type certificate. Only an airworthiness directive would require the owner to install the additional drain valves.

Analysis

Before take-off, the pilot did a full preflight inspection. Because the left tank fuel quantity indicator was defective, the pilot visually checked the fuel quantity in both tanks, and estimated that there was sufficient fuel for the flight planned. However, the aircraft was not level when the fuel tanks were drained, which is contrary to the manufacturer's recommendations. Since the aircraft had a right bank angle, it was impossible for the pilot to drain the water accumulated in the right fuel tank because the water was lower than the drain point. Without a level, it is hard to verify visually the aircraft bank angle. Also, it is hard to easily catch the fuel drained from the gascolator to examine it. As a result, the pilot drained the contents of the gascolator onto the ground without properly examining it.

The pilot took off with the conviction that the fuel system had been drained correctly and that there was no contamination. About 15 minutes after take-off, while the aircraft was in cruise flight, in a left turn, the water in the right tank shifted and entered the engine fuel supply system, causing the engine to stop.

Water may be present in the fuel tanks for the following reasons:

- inadequate refuelling source;
- a leaky fuel filler cap seal;
- an improperly secured fuel filler cap when it rains or when the aircraft is washed; or
- condensation on the surface of a partly full fuel tank.

In this occurrence, the refuelling sources used on previous flights were equipped with a filtration system that included water separators. With the exception of the right fuel filler cap chain being unhooked from the fuel filler cap, the two fuel filler caps showed no defects related to their seals. It is therefore possible that water entered via an improperly secured fuel filler cap when it rained or that water formed by condensation. With the aircraft parked for about seven weeks with its fuel tanks half full, conditions were conducive to water condensation.

Analysis of the gascolator bowl showed that it had been in contact with water for a considerable period of time, probably several years. Since the aircraft was parked in the same place with a right bank angle most of the time, the quantity of water in the right fuel tank was undetectable. It is possible that a small quantity of residual water that was not drained from the fuel tanks made its way from the right fuel tank to the gascolator bowl in flight and stayed there until the next draining. The accumulated quantity of water that migrated during the occurrence flight saturated the gascolator bowl, causing the engine to stop.

The chain found in the right fuel tank was examined, and surface corrosion was found on the hooks; that corrosion may have formed over a period of several months. The chain may have fallen into the fuel tank when the tank compartments were inspected in November 2005. Since then, the fact that the chain was missing was not noticed by the aircraft maintenance engineer doing the periodic inspection in May 2006 nor by the pilot on subsequent preflight inspections.

The aircraft had only one drain point per tank, as built in 1974. In this occurrence, adding the additional drain valves as specified in service bulletin SEB 92-26 would have allowed the water accumulated in the right fuel tank to be drained properly. CARs do not require aircraft owners or operators to comply with service bulletins to maintain the airworthiness of aircraft. Only an airworthiness directive would have required the owner to add the additional drain valves.

The following TSB Engineering Laboratory report was completed:

LP094/2006 – Examination of Gascolator

This report is available from the Transportation Safety Board of Canada upon request.

Findings as to Causes and Contributing Factors

1. The aircraft was not on level ground when the draining was done before the flight. Consequently, the water in the fuel tank was lower than the drain valve and could not be removed with the pipette.

2. The water accumulated in the right fuel tank migrated to the gascolator bowl, saturating it, and causing the engine to stop.

Findings as to Risk

1. The inspections done by the approved maintenance organization and the pilot did not find that the fuel filler cap chain for the right fuel tank was missing. As a result, the chain was exposed to the water in the bottom of the tank, and the fuel was contaminated by corrosion from the chain hooks.

2. On the Cessna 172, the location of the gascolator drain valve makes it hard to collect fuel for visual examination before flight.

3. The *Canadian Aviation Regulations* do not require aircraft owners to comply with service bulletins. As a result, service bulletin SEB 92-26 was not completed on C-FFRV. This upgrade would have made it possible to properly drain the water that had accumulated in the right fuel tank before the flight.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 29 October 2007.

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