Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

# AVIATION INVESTIGATION REPORT
# A00C0162

## LOSS OF CONTROL—COLLISION WITH TERRAIN

## PIPER PA-25-150 C-GSRG
## HARDING, MANITOBA
## 17 JULY 2000

Canada

# Aviation Investigation Report

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## *Summary*

The pilot was operating a Piper PA-25-150 spray aircraft, which he had refuelled and reloaded with chemical at the Rivers, Manitoba, airport. He took off and flew about 10 nautical miles southwest and completed three passes applying fungicide to a wheat field when the engine abruptly lost all power. He applied carburettor heat and attempted to restart the engine, but it did not respond. As the pilot turned in an attempt to reach a gravel roadway, the aircraft stalled, descended, and crashed into a farm field. At impact, a fuel-fed fire ensued, and the pilot suffered serious burns as he climbed from the aircraft. He was transported to hospital by a neighbouring farmer. The aircraft was destroyed by fire.

*Ce rapport est également disponible en français.*

# *Other Factual Information*

On the morning of the occurrence, the pilot sampled the fuel from the gascolator drain on the aircraft and determined that the samples were free of water. He then attempted to conduct spraying operations, but he stopped spraying because of turbulent conditions. In the evening, the pilot loaded the aircraft with a full hopper of chemical mix and approximately 30 gallons of fuel, then flew to the field to complete the spraying. The accident occurred at 2030 central daylight time,[1] on the second-last pass that remained to finish spraying the field.

The pilot had refuelled his aircraft from a fuel supply tank installed on his pickup truck. The fuel from the supply lines of this tank was sampled and found to be free of contamination. The tank was labelled as aviation-grade 100 low lead; the fuel samples were consistent with the labelling. The fuel tank was equipped with a no-go filter, and the system pumped clean fuel without difficulty when tested.

When the engine lost power, the aircraft was flying approximately 300 feet above ground level, at an approximate airspeed of 90 knots. As the pilot turned in an attempt to reach a local farm road, he pulled the cockpit carburettor heat control to the full-heat position and tried to restart the engine. Although the propeller continued rotating, the engine did not respond. The pilot attempted to maintain sufficient altitude to reach the road, and the airspeed decreased to the aircraft's stalling speed.

Inspection of the aircraft wreckage at the accident site indicated that the aircraft had remained intact until ground contact. All primary flight controls maintained their integrity. The aircraft struck the ground in a left-wing-low and slightly nose-down attitude, cartwheeled, and slid rearwards, coming to rest in an upright position on its belly. The propeller was pulled from the engine. Some of the engine-mount structure failed, allowing the engine to partially separate and move downwards and away from the engine firewall. The chemical hopper and the fibreglass fuel tank ruptured when the aircraft struck the ground. Fuel from the ruptured fuel tank ignited from contact with hot exhaust or arcing from shorted electrical wiring in the engine compartment.

The aircraft was originally designed with, and was being operated with, a fibreglass fuel tank. The aircraft was not equipped with a fuel tank bladder, which was recommended by the aircraft manufacturer (Piper Aircraft Service Bulletin No. 878, dated 18 January 1988). The fuel tank bladder was recommended to mitigate the effects of impact damage to the fibreglass fuel tank in the event of an accident, but no airworthiness directives had been issued to make the installation mandatory. Responding to similar post-accident fires, Transport Canada issued Service Difficulty Report AL-91-08, dated 16 December 1991, which "strongly recommended" that owners and operators of Piper PA-25 aircraft replace original fuel tank assemblies with the ones specified in Service Bulletin No. 878. Additionally, Transport Canada referenced Service Bulletin No. 878 in an article included in *Aviation Safety Maintainer,* issue 3/92.

The throttle and mixture controls maintained their integrity. The carburettor heat control cable failed between the control arm and the outer shielding of the carburettor heat cable. The carburettor heat control is equipped with a spring-loaded detent at the full-heat and full-cold selections. The severed end of the control cable remained securely attached at the control arm, and the butterfly valve of the heat control was found in a neutral position, approximately midway between the detents.

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[1] All times are central daylight time (Coordinated Universal Time minus five hours).

During impact, the upper portion of the carburettor heat box was bent downwards in a V-shape, intruding into the travel path of the carburettor butterfly valve. While this bending of the carburettor box would have resulted in a movement of the carburettor heat control valve from a full-heat selection toward a neutral selection, there were no marks evident to indicate that the heat box material had contacted the valve. It is probable that the cable failed as the pilot moved the carburettor heat control from a full-cold toward a full-heat selection.

The fracture faces of the failed carburettor heat control wire were exposed to the effects of post-impact fire, which masked some of the characteristics of the failure, but it was evident that the wire had been pre-weakened by the effects of fatigue cracking. Additionally, the control wire showed signs of a uniform and repetitive wear pattern, reducing the dimension of the cable at several locations along the control wire. The fractured portions of the control wire, along with a section of the cable outer shielding, were sent to the TSB Engineering Branch for confirmation of the mode and manner of failure. Inspection and analysis determined that vibrational contact between the control wire and the inner diameter of the wire-wound outer shielding resulted in the repetitive wear sites on the control cable. The fatigue cracking of the control wire initiated in one of these wear sites, and the fatigue continued until the weakened wire failed in overload. The wear in the carburettor heat control cable wire probably went undetected when the aircraft annual inspection and certification was completed, approximately 60 flight-hours before the occurrence.

A teardown and inspection of the engine did not reveal any anomalies that would have caused a complete loss of engine power. All four cylinders were producing compression, there were no internal mechanical failures of the main or accessory drive trains, and the magnetos were capable of providing appropriately timed electrical sparking after the accident.

The closest weather reporting station is located at Brandon, Manitoba, approximately 25 nautical miles southeast of the accident site. At 2000, the reported temperature was 15 degrees Celsius (°C), and the dewpoint was 7°C. At 2100, the temperature was 13°C, the dewpoint 9°C. At 2100, at Dauphin, about 78 nautical miles northeast of the accident site, the temperature was 13°C, the dewpoint 8°C. When these temperatures and dewpoints are plotted on the carburettor icing chart found in Transport Canada's *Aeronautical Information Publication,* the readings indicate that these conditions can produce serious icing at any power setting. Harding, where the accident occurred, is northwest of Brandon and southwest of Dauphin. Similar temperature and dewpoint conditions would have existed at Harding at the time of the occurrence.

## *Analysis*

The engine teardown and analysis did not reveal any mechanical condition that would have resulted in a complete loss of engine power. The fuel-fed fire at the accident site indicated that ample fuel was available, and the aircraft's fuel source was found to be clean and of the required grade. The loss of engine power likely did not result from mechanical failure, fuel contamination, or fuel exhaustion.

It is likely that the carburettor for this aircraft became contaminated by carburettor ice to a degree that the engine lost power. The aircraft was operating under conditions that were conducive to serious carburettor icing at all power settings. Carburettor icing is not immediately resolved when carburettor heat is applied; time is required for the carburettor heat to melt the ice away. The carburettor heat valve was found in a neutral position, either as a result of impact damage or as a result of cable failure when the carburettor heat was selected. The engine lost power when the aircraft was 300 feet above ground level. A neutral position of the carburettor heat valve would extend the time required to clear any ice from the carburettor; however, given the low altitude, it is unlikely that a full application of carburettor heat would have cleared the ice from the carburettor in sufficient time for the pilot to avoid ground contact.

Because the failure site and several of the wear sites on the carburettor heat control wire were located at a position that would be extended beyond the cable outer shielding when carburettor heat was applied, it is probable that the wear on the cable was not detected during the annual inspection.

The pilot continued to turn and stretch his glide in an attempt to reach a nearby roadway. This caused the airspeed to reduce to the point where the aircraft entered an aerodynamic stall and descended in an uncontrolled manner to the ground. It is probable that the impact forces would have been greatly reduced if the pilot had landed the aircraft straight-ahead, in a controlled manner, on the wheat field.

The following Engineering Branch Laboratory Report was completed:

LP 89/00—Carburettor heat control cable.

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

## *Findings as to Causes and Contributing Factors*

1. The aircraft engine lost power, likely as a result of carburettor icing.

2. Following the loss of power, the pilot allowed the airspeed to decrease to the point that the aircraft stalled and descended uncontrollably to the ground.

3. From the altitude at which the loss of power occurred, it is unlikely that carburettor icing could have been cleared with full carburettor heat applied.

## *Findings as to Risk*

1. The carburettor heat cable was weakened by fretting wear and the effects of fatigue. This weakening caused the cable to fail, either in a neutral position during impact or as the pilot applied carburettor heat.

2. The fretting wear of the carburettor heat cable probably went undetected when the aircraft was inspected and certified for an annual inspection, approximately two months and 60 flight-hours before the occurrence.

3. The aircraft was not equipped with an optional post-production fuel bladder kit, recommended on 18 January 1988 by the aircraft manufacturer.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 26 April 2001.*