AVIATION OCCURRENCE REPORT

CRASH ON TAKE-OFF

PIPER MALIBU PA-46-350P C-FLER
ST-MATHIEU-DE-BELOEIL AIRPORT, QUEBEC
22 OCTOBER 1997

REPORT NUMBER A97Q0222

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Summary

A Piper Malibu Mirage, registration C-FLER, serial number 46-36090, was preparing for an instrument flight rules (IFR) private business flight from St-Mathieu-de-Beloeil Airport, Quebec, to Burlington, Vermont, USA, with two persons on board. The pilot/owner and passenger moved the aircraft out of the hangar and did the usual preparations and checks. After doing the run-up, the pilot listened to the automatic terminal information system (ATIS) message from Saint-Hubert, Quebec, and requested IFR clearance. When the tower advised him that there would be a delay of about 10 minutes, the pilot taxied back to position the aircraft on the threshold of runway 15. At that time, heavy snow had been falling for over two hours. After waiting 11 minutes, the pilot received IFR clearance and initiated take-off. The aircraft lifted a few feet off the ground, then bounced and came to rest in a cornfield several hundred feet from the runway end. The pilot shut off electrical power, fuel and the magnetos, and the two occupants evacuated the aircraft. There was no post-impact fire. The occupants sustained minor injuries, and the aircraft sustained substantial damage.

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 was the owner of the aircraft and had about 1,600 flying hours at the time of the occurrence, including about 850 hours on type. He had held a private pilot's licence since 1994, with
multi-engine rating, night flying rating, and group 3 (single-engine) instrument flight rating since November 1996. The pilot had 300 IFR flying hours at the time of the occurrence.

Examination of the aircraft log books indicated that the aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The aircraft had about 200 hours of flight since it was built in March 1997, and was in compliance with all airworthiness directives. The aircraft had flown about five hours since its last 100-hour inspection, and it had no known deficiencies before the flight. The weight and centre of gravity were within the prescribed limits.

The pilot received a full weather briefing from Dorval Flight Service Station (FSS) at 2000, eastern daylight time (EDT), on the evening before the flight. The next morning, snow began to fall about two and a half hours before the start of the flight and accumulated at a rate of approximately four centimetres per hour. The Environment Canada report for the Saint-Hubert area at 0800 indicated a sky obscured at 300 feet, visibility three quarters of a mile in light snow, temperature 0 degrees Celsius, and dew point minus 1 degree Celsius. The winds were from
350 degrees magnetic at 3 knots.

The aircraft was stored in an unheated hangar when not in use. On the morning of the flight, the pilot checked the aircraft and fuel before moving the aircraft out. He reported that wet snow was falling. The pilot indicated that despite the snow accumulation on the runway he had no particular problem taxiing into position for take-off.

About 20 to 25 minutes elapsed between the time the aircraft was moved out of the hangar and the take-off from runway 15. Part of the delay was the 11 minutes it took to receive IFR clearance from the Saint-Hubert control tower. During that time, the pilot noticed that snow had accumulated on the wings. However, the pilot stated that it dissipated as he increased and decreased power while taxiing. When he received IFR clearance, the pilot initiated the take-off run with 10 degrees of flap. At 60 knots, the pilot noticed that the snow had blown off the wings. He used three quarters of the runway length, as he normally did.

The aircraft lifted off only a few feet, and the pilot heard engine misfires and dull thuds and felt the whole aircraft shaking. The engine was not producing enough power to take off, and the aircraft struck the ground with the main gear, bounced a few feet, then struck the ground again, causing the main gear to separate. The aircraft continued its course and came to rest in a cornfield, 450 feet from the end of the runway. The passenger reported feeling severe vibrations two or three seconds after take-off. He said he also heard an audible warning and saw a warning light at the same time.
The aircraft sustained substantial damage in the crash sequence. The wings remained attached to the fuselage.

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[1] All times are EDT (coordinated universal time (UTC) minus four hours) unless otherwise noted.

The flaps were extended 10 degrees. The landing gear was down but the wheels had separated from the oleo shock struts and the main gear doors were torn off. The fuel tanks were full and undamaged. Flight control continuity was established, including the engine and propeller controls.

Various static checks were done on the systems and engine components. Dynamic engine testing was done at 800 to 2,500 rpm with an intake pressure of 25 inches of mercury (Hg). The checks performed on the engine and accessories revealed no technical deficiencies that could have affected take-off performance. However, the engine air filter was saturated with water to over three quarters of the thickness. Atmospheric conditions were conducive to the accumulation of water in the air filter but, based on discussions with pilots experienced on this type of aircraft and with Piper representatives, it was concluded that water accumulation in the air filter is not a common problem on this type.

For operating requirements, the engine breathes in air via either the primary system or the alternate system. The pilot selects one of the two systems using a control on the centre console just below the engine controls. The primary system filters the air before directing it into the engine; the alternate system does not filter the air. The Pilot's Operating Handbook for the Malibu states that "alternate air should never be used during ground operations, except for checking its operation," because the engine could ingest debris and be damaged.

The TSB Engineering Branch was asked to do a theoretical analysis to estimate the minimum runway length required to take off in the weather conditions at the time of the accident, since that information is not provided in the Pilot's Operating Handbook. For the purposes of the analysis, the Engineering Branch assumed that taking off on a runway covered with two inches of wet snow is as unfavourable as taking off on a runway covered with long grass. The analysis showed that just to reach take-off speed the aircraft would need 1,900 feet on a short-grass runway and 2,500 feet on a long-grass runway. The runway at St-Mathieu-de-Beloeil is 2,200 feet long.

Airworthiness Notice No. B017, Edition 1 issued by Transport Canada regarding the clean aircraft concept, states that "test data indicate that frost, ice or snow formations having a thickness or roughness similar to medium or coarse sandpaper, on the leading edge and upper surface of a wing, can reduce wing lift by as much as 30% and increase drag by 40%. The changes in lift and drag significantly increase stall speed, decrease controllability and alter aircraft flight characteristics. Thicker or rougher frozen contaminants can have increasing effects." In addition, subsection 602.11(4) of the *Canadian Aviation Regulations* states:

> Where conditions are such that frost, ice or snow may reasonably be expected to adhere to the aircraft, no person shall conduct or attempt to conduct a take-off in an aircraft unless (a) the aircraft has been inspected immediately prior to take-off to determine whether any frost, ice or snow is adhering to any of its critical surfaces.

The Transport Canada study and reference guides for instrument flight qualification list several subjects which pilots must be taught during theoretical courses. These subjects include icing, surface contamination, the clean aircraft concept, cold-soaked aircraft phenomena, pre-take-off inspection, aircraft operations in winter, and the effects of snow, ice and frost on the take-off run and landing.

Analysis

The pilot was certified and qualified for the flight in accordance with existing regulations. The aircraft was airworthy and had no known deficiencies before the flight, and the engine was capable of producing maximum power.

The pilot stated that the engine misfired as the aircraft left the ground. The actual causes of the engine misfires could not be determined, but the atmospheric conditions at the time of the accident were conducive to the formation of frost or ice. The filter in the engine air intake system was found to be saturated with water to over three quarters of its thickness, it is possible that the filter froze during the take-off run and blocked the supply of air to the engine. The pilot did not select the alternate air intake system when the engine misfired because the Malibu Pilot's Operating Handbook does not suggest that this be done while operating on the ground.

On the day of the flight, snow had begun to fall two hours before the aircraft took off. The runway was contaminated with wet snow. Although the pilot did not notice any impediment on the manoeuvring areas and he said he executed the rotation at the usual location, a contaminated runway will in all cases extend the take-off run.

Between 20 and 25 minutes elapsed from the time the pilot moved the aircraft out of the hangar to the take-off. When initiating the take-off, the pilot did not inspect the critical surfaces of the aircraft as prescribed in the *Canadian Aviation Regulations*. He supposed that if the snow dissipated from part of the wings when he accelerated on the ground the same thing would happen on all other critical surfaces.

Immediately after leaving the ground, the entire aircraft shook severely and an audible alarm and warning light activated. These indications show that the aircraft had not attained the speed necessary to sustain flight, even in the ground effect, and it stalled. The pilot was in a situation where the outcome was unavoidable due to the runway length available.

Findings

1. The pilot was certified and qualified for the flight.

2. Examination of the aircraft log books indicated that the aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures.

3. The weight and centre of gravity were within the prescribed limits.

4. The air intake filter was contaminated by water to three quarters of its thickness.

5. The runway was contaminated by a two-hour accumulation of wet snow.

6. The pilot initiated the take-off without checking if the critical surfaces were contaminated by wet snow.

7. The aircraft stalled on take-off just after the rotation.

Causes and Contributing Factors

The aircraft was not producing sufficient lift to sustain flight and it stalled immediately after the rotation for take-off. The following factors may have contributed to the accident: a runway contaminated by wet snow; an aircraft contaminated by precipitation; and engine misfires, which may have been caused by a filter saturated with water.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 18 May 1999.