AVIATION OCCURRENCE REPORT

WIRE STRIKE ON TAKE-OFF

PIPER AZTEC PA23-250 C-GFNT
SQUAW LAKE, QUEBEC
22 AUGUST 1997

REPORT NUMBER A97Q0183

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Summary

The float-equipped Piper Aztec, serial number 274191, with three occupants on board, was on a private business flight from Squaw Lake, Quebec, to Dick Lake, Quebec, under visual flight rules. The pilot first tried to take off northward, but had to abort the take-off because a fuel tank cap was open. A few moments later, he began the take-off run southward; the aircraft travelled about 8,000 feet before becoming airborne. The aircraft did not attain a high rate of climb, but continued its flight at about 100 feet above the trees. The Flight Service Station (FSS) specialist, who was following the aircraft visually, noticed a brief power outage at his work station, then saw a cloud of smoke rising on the horizon. He tried unsuccessfully several times to contact the aircraft by radio. He then asked a helicopter flying over the area to go to the source of the smoke and check whether an accident had occurred. The helicopter pilot arrived a few minutes later, and confirmed that the aircraft had crashed after striking a high-voltage line.

An intense fire then erupted, and the aircraft sustained substantial damage. The pilot was able to evacuate the aircraft by the left forward door, passing through the flames and suffering serious injuries. The two passengers were unable to evacuate the aircraft, and they were fatally injured.

Ce rapport existe également en français.

Other Factual Information

The pilot was certified and qualified for the flight in accordance with existing regulations. He had approximately 13,000 flying hours, including approximately 3,000 hours on multi-engine aircraft and 800 hours on type.

According to the records, the aircraft was certified, equipped and maintained in accordance with existing regulations and approved procedures. There was no evidence of any airframe failure or engine or system malfunction on take-off. The aircraft had no known deficiencies before the flight.

The pilot had little rest in the 48 hours before the flight. He had been busy preparing his hunting camps for the season that was just opening. Logistics and monitoring his employees took a great deal of his time. He had slept for only about three hours on each of the two nights preceding the flight.

> A person who does not get as much sleep as he needs will suffer from sleep deprivation and degraded performance. Cognitive tasks or those requiring alertness are especially affected. A person who is fatigued is also more willing to take risks: repeated lack of sleep and circadian disruption can lead to reduced alertness, degraded performance and mood impairment.

Section 602.02 of the *Canadian Air Regulations* states the following:

> No operator of an aircraft shall require any person to act as a flight crew member and no person shall act as a flight crew member, if either the person or the operator has any reason to believe, having regard to the circumstances of the particular flight to be undertaken, that the person (a) is suffering or is likely to suffer from fatigue; or (b) is otherwise unfit to perform properly the person's duties as a flight crew member.

On the morning of the occurrence, the pilot left his home in Saint-Nicéphore, Quebec around 6 o'clock for Dorval Airport, Montreal, to take a commercial flight to Schefferville, Quebec. From Schefferville he was to fly his private aircraft to take two of his employees, who were cooks, to two different camps, with their personal effects, food and equipment for the camps. The clients, who were also going to the same camps, had already taken off and were en route to their destinations.

The weather observations taken by the FSS specialist at Squaw Lake at 1218, eastern daylight time, a few minutes after the occurrence, were as follows: winds from 120° true at three knots, and visibility 15 miles. The cloud layer consisted of a few clouds at 3,000 feet, and the ceiling was estimated at 20,000 feet with broken clouds. The temperature was 18 degrees Celsius (°C), the dew point 4°C and the altimeter setting 30.20. The

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[1] Mark R. Rosekind, Philippa H. Gander, et al., *Crew Factors in Flight Operations X: Alertness Management in Flight Operations*, NASA technical memorandum, DOT/FAA/RD-93/18,(NASA Ames Research Center, 1994).

[2] All times are EDT (coordinated universal time (UTC) minus four hours), unless otherwise stated.

clouds were cumulus with an opacity of five eighths, and cirrus with an opacity of three eighths. According to the pilot, there was a light tail wind on the take-off toward the south.

The aircraft was loaded at the Air Saguenay dock. Both internal tanks were filled to capacity, while the level in the two external tanks was about one inch from the bottom. While the pilot was busy preparing the aircraft for the flight, two of his employees loaded the baggage on the aircraft. No baggage or cargo was weighed on the scale available on the Air Saguenay dock. According to the information obtained, two weight and centre of gravity estimates were calculated; they are appended. The first estimate was calculated using the weight as evaluated by the pilot; this evaluation shows that the aircraft was not overloaded and that the centre of gravity was within the envelope. The maximum zero fuel weight, which is 4,400 pounds, was exceeded by 113 pounds (see Appendix A). A second evaluation was done according to the statements of the employees who loaded the aircraft. According to that evaluation, the aircraft was overloaded by 322.5 pounds, and the centre of gravity was 5.97 inches aft of the aft limit, and outside the envelope. In that configuration, the maximum zero fuel weight was exceeded by 630.5 pounds (see Appendix B).

In an aircraft, the position of the centre of gravity plays a very important role in longitudinal stability. If the aircraft is loaded so that the centre of gravity is too far aft, the aircraft will tend to adopt a nose-up attitude rather than nose-down. Inherent stability will be lacking, and even though it is possible to correct this situation by moving the elevator down, longitudinal control of the aircraft will still be difficult, or impossible in some cases. Weight affects the aircraft's stall speed. Additional weight forces the aircraft to maintain a greater angle of attack to produce the lift necessary to sustain flight. Thus the critical angle of attack will be attained at a higher speed. The greater the angle of attack, the greater the drag will be. At a specific angle of attack, the aircraft enters the slow flying range. In the slow flying range, if the angle of attack is increased, lift does not increase further; on the contrary, it decreases, and drag increases. A slight increase in angle of attack may result in a stall. During initial training, pilots are trained to recognize the symptoms of slow flying, especially to avoid this phase of flight, and thereby to avoid a stall. There are several conditions where an aircraft may encounter the slow flight speed range. Some of these conditions are: take-off, landing, recovering from a misjudged landing, an overshoot, and an approach to a stall.

Squaw Lake is oriented northwest/southeast and is about two and a half miles long (see Appendix C). To the southeast, at the end of the lake, there is a valley between two hills. The elevation of the lake is 1,616 feet above sea level (asl), whereas the elevation at the first point of impact of the aircraft was 1,800 feet asl. The aircraft apparently covered about 8,000 feet before lifting off, and apparently flew for about 8,000 feet before striking the ground. The pilot stated that he realized that the aircraft was not achieving its usual performance during the initial climb. During the take-off run, the aircraft travelled for a longer than normal distance before taking off. The pilot attributed that situation to the tail wind. Normally, once the aircraft was flying, the pilot lowered its nose to retract the flaps and allow the aircraft to accelerate at the best rate of climb. In this case, the pilot could not retract the flaps because of the shoreline and the obstacles that were quickly approaching. He pulled back on the controls and tried to gain altitude while maintaining a speed of approximately 80 mph, with the flaps still down 15 degrees. The pilot attempted to clear the obstacles on his flight path, but when the high-voltage wires appeared ahead, he could not take evasive action to clear the obstacle. The aircraft struck the high-voltage lines and a wooden pole, then went nose down and pivoted around the pole before crashing on the ground. An intense fire broke out after the aircraft came to rest.

According to the owner's manual for the Piper Aztec, the climbing speed recommended for maximum weight configuration is 120 mph. At that speed, the aircraft is capable of a rate of climb of 1,490 feet per minute. The speed at the best angle of climb, used to clear an obstacle at the end of the runway, is 107 mph.

According to an experienced pilot with many flying hours on the same float-equipped aircraft type, when loaded to the maximum weight of 5,200 pounds, with the flaps at 15 degrees, the aircraft requires a distance of about 3,000 feet for take-off. For example, on a lake a mile and a half long, if the aircraft does not lift off within the set limits, the loading must be revised to distribute the weight better, and the floats must be checked to make certain they do not contain any water. According to this pilot, the most critical factor is not to exceed the 150-pounds limit in the aft baggage hold, so as not to move the centre of gravity aft outside the envelope; that would cause the aircraft to be nose-up, both during the take-off run and when airborne.

Examination of the wreckage showed that the fuel on board the aircraft flowed toward the centre of the aircraft, helping the fire spread quickly and contributing to the almost total destruction of the aircraft. Due to the fire damage, no evidence could be found as to whether any of the aircraft systems malfunctioned in flight or there was a structural failure of the airframe or other aircraft components. It was impossible to confirm the flight controls integrity. However, the pilot confirmed that the aircraft had no known or suspected deficiencies before the flight.

The initial information suggested that there had been a loss or reduction in power in one of the engines during the initial climb; that would explain why the aircraft was unable to gain sufficient altitude to clear the obstacles. The damage observed to the engines and propellers is consistent with an impact at high power. The engines and propellers were sent to the TSB Engineering Laboratory for analysis. The results of the analysis showed that both engines were producing power; that was confirmed by the pilot.

Analysis

The pilot had not taken enough rest in preparation for the flight he was to undertake. He had not allowed enough time to prepare his camps for the hunting season, placing himself under pressure. He was highly stressed because of the very tight schedules he had set for himself. The pilot, pressed for time, did not check the cargo weight on the scale available on the Air Saguenay loading dock. He decided to take off with an aircraft that was overloaded and whose centre of gravity was too far aft. Knowing that his clients were already flying to the camps, and that the cooks had not yet arrived, led him to be determined to take off on his second attempt. The aircraft used a greater than normal distance before lifting off. At any time during this second attempt, the pilot could have aborted the take-off run and revised his load, but he decided to continue.

The aircraft took an abnormally long distance before rising out of the water because of its nose-up attitude, caused by the fact that the centre of gravity was outside the envelope and displaced aft, and because of the excess weight. This nose-up attitude of the floats in the water caused drag that prevented the aircraft from accelerating during the take-off run within the normal distance. After 8,000 feet of take-off run, which is over twice the distance normally required, the aircraft lifted off, partly due to the ground effects phenomenon. The observed behaviour of the aircraft on take-off suggests that the estimates of the aircraft's weight by the pilot and the employees were too low. Then the pilot, seeing the approaching obstacles on the shoreline, pulled back on the controls to try to clear them. The aircraft was travelling at 80 mph, which is well below the recommended climb speed of 120 mph, and even below the speed for the best climb angle of 107 mph. Due to its configuration, the aircraft stall speed was higher than normal. It can thus be concluded that the aircraft was in the slow flying range. The more the pilot pulled back the controls, the greater the drag. Thus the aircraft could not attain a climb rate sufficient to clear the obstacles on its flight path, and it struck the high-voltage lines and a pole.

The following laboratory report was completed:

LP 138/97 - Engine & Propellers Examination, Aztec PA-23-250, C-GFNT.

Findings

1. The pilot did not allow enough time to prepare his camps for the hunting season, thereby putting pressure on himself.

2. The pilot was fatigued, because he did not take enough rest in preparation for the flight.

3. The aircraft was overloaded, and the centre of gravity was outside the envelope.

4. The aircraft covered a longer than normal distance before lifting off.

5. The pilot did not abort the second take-off and decided to continue the flight rather than revise the loading in accordance with the recommended weight and centre of gravity.

6. Just before the occurrence, the aircraft was in the slow flying range, and it therefore could not attain a rate of climb sufficient to clear the obstacles on its flight path.

Causes and Contributing Factors

Due to its excessive weight and its centre of gravity outside the envelope, the aircraft lifted off only after a long run, and it could not maintain a rate of climb sufficient to clear the obstacles on its flight path. Contributing to the occurrence were the pilot's stress, disorganization and fatigue.

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 H. Simpson and W.A. Tadros, authorized the release of this report on 10 February 1999.

Appendix A - Weight and Centre of Gravity (according to the pilot's data)

	Weight (lb.)	Arm (in.)	Moment
Aircraft empty weight	3,572	91.147	325,577.08
Rear seat (removed)	-45	157	7,065
Fuel	432	113	48,816
Row 1 - Pilot and Passenger	340	89	30,260
Row 2 - Passenger, Maps and HF radio	154	126	19,404
Row 3 - Cargo	422	157	66,254
2 outboard motor fuel tanks, Float compartment	10	92.58	925.8
Aft cargo position	60	183	10,980
Total	**4,945**	**100.132**	**495,151.9**
Mass without fuel	4,513		
Maximum mass without fuel	4,400		
Overload	113		
Maximum take-off weight	5,200		
Overload	00		
Centre of gravity position		-0.37	within the envelope
LOAD			
Rear Seat Position			
3 ten-hp outboard motors	222		
6 boxes of food	80		
2 hockey bags	120		
Total	**422**		
Cargo Position			
1 generator (Coleman)	35		

1 tin stove	25
Total	**60**
Total cargo	**482**

Appendix B - Weight and Centre of Gravity (according to the employees' data)

	Weight (lb.)	Arm (in.)	Moment
Aircraft empty weight	3,572	91.15	325,587.8
Rear seat (removed)	-26	157	4,160.5
Fuel	492	113	55,596
Row 1 - Pilot and Passenger	362	89	32,218
Row 2 - Passenger	140	126	17,640
Row 3 - Cargo	688	157	108,016
Float compartments	10	92.58	925.8
Aft cargo position	285	183	52,155
Total	**5,522**	**106.47**	**587,978.1**
Mass without fuel	5,030		
Maximum mass without fuel	4,400		
Overload	630		
Maximum take-off weight	5,200		
Overload	322		
Centre of gravity position		5.97	aft of the envelope

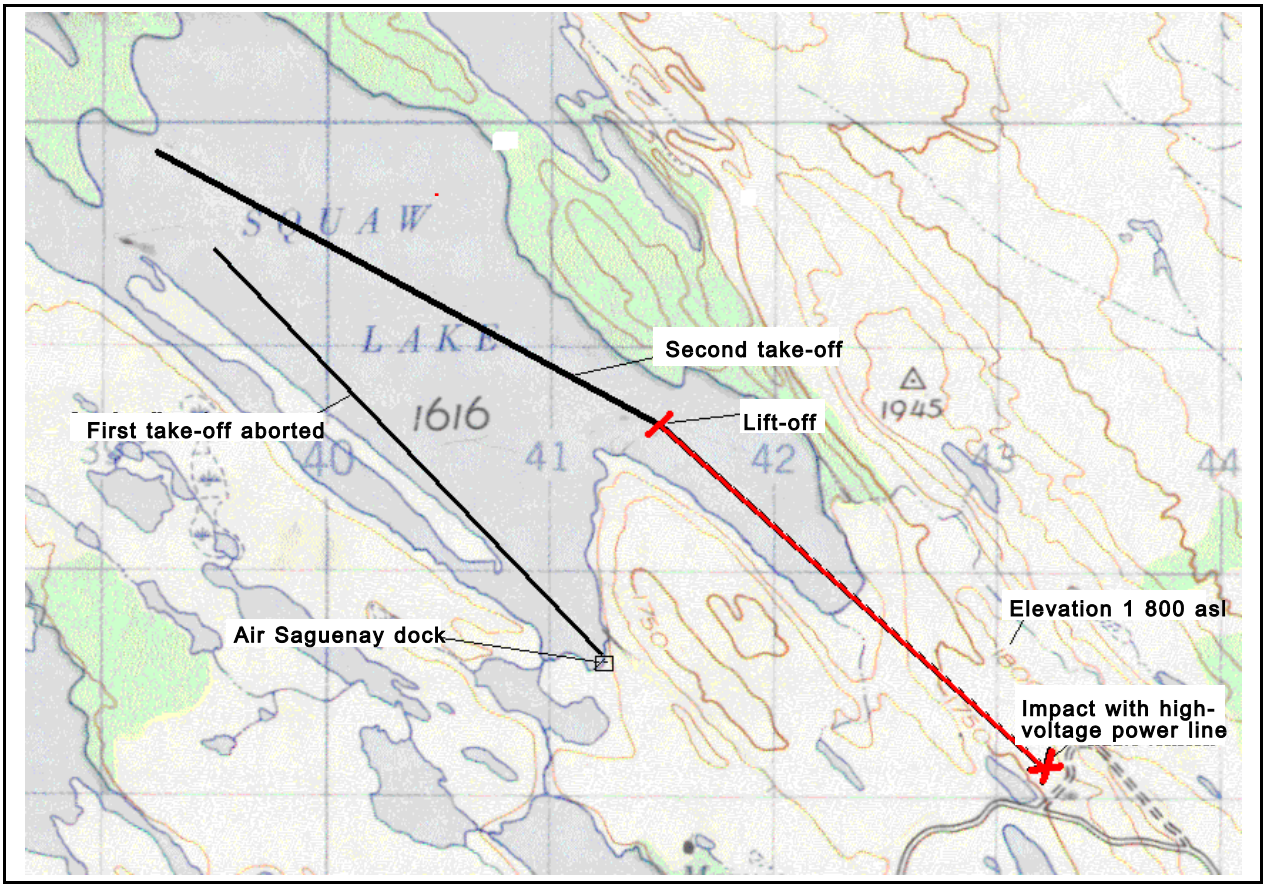
LOAD

Rear Seat Position

3 ten-hp outboard motors	216
6 bags (5 to 10 lb. each)	60
Radiator and radio	37
5 boxes of food (75 lb. each)	375
Total	**688**

Cargo Position

1 generator (Coleman)	85
2 hockey bags	200



Total	285
Total Cargo	973

Appendix C - Topographical Map of Squaw Lake, Quebec