

AVIATION OCCURRENCE REPORT

A98Q0007

ENGINE FIRE AND CRASH ON TAKE-OFF

AIR NUNAVUT LTD.

PIPER PA31-350 NAVAJO CHIEFTAIN C-FDNF

SANIKILUAQ, NORTHWEST TERRITORIES

20 JANUARY 1998

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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### *Summary*

The Piper Navajo Chieftain PA31-350, serial number 31-8252042, was on an instrument flight rules (IFR) flight from Sanikiluaq to Iqaluit, Northwest Territories. Two pilots and two passengers were on board. After checking the runway condition and weather, the pilot commenced his take-off run on runway 27. After take-off, the pilot saw flames coming out of the right engine cowl. The right engine was shut down but the aircraft could not maintain a sufficient rate of climb, and it crashed on flat, snow-covered ground about one mile from the end of the runway. The aircraft sustained substantial damage on landing. After the aircraft came to a stop, the occupants evacuated via the left front door and walked back to the airport terminal for shelter and assistance. There were no injuries. The occurrence happened at night in instrument meteorological conditions.

*Ce rapport est également disponible en français.*

## *Other Factual Information*

The weather at the time of the accident was : wind 310 degrees True at 20 knots, visibility one and a half miles in light snow and blowing snow, temperature minus 22 degrees Celsius, dew point minus 24 degrees Celsius, altimeter 30.04.

When the aircraft crashed at the end of the runway, there was no one at the airport and no one was aware of the accident. The two pilots and two passengers had to walk across large snow-covered fields to reach the shelter of the terminal, which had been left open. The pilot-in-command then contacted the Flight Service Station (FSS) at Kuujuarapik, Northwest Territories, and the municipal authorities to report the accident and request assistance.

The Sanikiluaq aerodrome, which is operated by the government of the Northwest Territories, consists of one gravel runway 3,800 feet long by 100 feet wide. The airport is equipped with a Community Aerodrome Radio Station (CARS). At the time of the accident, the CARS employee (observer/communicator) was not on duty because the flight was after usual business hours. When an aircraft lands or takes off outside usual business hours, additional fees must be paid by the company operating the aircraft. The pilot had elected not to call the CARS employee. However, the employee heard that an aircraft had landed at the airport, and he came to the airport on his own initiative to help the pilot prepare the flight. When the aircraft took off, he left the CARS and did not monitor the aircraft. The pilot had not officially requested monitoring. There are no aviation regulations requiring that an observer/communicator be present in the CARS when an aircraft lands at or takes off from the aerodrome.

Records reveal that the pilot was certified and qualified for the flight under existing regulations. He had approximately 2,800 flying hours, including approximately 1,400 hours on multi-engine aircraft and 1,000 on type. A trainee pilot was seated in the right-hand seat. On this flight, the pilot-in-command had decided that the trainee pilot would observe.

The crew reported that the engines were producing maximum power on take-off and that the accident occurred when the right engine was shut down because of the engine fire. The pilot said he observed that the propeller was not feathered after the accident, although he thought it should have been because he had carried out the feathering procedure. He also indicated that he had not observed anything unusual about the propeller on the previous flight or during the last take-off. Visual examination of the right propeller revealed that one blade was bent backward over 100 degrees at a point approximately 15 inches from the hub. The other two blades were bent backward approximately 70 degrees about 12 inches from the tip. The right propeller pitch was not determined but it was estimated to be high. The observed damage was consistent with a propeller that was feathered but still turning at the time of impact.

The manufacturer has a warning in the *Pilot's Operating Handbook*, section 3 "Emergency Procedures":

Flight tests have indicated that as much as 100 feet may be lost during gear and flap retraction and the transition to the best single engine angle of climb speed (104 Knots (Kts)). The altitude loss is a difficult variable to quantify and is primarily predicted on pilot proficiency; however aircraft weight and ambient conditions must also be considered.

## WARNING

Negative climb performance may result from an engine failure occurring after lift off and before the gear and flaps have been retracted, the failed engine propeller has been feathered, the cowl flap on the failed engine is closed and a speed of 106 Knots (Kts) (best rate of climb speed - single engine) has been attained. Refer to "Single Engine Climb" chart, Figure 5-23, for clean configuration positive climb performance.

Based on the climb chart, with weight configuration and ambient conditions, the aircraft could have achieved a rate of climb of approximately 1,400 feet per minute on two engines with gear and flaps retracted. The rate of climb drops to 230 feet per minute on one engine with gear and flaps retracted, engine cowl flap closed, and the aircraft inclined five degrees toward the engine operating, and maintaining a speed of 106 knots "blue line, best rate of climb speed - single engine". According to the pilot, the aircraft had attained a speed in excess of 85 knots when he initiated rotation. About 100 feet above ground level, while retracting the landing gear, he saw the flames and immediately started the emergency procedure to shut down the right engine. During the engine shutdown procedure, the aircraft lost altitude and crashed.

The wreckage was found approximately one mile beyond the end of Sanikiluaq runway 27 and a few hundred feet left of the runway centre line. Visible damage on the aircraft was limited to the two propellers and the upper cowl of the right engine. The aircraft systems were examined to the degree possible, and no evidence of a malfunction was found. The engines and propellers were still secured in their respective positions, and the damages indicate that the left engine was developing full power at the time of impact. The right engine exhibited severe fire damage to the outboard half of the engine cowl. The flames had melted through the upper outboard half of the cowl skin, creating two 10-inch diameter holes. The upper cowl was removed, and examination revealed that the fire damage was limited mainly to the engine cowl and the flexible air intake duct to the heat exchanger (exhaust muffler) for the cabin auxiliary heating unit. The upper outboard engine mount also showed fire damage. The spark plug cables for cylinders Nos. 1, 3 and 5, various electrical wires, and the ducts for the turbo air intake had been damaged by the intense heat. The damage caused by the flames had not spread to the firewall. The exhaust muffler was found disconnected from the exhaust pipe for cylinders Nos. 1, 3 and 5. The exhaust muffler and exhaust pipe were found butted up against each other, jammed together end-to-end, with only about half their respective diameters connecting. In this position, the exhaust gases could not be exhausted normally and were projected onto the end of the exhaust muffler then directly onto the engine cowling. The exhaust gas temperature was estimated at approximately 1,400 degrees Fahrenheit. The fibreglass cowl skin could not withstand such high temperatures and was melted by the flames. Two stainless steel collars were found on the far aft side of the No. 5 cylinder exhaust pipe. With the two collars positioned as they were, the exhaust muffler could only be inserted less than one-quarter inch over the pipe; these parts were designed to overlap by more than an inch and a half into one another. The installation was not in accordance with existing requirements. No other deficiency in the exhaust system was found.

The records revealed that the aircraft was certified and equipped in accordance with existing regulations and approved procedures. A review of the aircraft log-books indicates that the aircraft was maintained in accordance with the inspection schedule approved by Transport Canada and the manufacturer's progressive inspection program. An audit of the main maintenance base revealed that the facilities were adequate and that the equipment required to maintain the aircraft was available. Inspection of the aircraft files revealed several deficiencies in records management; the records consisted of task sheets, additional worksheets and a sheet to record completed inspection events. Most of these documents could not be identified as relating to a specific aircraft. No dates, signatures or aircraft registration numbers were indicated on the sheets. Some of the documents submitted were in a disorderly pile in a desk drawer, and the remainder were retrieved from a file cabinet containing a variety of files. Some documents relating to other aircraft were found in the box of papers submitted for our examination. The record keeping and files for the subject aircraft were incomplete and

inadequate. A review of the aircraft log-book revealed that the persons in charge of maintenance had authorized the aircraft to be used while some deficiencies had not been corrected, including an unserviceable fuel regulator shut-off. Each time, the aircraft continued to operate until the required parts were delivered.

From 1992 to 1996, the company was monitored by Transport Canada, Quebec Region. The Val d'Or office monitored maintenance. During this period only one review of the maintenance department was done, in September 1994. In November 1996, when the new *Canadian Aviation Regulations* (CAR) came into effect, responsibility for monitoring was transferred to Winnipeg Region for company operations, and to Yellowknife for maintenance. The first inspection by airworthiness inspectors was on 30 January 1997; no aircraft inspections were done at that time. In June 1997, inspectors from the Enforcement Division conducted an inspection and, after interviewing a pilot, noted several major operational deficiencies. No follow-up report was found in the company file to indicate that any follow-up action was taken. An entry in the aircraft log-book on 14 December 1997 refers to maintenance work on the right engine. This work was for the replacement of the right rear exhaust pipe, the same exhaust pipe that was found disconnected after the accident. The Transport Canada file on the company maintenance department indicates that in 1997, at least three different persons held the position of Director of Maintenance. On 22 December 1997, the Director of Maintenance went on vacation, and on 31 December 1997, he sent a letter to Transport Canada indicating that he was resigning from his position as Director of Maintenance and would no longer be responsible for aircraft maintenance effective 22 December 1997. At the time of the accident, the Director of Maintenance position at the maintenance base was vacant. A post-occurrence review of the maintenance department conducted by Transport Canada from 9 to 11 February 1998 confirmed the findings of the investigation, and the company operating certificates were temporarily suspended.

## *Analysis*

The pilot did not request CARS services after usual business hours, thereby depriving himself of services such as flight monitoring, which would have allowed the occupants of the aircraft to be rescued more rapidly.

When the engine was shut down on take-off, climb performance was negative, as indicated by the manufacturer. The engine was shut down at the most critical time in the initial climb, between rotation and acceleration, causing the aircraft to crash.

The exhaust muffler on the right side of the engine and the exhaust pipe became disconnected because two stainless steel collars were installed on the far aft side of the No. 5 cylinder exhaust pipe to prevent the exhaust muffler from coming into contact with the No. 5 cylinder baffle. The technician did not deem that there was a risk in making that modification. Installation of the collars was not prescribed in the modification for Supplemental Type Certificate SA-240. Also, the way the collars were installed was inconsistent with quality standards and the manufacturer's instructions, thus contributing to a considerably greater risk of fire.

In 1997, three different individuals held the position of Director of Maintenance. Due to frequent staff changes, it was difficult for company personnel to properly follow up on aircraft records. The aircraft flew a lot of hours and were not to be kept on the ground very long for maintenance. In this remote area, Transport Canada inspections are infrequent, which is confirmed by the information found on file. In addition, correspondence between the company and Transport Canada was almost exclusively of a bureaucratic nature.

A review of the aircraft log-book showed that the aircraft had been operated with uncorrected deficiencies. The record keeping and files for the aircraft were incomplete and inadequate.

## *Findings*

1. By not requesting the services of the CARS observer/communicator after usual business hours, the pilot deprived himself of the services normally provided, including flight monitoring, which would have allowed the occupants of the aircraft to be rescued more rapidly.
2. The aircraft could not maintain a sufficient rate of climb when the right engine was shut down at the most critical time of the flight, between rotation and acceleration, thereby causing the crash.
3. Two stainless steel collars installed on the far aft side of the No. 5 cylinder exhaust pipe caused the exhaust pipe to become disconnected. This modification was inconsistent with the exhaust muffler (heat exchanger) installation procedures.
4. The company had three different Directors of Maintenance in 1997, and that position was vacant on the day of the accident.
5. An inspection of the records and files for the aircraft revealed several deficiencies in records management.
6. The persons in charge of maintenance authorized the aircraft to be used while deficiencies had not been corrected.
7. Transport Canada had not made regular audits of the company since 1992.
8. Only one review of the maintenance department was conducted, in September 1994. The last review of the maintenance department was conducted after the accident, in February 1998, and several deficiencies concerning the maintenance department and the company were found; the review resulted in the suspension of the company operating certificates.

## *Causes and Contributing Factors*

A modification to the cabin heating unit inconsistent with the manufacturer's recommendations and aviation regulations caused an engine fire in the right engine cowl during the initial climb. The pilot shut down the engine, but the aircraft could not maintain a positive rate of climb and crashed to the ground.

## *Safety Action*

As a result of the TSB investigation, Transport Canada took immediate action by suspending the Aircraft Maintenance Organization certificate of Air Nunavut Ltd.

*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 22 October 1999.*