

AVIATION OCCURRENCE REPORT

REJECTED LANDING/LOSS OF CONTROL

FIRST AIR DHC-6 SERIES 300 C-GNDN
IQALUIT, NORTHWEST TERRITORIES 85 NM NW
12 AUGUST 1996

REPORT NUMBER A96Q0126

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

First Air 064, a DHC-6 Twin Otter (Serial No. 427), took off from Iqaluit, Northwest Territories (NWT), at 1258 Coordinated Universal Time (UTC) on a charter flight to Markham Bay, Lake Harbour, and back to Iqaluit. The aircraft was carrying six barrels of Jet B fuel to be delivered to Markham Bay, an off-strip landing site. At 1300, just after he took off, the captain told the Iqaluit Flight Service Station (FSS) specialist that the estimated time of arrival (ETA) for Markham Bay would be 1335. At approximately 1345, the crew informed First Air dispatch that they were landing at Markham Bay. After touching down, the pilot attempted an overshoot. During the attempt, the aircraft struck the ground about 200 metres past the end of the landing area, got airborne again, cleared a ridge, then crashed onto a rocky beach. A helicopter located the airplane 629 metres from the beginning of the landing area, partially submerged in water. The two pilots, the only occupants, received fatal injuries in the crash.

The accident occurred during daylight hours at 1347, as per the clock of the airplane, at latitude 63°40'N and longitude 071°39'W. There were no witnesses to this accident.

Ce rapport est également disponible en français.

¹ All times are UTC (local time plus four hours) unless otherwise noted.

Other Factual Information

The captain and the first officer were certified and qualified for the flight in accordance with existing regulations. The captain had accumulated a total of 3,813 hours, of which 2,028 were on Twin Otter aircraft. He was hired by First Air in February 1991, promoted to captain on the Twin Otter in June 1995, and had flown 395 hours as captain on the Twin Otter at the time of the occurrence. Company policy stipulates that the captain, rather than the first officer, is to land the aircraft on a short strip like Markham Bay. The first officer was hired in February 1995 and had accumulated a total of 2,724 hours, of which 1,000 were with First Air on Twin Otter and Beechcraft aircraft.

Records indicate that the aircraft was certified, equipped, and maintained in accordance with existing regulations and procedures. The airplane was loaded, under the supervision of the captain, with six barrels of Jet B fuel. The take-off weight at Iqaluit was calculated to be 12,862 pounds, and the landing weight at Markham Bay to be 12,412 pounds. The maximum authorized take-off weight is 12,500 pounds and the maximum authorized landing weight is 12,300 pounds. As both the take-off weight and landing weight were outside of the aircraft's flight envelope, the take-off centre of gravity and landing centre of gravity could not be determined.

The cargo was secured in the fuselage by the use of straps, tie-down rings, and Brownline tie-down tracks. Examination of the tracks revealed that the fasteners used to attach the straps to the tracks had torn free on impact. Four drums were found inside and two were found outside the fuselage. None of them had moved into the cockpit.

Autopsies on the pilots were performed by the Forensic Pathology Unit, Office of the Coroner for Ontario. The cause of death for the captain was determined to be head and neck injuries. The cause of death for the first officer was determined to be head and neck injuries, complicated by drowning. The autopsy report revealed injuries to the first officer's left leg, ankle, and foot. These types of injuries are commonly found on pilots who were flying the aircraft and were at the controls at the time of impact. The toxicology analysis was performed by the Center of Forensic Sciences. The testing for the presence of common drugs and alcohol was negative for each crew member. There was no evidence that incapacitation or physiological factors affected the crew's performance.

Markham Bay is located 85 nm northwest of Iqaluit and 69 nm north of Lake Harbour. There is no weather information available for Markham Bay, and pilots use weather information from Iqaluit and Lake Harbour. At 1300 and 1400, the reported weather at Iqaluit was as follows: visibility 30 statute miles, a few clouds at 26,000 feet, wind calm, temperature 9 degrees Celsius, and dew point 3 degrees. At 1400, the reported Lake Harbour weather was as follows: visibility 15 statute miles, scattered cloud at 1,500 feet with a second layer at 25,000 feet, wind calm, temperature 12 degrees Celsius, and dew point 2 degrees. The helicopter pilot who found the wreckage confirmed that there was no wind and no cloud around Markham Bay.

The Markham Bay off-site landing surface is composed of loose, small-to-medium gravel with three shallow, obliquely transverse wash-outs located along its length. The area was well known by the captain, as he had

landed there on several occasions. The length of the landing site is 209 metres on a heading of 032 degrees magnetic. The actual landing area is marked by four, red 45-gallon drums placed at each corner of the landing strip. Past the end of the landing strip, there is a depression with water in it, rising rocky terrain, a ridge, and then descending terrain to the waters of Hudson Strait.

During the landing attempt, the airplane made four separate sets of marks along the landing area. The first three sets of marks showed no evidence of braking, but the last set of marks showed evidence of heavy braking and skidding towards the right by approximately five degrees. The last marks also showed evidence of nosewheel digging and steering input. The brakes were released 12 metres after the end of the runway, and a new heading of 044 degrees magnetic was established. The airplane became airborne 34 metres further on, past the end of the landing area, where there was a downslope of 11 degrees. There were no more marks for over 185 metres, then the right main gear was torn off when it hit a rock. Small flakes of metal and paint were found in a large area around the gear, but no other significant pieces were found. The airplane managed to continue over a ridge and came to rest on the other side, 629 metres from the beginning of the landing area.

The airplane struck the sea bed right wing first with a nose-down attitude of at least 60 degrees. On impact, the right wing moved backward and buckled the fuselage. The imprint of the flaps on the fuselage indicated a flap setting of 20 degrees, which is the normal flap setting for a short field take-off. The flap setting was later confirmed by the actuator length and flaps selector position. The right engine and propeller were torn from the firewall and were found approximately 10 metres to the left, behind the main wreckage. The firewall fuel shut-off valve was in the open position. The left wing failed forward and inward toward the fuselage. Cuts in the fuselage aft of the captain's seat were made by the left propeller. The left engine and propeller remained attached to the wing.

A continuity check of the rudder, rudder trim, elevator and elevator trim control cables, and associated bellcranks and pushrods was completed. The aileron and aileron trim cables failed in overload as the wings tore free from the fuselage, but continuity was established from the failures through the fuselage to the control column and through the wings to the associated bellcranks, pushrods, and flight controls.

Both engines were disassembled, under TSB supervision, at the Pratt & Whitney Canada facility. The engines displayed light impact damage and minimal compression damage, as well as slight torsional damage to the exhaust duct. Circumferential rubbing and scoring were displayed by the internal rotating components due to impact loads and external distortion, and were considered an indication that the engines were producing power at impact. There was no indication of any anomalies observed during the examination that would have precluded normal engine operation.

Both propellers were disassembled at the TSB Engineering Branch. No pre-impact anomalies which would preclude normal propeller operation were noted with either propeller. The analysis of the information gathered during the examination indicated that the propellers were rotating and absorbing power from the engines at the time of impact. The blade angle markings indicated a high power setting, at, or close to, full power. When a decision is made to abort the landing, the power levers are advanced to obtain take-off power, and the flaps are retracted to 20 degrees.

During examination of the right engine, it was found that the inboard isolation mount, one of three attachment points for the engine, was broken. All of the mounts from both engines were removed and forwarded to the TSB Engineering Branch for more detailed examination. The analysis determined that fatigue cracking had preceded the separation of the broken mount, and that four of the remaining five mounts also had fatigue cracks. It was not conclusively determined whether the broken mount failed before or during the accident sequence.

The TSB had recently conducted a failure analysis of a right-engine inboard isolation mount from the same model of aircraft. The pilot of that aircraft was questioned to help assess the probable effect of such a failure on the operation and performance of the powerplant. He indicated that there was no noticeable effect on movement of the engine or propeller controls or on aircraft performance or handling.

On short runways, pilots use a short-field landing technique. The Twin Otter Manual states that in standard conditions using a short-field technique, a ground roll of 515 feet (157 metres) would be necessary to stop the airplane at maximum landing weight when using 37.5 degrees of flaps (full flaps), an approach speed of 70 knots, full brakes on a hard surface, and full reverse thrust. Moving the throttles into reverse can only be achieved after the propeller levers have been moved into full forward position.

The flaps actuator needs between 16 and 23 seconds to move from 37.5 degrees to 20 degrees of flap, if there is no air load on the flaps. Assuming an average airspeed of between 52 knots (stalling speed at maximum gross weight and 37.5 degrees of flaps) and 56 knots (stalling speed at maximum gross weight and 20 degrees of flaps), the flaps had 17 to 19 seconds to retract from the time the airplane landed and the crew applied brakes until the aircraft reached the location where it crashed. At Markham Bay, only the last set of marks showed signs of braking for a measured distance of 88 metres.

Analysis

There were no witnesses to the occurrence. The crew was qualified and certified for the flight. The weather conditions were not considered to be a factor in this occurrence. The aircraft's weight was determined to have been above the maximum take-off weight and the maximum landing weight.

Company policy requires the captain to do all landings at any off-site landing strips. When the airplane departed Iqaluit, the captain was speaking on the radio, a function normally performed by the pilot not flying. The injuries to the first officer's left leg, ankle, and foot suggest that he may have been at the controls at the time of impact. However, given that the first officer was in the right seat and the initial impact forces were more severe on the right side of the aircraft, it is possible that the first officer's additional injuries were a result of the impact forces and not of his being at the controls of the aircraft. Examination of the off-site landing area revealed that there were signs of nosewheel steering input at the fourth set of tire marks. Because the steering lever is located on the hub of the captain's control wheel, either the captain was flying the aircraft at the time of the occurrence,

or he was attempting to take control of the aircraft. Notwithstanding the above, it could not be determined with certainty who was at the controls of the aircraft.

The four sets of imprints on the landing strip at Markham Bay indicate that the aircraft bounced into the air three times during the landing attempt, and that the pilot flying the aircraft had difficulty controlling the aircraft on landing. In order to bounce on three different occasions, the airplane needed a speed in excess of the normal landing speed. Excessive speed can come from a higher than normal speed on final approach for the landing or from power application during the landing sequence. The use of full flaps during the approach, in addition to the use of brakes and reverse thrust on landing, will decrease the aircraft's landing speed and shorten the landing roll. It was not possible to determine what flap setting was used for the approach or if the pilot used reverse thrust on landing. The fact that the flaps were at 20 degrees and the engines were developing maximum power indicates that the pilots were likely attempting an overshoot using a short field take-off flap setting.

The airplane became airborne 34 metres after the crew released the brakes; the point at which they released the brakes is likely when they decided to overshoot. The fact that the aircraft became airborne in such a short distance is likely the result of the aircraft having a high residual airspeed, a take-off speed close to stall speed, and the downslope terrain. Controlling the aircraft is more difficult at such a low airspeed. The weight condition and the low airspeed did not allow the aircraft to gain sufficient height to clear the obstacle located 185 metres after lift-off. When the landing gear hit the rock and the airplane went over the ridge, the small margin between flying and stall speed was removed. The airspeed decreased below the stall speed and the aircraft fell nose down into the waters of Hudson Strait.

The following Engineering Branch reports were completed:

LP 142/96 - Occurrence Investigation - Regional Support;
LP 143/96 - Engines and Propellers Examination; and
LP 094/96 - Engine Mount Failure.

These reports are available upon request from the Transportation Safety Board of Canada.

Findings

1. The crew was qualified for the flight.
2. It could not be determined with certainty who was at the controls of the aircraft.
3. The aircraft was loaded under the supervision of the captain.
4. The aircraft's weight was determined to be above the maximum take-off weight and the maximum landing weight.

5. The flaps were found set to 20 degrees at the accident site.
6. The inboard isolation mount of the right engine was broken; the time of failure could not be determined.
7. The aircraft stalled when going over the ridge.

Causes and Contributing Factors

For unknown reasons, a decision was made to overshoot even though insufficient runway remained for acceleration, take-off, and climb. Likely contributing directly to the decision to overshoot was the difficulty in controlling the aircraft on touchdown.

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 30 April 1998.