Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A06A0114

COLLISION WITH OBSTACLE DURING TAKE-OFF

PROVINCIAL AIRLINES LIMITED
de HAVILLAND DHC-6 TWIN OTTER C-FIZD
PORT OF GOOSE BAY DOCK, HAPPY VALLEY
GOOSE BAY, NEWFOUNDLAND AND LABRADOR
06 NOVEMBER 2006

Canada

Aviation Investigation Report

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Port of Goose Bay Dock, Happy Valley
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Summary

The de Havilland DHC-6-300 Twin Otter (registration C-FIZD, serial number 461) had been converted from float to wheel landing gear and was being repositioned from the Marine Atlantic dock to the Goose Bay Airport. During the take-off from the dock, the main wheels of the aircraft struck a wooden safety curb that surrounded the dock perimeter. After visually inspecting the landing gear in flight, the pilots continued the planned flight and landed at the Goose Bay Airport. On landing, the right main gear collapsed and separated from the aircraft. The aircraft veered to the right and came to rest on a taxiway on the right side of the runway. There was damage to the right landing gear, the right wing tip, and the outboard aileron hinge. There were no injuries to the two pilots on board. The accident occurred at 1631 Atlantic standard time during daylight hours.

Ce rapport est également disponible en français.

Other Factual Information

The accident occurred approximately one hour before sunset. The Goose Bay Airport weather at the time of the accident was as follows: surface wind 250° magnetic (M) at 7 knots, visibility 15 statute miles, scattered clouds, and temperature 0°C. Strong wind conditions were forecast for several days following the day of the occurrence.

The de Havilland DHC-6 Twin Otter is a fixed landing gear, short take-off and landing (STOL) aircraft designed for use on unprepared, short landing strips. The aircraft is convertible to float-type landing gear. Early on the day of the accident, the aircraft, with minimum fuel on board, was taxied from the floatplane base to the marine dock a short distance away. At the dock, the aircraft was lifted from the water with a crane and suspended while maintenance personnel removed the floats and replaced them with the wheel landing gear. All unnecessary equipment had been removed from the aircraft to reduce the take-off weight and the take-off distance required.

At approximately 0830 Atlantic standard time,[1] the captain and first officer arrived at the Port of Goose Bay main dock, two nautical miles east of the Goose Bay Airport, to fly the aircraft to the Goose Bay Airport. This was to be the first take-off from the dock for this operator and for the captain.

The DHC-6 aircraft was operated by the company in accordance with *Canadian Aviation Regulations* Part VII, Subpart 4, Commuter Operations (CAR 704). The pilot qualifications, training, and operating requirements are delineated in the company operations manual (COM). In particular, the COM contains the operating requirements for a maximum performance STOL (MPS) take-off, which was the procedure used for the take-off from the dock. These requirements included the following:

- ground and flight training annually;
- a minimum of three MPS take-offs annually;
- proof of the training on the pilot's company training file;
- certification of the MPS qualification by the chief pilot and a copy of that certification kept on the pilot's training file; and
- prior to first time operations from a site, all operational aspects are to be discussed with the Director of Flight Operations (DFO) or chief pilot "as flight safety is the primary concern."

All of these requirements, with the exception of consultation with the DFO or chief pilot, were met before undertaking the flight.

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1 All times are Atlantic standard time (Universal Coordinated time minus four hours).

DHC-6 landing gear conversions and subsequent take-offs from this dock have been conducted for many years by another operator in the area. No one had taken off from the same general area and in the same general direction as the accident flight.

Both the captain and first officer were licensed and qualified for the flight. The captain was also the supervisor of the company's Goose Bay operational base. Both pilots had short field take-off experience. The first officer had taken off from the dock several times previously as pilot-in-command with another operator. The pilots discussed the operation with another company pilot before the decision to take off was made. The captain had 16 000 hours of total flight time, 9000 of which on the Twin Otter. The first officer had 12 500 hours of total flight time, 11 300 of which on the Twin Otter.

The orientation of the concrete-surface dock is northwest to southeast (see Appendix A). There is a dividing chain-link fence at the midpoint of the dock running perpendicular to the dock edge. There is a 14-inch-high wooden safety curb, made of wood beams measuring 12 inches by 12 inches, surrounding the outside perimeter of the dock. Approximately 105 feet from the water side, in the direction of the take-off, there is a depression approximately 60 feet wide and 1.5 feet deep in the surface of the dock, running parallel to the edge or 45° to the direction of take-off.

The captain measured the take-off run by pacing off the distance and estimated the available distance at approximately 400 feet. Using performance charts from the aircraft flight manual (AFM), the captain then calculated the required take-off ground run at approximately 300 feet.[2] The captain was aware of the depression in the surface of the dock, and calculated that the aircraft would be airborne before reaching it. The actual take-off run available was measured after the accident; it was 335 feet.

The pilots then taxied the aircraft on the dock to allow for the maximum take-off run available, taking into account the wind speed and direction and obstacles on the dock. The obstacles comprised equipment parked at the southeastern end of the dock and containers and aircraft floats sitting on the southeastern side of the chain-link fence. The take-off run chosen was from the south corner of the concrete surface toward the water edge of the dock, in a northerly direction, approximately 45° to the dock orientation (see Appendix A).

The pilots used an MPS technique to ensure that the aircraft would be airborne in the shortest possible distance. The wheel brakes were applied and engine power was advanced to the maximum power output. When it was determined that the engines and aircraft systems were operating normally, the captain released the wheel brakes while holding the control column to the furthest aft position, and the aircraft accelerated toward the edge of the dock. At approximately three-quarters of the available take-off distance, the aircraft nose landing gear settled into the depression in the dock surface. This caused a momentary decrease in the wing angle of attack, slightly delaying the rotation of the aircraft, which would increase the ground run.

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2 The AFM states the conditions assuming that the take-off is from a "dry, hard, level surface."

The right main landing gear struck the wooden safety curb at the perimeter of the dock, and the left main gear struck and severed a partially decomposed 10-foot section of the curb. The aircraft became airborne and the flight continued to Goose Bay.

The pilots were aware that the aircraft had struck an object on departure. However, they considered the impact forces minimal. The pilots carried out an in-flight visual inspection of the landing gear. They concluded that there was no damage, and that the tires appeared to be inflated. After the visual inspection was complete, it was decided to continue the flight to the Goose Bay Airport.

The pilots contacted the Goose Bay control tower to request landing clearance. They did not request any assistance. On landing, the right main gear collapsed and separated from the aircraft. The aircraft settled onto the remaining portion of the landing gear, the right wing tip, and the outboard aileron hinge. The aircraft continued on the runway for approximately 800 feet from the touchdown point, then veered to the right and came to rest on the edge of a taxiway on the right side of the runway. Goose Bay control tower personnel alerted the airport rescue and firefighting services, and they arrived within a few minutes of the aircraft coming to rest.

The cockpit voice recorder (CVR) was removed from the aircraft. It was determined that the CVR had not been recording during the accident flight because the integral inertial switch had activated at some time before the accident flight. The time and date that the switch had activated could not be established. The activation of this switch removes electrical power from the recorder. Further inspection by the operator's maintenance personnel found that the switch could be activated with less than the certified required g force. It could not be determined if the CVR test function had been completed before the incident flight.

Examination of the aircraft did not reveal any mechanical, maintenance, or performance discrepancy that could have contributed to the accident.

The emergency locator transmitter (ELT), manufactured by Pointer Sentry (model 4000-10, serial number 408997), was found detached from its mounting bracket, likely as a result of impact forces. It was hanging by the antenna coaxial cable. The mounting bracket (part number 2017) uses a rear bracket clip to hold the ELT in place. Although the ELT had become detached, the rear bracket clip was still fastened to the mounting bracket.

The installed bracket was approved under Technical Standard Order[3] (TSO) C91. However, the bracket was intended for an earlier model Pointer Sentry ELT. The 4000-10 ELT that was on the occurrence aircraft was supposed to be installed using a different mounting bracket (part number 2017-10). This bracket uses a hold-down strap instead of a rear bracket clip. TSO C91A, not TSO C91, pertains to this installation, and the manufacturer has advised that only part number 2017-10 is the correct installation with the model 4000-10 ELT.

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[3] A Technical Standard Order (TSO) is a minimum performance standard issued by the United States Federal Aviation Administration (FAA) for specified materials, parts, processes, and appliances used on civil aircraft. Articles with TSO design approval are eligible for use on the United States type-certificated products. The TSO authorization or a letter of TSO design approval does not necessarily convey approval for installation.

The TSB is aware of at least three other occurrences[4] where a TSO C91 Pointer ELT rear bracket clip did not restrain the ELT. In these accidents, the ELTs became detached from their antennae, resulting in either a weak signal or no signal. Other agencies have identified problems with the TSO C91–compliant Pointer ELT bracket. In the preamble to its ELT–related recommendations (A-99-62 and A-99-63), the National Transportation Safety Board (NTSB) stated the following: "Since the TSO for C91 ELTs was issued in 1971, unsatisfactory performance associated with TSO C91 units has included dislodgment from aircraft because of impact. . . ."

The NTSB recommendation emphasized that "A reliably functional ELT not only aids in rapidly pinpointing crash sites but also reduces search teams' exposure to potential hazards, the expense of rescue efforts, and the amount of time family members must wait for survivor information."

The New Zealand Civil Aviation Authority (CAA) issued Airworthiness Directive (AD) DCA/RAD/8D, effective 15 January 1999. The AD requires all aircraft fitted with Pointer model 3000, 3001-10 or 4000 ELTs to have TSO C91A brackets (part number 2017-10) installed "to prevent failure of the ELT mounting bracket." Transport Canada has not issued any similar directives.

The TSB is not aware of any TSO C91A–compliant Pointer ELT mounting bracket (part number 2017-10) failures in survivable accidents.

Analysis

No mechanical fault was found with the aircraft. This analysis will focus on the operational, environmental, and human elements that were present.

There is a history of DHC-6 operators successfully conducting take-offs from the marine dock after float-to-wheel conversions. Although this was the first attempt by this captain to take off from the dock, the first officer had completed a number of take-offs from the dock with another operator. Both pilots were highly experienced on type, and both mentally calculated that there was sufficient distance on the planned take-off path to get airborne safely. However, the take-off distance available measurement was shorter than estimated, and the reduction in take-off performance due to the effect of the dock depression was unforeseen. The combination of these circumstances resulted in the landing gear striking the wooden safety curb.

The aircraft was being operated under CAR 704 and the associated requirements of the COM. However, not all of these requirements were met in that the discussion between the captain and the DFO or chief pilot did not take place. This discussion might have led to an alternative course of action to mitigate the risks associated with taking off from the dock.

The CVR had not operated during the accident flight due to a faulty inertial switch. In a more serious accident, crucial investigation data and safety information could have been lost.

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4 TSB reports A87O0076, A95C0197, and A02A0098

TSO C91–compliant Pointer ELT mounting brackets (part number 2017) continue to fail, even in accidents where impact forces are relatively low. Although the ELT was inconsequential in this occurrence, its function in a more severe or remote accident could be critical to the survival of aircraft occupants. Failure of TSO C91–compliant Pointer ELT mounting brackets (part number 2017) in a survivable accident could cause a malfunction of the transmitter and prevent a timely and effective search and rescue (SAR) response.

Findings as to Causes and Contributing Factors

1. The take-off length available on the dock was shorter than estimated. This, in combination with the reduction in take-off performance due to the effect of the dock depression, resulted in the landing gear striking the wooden safety curb.

2. The right main landing gear collapsed on landing as a result of damage incurred when the gear struck the wooden safety curb.

Findings as to Risk

1. The company operations manual (COM) requirement for a discussion between the captain and the Director of Flight Operations (DFO) or chief pilot did not take place. This discussion might have led to an alternative course of action to mitigate the risks associated with taking off from the dock.

2. The cockpit voice recorder (CVR) was not operating because of a faulty inertia switch. In a more serious accident, crucial investigation data and safety information could have been lost.

3. Failure of Technical Standard Order (TSO) C91–compliant Pointer emergency locator transmitter (ELT) mounting brackets (part number 2017) in an accident could cause a malfunction of the transmitter and prevent a timely and effective search and rescue response.

Other Finding

1. If the actual take-off distance available had been what was estimated by the captain (400 feet), the take-off would likely have been successful.

Safety Action Taken

On 13 July 2007, the TSB issued Safety Advisory A06A0114-D1-A1 *(Emergency Locator Transmitter – Pointer Mounting Bracket P/N 2017)* to Transport Canada regarding the detachment of the emergency locator transmitter (ELT) from its mounting bracket.

On 03 October 2007, Transport Canada responded to Safety Advisory A06A0114-D1-A1 and indicated that it would review the design approval to determine compliance with Technical Standard Order (TSO) C91. If required, the design standard of Airworthiness Manual 551.104 will be reviewed and updated. The Department will also request a position from Pointer Sentry regarding this advisory. Pointer, as the manufacturer of the subject mounts, should take the lead on any required action concerning its design of the earlier TSO C91 mounting brackets.

As a result of this accident, the operator has taken the following actions: ceased take-off operations from the dock; submitted a Service Difficulty Report on the faulty cockpit voice recorder (CVR) inertial switch to Transport Canada; and removed the clip-type ELT mounting bracket and replaced it with the mounting bracket with the hold-down strap.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 18 October 2007.

Appendix A – Take-Off Run – Plan View