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

AVIATION INVESTIGATION REPORT
A09O0073

AFT FUSELAGE STRIKE

PORTER AIRLINES INC.
BOMBARDIER DHC-8-402, C-GLQD
OTTAWA/MACDONALD-CARTIER INTERNATIONAL AIRPORT
OTTAWA, ONTARIO
22 APRIL 2009

Canada

Aviation Investigation Report

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Summary

The Porter Airlines Inc. Bombardier DHC-8-402 (registration C-GLQD, serial number 4138) was operating as POE 263 on a scheduled flight from Toronto City Centre Airport to the Ottawa/Macdonald-Cartier International Airport. During touchdown on Runway 07 at 2214 eastern daylight time, the aft fuselage touched the runway. After landing, the aircraft taxied to the gate as normal where the passengers were deplaned. There were no injuries and there was some damage to the aircraft.

Ce rapport est également disponible en français.

Other Factual Information

History of the Flight

The occurrence flight was the fifth and final sector of the day for the aircraft and the flight crew. The flight crew began their day at 1330 [1] at the Porter Airlines Inc. main base at Toronto City Centre Airport (CYTZ). The planned routing for the day was five sectors between CYTZ and Ottawa/Macdonald-Cartier International Airport (CYOW). The captain performed the role of pilot flying (PF) on the third and fourth sectors, and the first officer performed the role of PF on all other sectors including the occurrence sector. This last sector took place at night.

Weather

The 2200 Aviation Routine Weather Report (METAR) for CYOW reported the weather as winds from 070° True (T) at 12 knots, visibility 4 statute miles (sm) in mist, overcast ceiling at 300 feet above ground level (agl) [2], temperature 7°C, dew point 6°C, altimeter 29.62 inches of mercury. Remarks indicated the ceiling was made up of 8 octas [3] of stratus cloud, and the pressure was falling, currently at 1003.4 millibars.

At 2148 the flight crew received CYOW Automatic Terminal Information Service (ATIS) information India, which stated at 2100 the winds were 080° Magnetic (M) at 12 knots. When the flight crew received their clearance to land at 2210, the CYOW control tower informed them that the winds were 090°M at 13 knots. While conducting the approach, the flight crew were in instrument meteorological conditions (IMC) until becoming clear of cloud at approximately 400 feet.

Aircraft

Records indicate that the aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The weight and centre of gravity were within the prescribed limits.

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1 All times are eastern daylight time (Coordinated Universal Time minus four hours).

2 All heights are agl unless otherwise noted.

3 Octas - The opacity of the cloud layers measured in eighths of the sky concealed.

The DHC-8-402 is the latest model of the DHC-8 line from Bombardier, which began with the DHC-8-100. The fuselage was progressively lengthened from 73 feet in the 100/200 series to 84 feet, 3 inches in the 300 series, and further to 107 feet, 9 inches in the 400 series. With the lengthened fuselage, the propensity for aft fuselage ground contact increased with contact pitch angles [4] decreasing from 9.5° [5] in the 100/200 series down to 7.5° in the 300 series. Although the geometry is different, the 400 series maintains this 7.5° contact pitch angle because of the length of the main landing gear.

The probability of aft fuselage/runway contact is greater with landing flaps set at 15° than it is with flaps set at 35°. This is attributed to the reduced flare capability of a flap 15° landing due to a nominal approach pitch attitude of 2° to 3° as compared with a nominal approach pitch attitude of -2° to -1° with a flap 35° landing.

Bombardier statistics show that there have been 20 reported DHC-8 aft fuselage/runway contact events worldwide; ten on the DHC-8 300 series and ten on the 400 series. After twelve aft fuselage contact occurrences, Bombardier created a training video entitled "Pitch Awareness" and recommended that operators develop pitch awareness standard operating procedures (SOPs).

Procedures

The Normal Procedures section of the Aeroplane Operating Manual (AOM) states that the normal approach speed is 170 knots to approximately 5 nautical miles (nm) from the airport, followed by a gradual reduction in airspeed to be stabilized at Vref [6] no later than 500 feet.

Porter Airlines Inc. SOPs describe the requirement for crews to adhere to a set of defined stabilized approach criteria at all times. Part of these criteria state that, at 500 feet, airspeed must be Vref with an allowance of plus 10 knots and minus 0 knots. An addition is made to Vref as necessary to account for wind gusts or icing conditions. No addition was necessary on this leg.

The SOPs further require certain calls to be made. The pilot monitoring (PM) must call "Stabilized" or "Not stabilized" as appropriate. If the PM makes a "Stabilized" call, the PF responds with "check". If the PM makes a "Not stabilized" call above 500 feet, the PF must respond with "correcting" or "go around, check power ". For calls of "Not stabilized" below 500 feet, the PF must respond with "go around, check power".

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4 The contact pitch angle is that angle that would likely result in the aft fuselage of an aircraft contacting or striking the ground.

5 All pitch angles referred to in this report are positive or nose-up angles.

6 Vref means the landing reference speed and is defined in the Aeroplane Operating Manual as "approach speed at a height of 50 feet above the runway in the landing configuration." Vref varies according to landing weight.

Section 2.17.2 of the SOPs describes pitch awareness and callouts. These SOPs define a pitch callout system where the PM will call out the pitch attitude below 100 feet on approach if the pitch is greater than or equal to 5°. If the pitch attitude reaches 6°, the PF must respond "correcting" and either decrease the pitch angle, or execute a go-around.

A note at the end of this SOP section states: "To decrease the landing descent rate and not exceed a pitch attitude of 6°, at anytime the landing descent rate is higher than desired, power will be required in the landing flare through touchdown." A similar note can be found in the AOM. The AOM also includes a note stating "DO NOT exceed 6° nose up during landing flare to avoid the fuselage contacting the runway."

Flight Crew

The flight crewmembers were certified and qualified for the flight in accordance with existing regulations.

Each flight crewmember had more than 15 hours off duty the night prior to the occurrence and a full day off work two days prior.

The captain has been employed by Porter Airlines Inc. since 11 September 2006. At the time of the occurrence, he had approximately 8700 hours total time, 4500 hours on DHC-8 aircraft, including 1500 hours with Porter Airlines Inc. on the DHC-8-400. He completed the initial DHC-8-400 type rating in October of 2006 and during this time he completed a computer based training (CBT) session entitled "Pitch Awareness." He was recently upgraded to the position of training captain, a position he had not held with previous employers, and this pairing was his twenty-second acting in this capacity.

The first officer was hired by Porter Airlines Inc. on 02 February 2009. At the time of the occurrence, he had approximately 2550 hours total time, including 17 hours on the DHC-8-400 with Porter Airlines Inc. He was currently undergoing line indoctrination training, and the occurrence landing was the first he had performed at night, outside of the simulator. The first officer's previous experience was on light aircraft (Beechcraft KingAir) and the DHC-8 was the largest aircraft he had flown. He finished his initial DHC-8 type rating on 15 March 2009, and during this curriculum he completed the pitch awareness CBT.

Training

The pitch awareness CBT consists of a short educational video and a series of six questions that emphasize the requirement for flight crews to arrest higher-than-normal descent rates below 100 feet on approach with the application of power, rather than with an increase in pitch attitude. This tutorial also describes the pitch awareness SOPs.

There is no specific flight training scripted in the simulator during the initial or recurrent syllabus to reinforce the correct procedure for reduction of higher-than-normal descent rates on approach.

The pitch awareness SOPs are scheduled as a training element to be completed during line indoctrination. The first officer was to complete this element later in the line indoctrination process. During all three of his previous line indoctrination trips, while flying with three different training captains, it was noted that the first officer was having difficulty timing the flare. During the occurrence day, the first officer's first flare in Ottawa was too early, his second was too late, and the third resulted in the aft fuselage contacting the runway.

The Approach

On arrival into Ottawa, the crew was cleared for the instrument landing system (ILS) approach, Runway 07. The approach was flown on autopilot, which does not incorporate an auto throttle feature. The applicable Vref for the flight was correctly selected and bugged at an airspeed of 116 knots.

Shortly after the first officer finished the approach briefing, the captain (who was the PM), in reference to previous flare difficulties, instructed the first officer that it would feel like the ground was rushing up, but to try to resist the flare at the 20-foot GPWS [7] callout and, rather, to flare at the 10-foot callout. The first officer acknowledged this instruction.

Above 1000 feet and at approximately 5 nm from the threshold, the aircraft was configured for landing with the landing gear down, flaps set to 15°.

At 1000 feet, all SOP criteria for a stabilized approach were met, but the airspeed was increasing.

Between 1000 and 650 feet, the aircraft accelerated from 120 to 134 knots. Meanwhile, torque values varied: from 20% to 27%, then to 16 %, then to 21% and, at 650 feet, following an instruction from the captain to reduce power to 10%, the torque was decreased to approximately 9%, where it generally remained for the remainder of the flight. Airspeed began to decrease, reaching 128 knots at 500 feet.

At 500 feet, the required stabilized call was made by the PM, while the airspeed continued to decrease.

At approximately 400 feet, the captain instructed the PF to increase power slightly. Other than a momentary 1% increase in power, there was no appreciable change in the average torque setting. This instruction was followed by another to not move the power on landing.

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7 Ground proximity warning system

At 200 feet and 116 knots with the elevator trim in motion, the crew disengaged the autopilot. Shortly thereafter, the aircraft pitch decreased from 4.1° to reach 3.1° at approximately 100 feet. This pitch change increased the rate of descent and the aircraft descended below the glideslope, which it never recaptured. The derived rate of descent increased from 570 feet per minute (fpm) to an average of 840 fpm on descent between 200 and ten feet. The speed during this phase slowly decreased to 114 knots.

At approximately 60 feet, the captain instructed the first officer to increase the power a small amount. This resulted in a net change in power of approximately 2 per cent.

At 50 feet, with the glideslope almost fully deflected, the GPWS started calling out the aircraft's height above ground in 10-foot decrements. The crew noticed these callouts were faster than normal, suggesting a high descent rate.

Immediately after the GPWS call out of "20"feet, the captain instructed the first officer to flare. At this point the pitch increased rapidly, and in approximately one second went from 3.1° to a peak of 7.5°. During this pitch peak, the aircraft landed firmly and the aft fuselage, in vicinity of the touched runway sensor [8], contacted the runway.

Analysis

The weather was not considered to be a factor in this occurrence. There were no reports of strong or gusty wind conditions; thus, no addition was made to Vref.

The captain was relatively new to line instruction and had limited experience training on the DHC-8. The first officer had some difficulty timing the flare, was performing his first night landing, and had not yet reached the portion of line indoctrination that addresses pitch awareness SOPs. Considering these facts, it is likely that the crew became focused on achieving a successful flare on this landing to the exclusion of monitoring other parameters, such as descent rate and glideslope deviation.

When the autopilot was disconnected, the aircraft pitched down. While the direct cause of this pitch change cannot be determined, the PF either initiated it or let it continue in an effort to maintain airspeed without the addition of power, as previously instructed by the captain. The rate of descent increased from 570 fpm to 840 fpm. The increase in rate of descent, despite the reduction in airspeed, was evidence that the power setting was insufficient to maintain the glideslope at a Vref speed of 116 knots.

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[8] The touched runway sensor is located on the bottom, aft portion of the fuselage. If the fuselage in the vicinity of the sensor comes into contact with the ground at any time, the sensor illuminates a "Touched Runway" warning light in the cockpit to alert the flight crew that fuselage contact with the ground has been made.

At 60 feet, the captain, likely realizing that the rate of descent was undesirable, instructed the PF to increase torque a small amount. This and previous instructions regarding torque changes were vague: the captain did not provide explicit torque settings to the PF. This resulted in net torque changes that were too small to have any appreciable effect on the descent rate.

As the GPWS began to make callouts at 50 feet, the crew realized that the descent rate was excessive. The PF did not increase power, likely due to the fact that he had received several instructions throughout the approach to resist doing so. Immediately after the GPWS call at 20 feet, contrary to what had been previously briefed, the PF was instructed to flare, presumably in reaction to the ground rush. The PF initiated the flare approximately one second before touchdown, which resulted in an abrupt change in pitch angle.

The pitch awareness SOPs, which require the callout of pitch attitudes on approach below 100 feet when the pitch is 5° or greater, proved ineffective in this case. The pitch during the flare changed from 3.1° to 7.5° in less than one second. This time frame was inadequate for there to be an expectation that the PM could recognize the attitude, alert the PF, and have him correct the condition.

The following TSB Laboratory report was completed:

> LP 051/2009 – Flight Data Recorder Download and Analysis – Bombardier DHC-8-400, C-GLQD

This report is available from the Transportation Safety Board of Canada upon request.

Findings as to Causes and Contributing Factors

1. The crewmembers were likely focused on having the pilot flying (PF) achieve a successful flare, to the exclusion of monitoring other approach parameters.

2. The captain provided vague instructions on managing power during the approach and the resultant settings went unchecked, resulting in an undesirable descent rate close to the ground.

3. The engine power was not adjusted sufficiently to arrest the descent rate and the aircraft was pitched to the contact angle in the flare, resulting in the aft fuselage striking the runway.

Safety Action Taken

On 17 August 2009, Porter Airlines Inc. issued a flight operations bulletin entitled “Pitch Awareness Training” addressing several issues contained in this report. Outlined in the bulletin is a clarification of the pitch awareness callout standard operating procedures (SOPs) and a reiteration of the requirement for arresting abnormal descent rates with power.

At the same time, the company added a training event to both initial and recurrent simulator training syllabi that addressed physical practice recovering from abnormal descent rates. However, it became apparent that the simulator fidelity was not sufficient for this acute manoeuvre, and the results led to negative training. Subsequently, the issue has been returned to the classroom to focus on awareness and on measures to prevent low-energy situations from developing.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 26 January 2010.