

Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

AVIATION INVESTIGATION REPORT

A01W0117



LANDING EVENT—HARD LANDING

FIRST AIR

BOEING 737-210C C-GNWI

YELLOWKNIFE AIRPORT, NORTHWEST TERRITORIES

22 MAY 2001

Canada

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 Flight 953, a Boeing 737-210C, serial number 21066, was on a scheduled flight from Edmonton, Alberta, to Yellowknife, Northwest Territories. On board were 2 flight crew, 4 cabin crew, and 98 passengers. The flight departed Edmonton at 1130 mountain daylight time, with an estimated time en route of 1 hour 35 minutes. As the aircraft approached Yellowknife, the spoilers were armed, and the aircraft was configured for a visual approach and landing on Runway 33. The computed V_{ref} was 128 knots, and target speed was 133 knots. While in the landing flare, the aircraft entered a higher-than-normal sink rate, and the pilot flying (the first officer) corrected with engine power and nose-up pitch. The aircraft touched down on the main landing gear and bounced twice. While the aircraft was in the air, the captain took control and lowered the nose to minimize the bounce. The aircraft landed on its nose landing-gear, then on the main gear.

The aircraft initially touched down about 1300 feet from the approach end of Runway 33. Numerous aircraft rubber scrub marks were present in this area and did not allow for an accurate measurement. During the third touchdown on the nose landing-gear, the left nose-tire burst, leaving a shimmy-like mark on the runway. The aircraft was taxied to the ramp and shut down. The aircraft was substantially damaged. There were no reported injuries to the crew or the passengers. The accident occurred at 1325, during the hours of daylight.

Ce rapport est également disponible en français.

Other Factual Information

The captain held a Canadian airline transport pilot licence and a valid Boeing 737 pilot proficiency check (PPC). He had a total time of 16 400 hours, notably 8000 hours as pilot-in-command (PIC), 7700 hours on the Boeing 737, and 3800 hours as PIC on the Boeing 737. He had been off regular flight duty from 22 November 2000 until 06 April 2001 for medical reasons. His PPC had expired on 01 January 2001. During his recurrent training before returning to flying duties, the captain received two 4-hour flight simulator training sessions on May 6 and 7, and his PPC on May 8. He then completed three take-offs and landings in the Boeing 737. The captain had not received a line check of at least three sectors, although this check was required to regain competency after PPC expiry. The captain was based at and familiar with Yellowknife Airport.

The first officer held a Canadian airline transport pilot licence and a valid Boeing 737 PPC. He joined First Air on 01 April 1999. He progressed from captain on the de Havilland DHC-6 to first officer on the Boeing 737. He had a total time of about 9500 hours, of which 840 hours were on the Boeing 737. He had carried out 1 landing in the past 24 hours, 2 landings in the past 3 days, and 15 landings in the past 30 days. The first officer was based at and familiar with Yellowknife Airport.

The cabin crew consisted of one purser and three flight attendants. All were certified and qualified for their intended duties.

The Yellowknife weather at 1300 mountain daylight time¹ was as follows: wind from 140° at 2 knots; visibility 15 statute miles; a few clouds at 3000, 8000, and 21 000 feet; temperature 10°C; dew point -2°C; and altimeter setting 29.90 inches of mercury.

Yellowknife Airport is operated by the Government of the Northwest Territories. Runway 33 is asphalt, 7500 feet long, and 150 feet wide and has a threshold elevation of 658 feet above sea level (asl). The runway is equipped with an instrument landing system and a non-directional beacon for instrument approaches. The runway is also equipped with a wind direction indicator and a 2-bar visual approach slope indicator system.

The maximum take-off weight of C-GNWI was 53 071 kg. The aircraft is configured as a combi aircraft and equipped with a gravel kit and a cargo door. Records show that the aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The weight and balance form prepared for the flight from Edmonton, Alberta, to Yellowknife, Northwest Territories, shows that the aircraft's weight was below maximum authorized take-off and landing limits and that the centre of gravity was within the normal range.

The cockpit voice recorder had been overwritten; there was no recorded data related to this occurrence.

The aircraft flight data recorder was sent to the TSB Engineering Laboratory, and the data were recovered. It was determined that the aircraft's altitude decreased at approximately 700 to 800 feet per minute (fpm), from 1150 feet asl to 670 feet asl, until just before touchdown. (The

¹ All times are mountain daylight time (Coordinated Universal Time minus six hours).

runway elevation is about 660 feet.) At a radio altitude of less than 200 feet, the pitch attitude dropped to -2.3° and the descent rate increased to 1140 fpm. The landing flare began at an altitude of approximately 45 feet, 2.3 seconds before touchdown. Coincident with the nose-up control command, engine pressure ratio (EPR) increased from 1.25 to 1.34. The first touchdown occurred with a descent rate of 400 fpm, a throttle setting of 1.34 EPR, a speed of 125 knots indicated airspeed (KIAS), and 1.86g. The aircraft rebounded into the air, touched down a second time 3.5 seconds later, at 122 KIAS and 1.75g, and again rebounded. During the second rebound, the throttle levers were moved to idle thrust. About 6 seconds after the initial touchdown, the aircraft touched down on the nose gear, at 128 KIAS and 3.2g. The touchdown control column command sequence was as follows: 7° nose up 1 second before initial touchdown, neutral 1 second after; 10° nose up 1 second before the second touchdown, 6° nose down 1 second after; and 2° nose up at final touchdown, 8° nose down 1 second after.

The *First Air Boeing 737 Aircraft Operating Manual* states that “in the event of a bounced landing, the pilot flying should hold or re-establish normal landing attitude. Add thrust as necessary to control the sink rate. Do not push over, as this may cause a second bounce and possibly damage the nose gear.”

The Boeing 737 pitch, roll, and yaw flight controls operate hydraulically. These controls are complemented by high-lift leading-edge slats, leading-edge flaps, and two trailing-edge flaps. The two ground spoilers and the two flight spoilers acting as speedbrakes provide aerodynamic braking in the air. On the ground, they add drag and destroy lift, making braking more efficient. The speedbrakes were armed during the pre-landing check. For nominal auto speedbrake operation, the following conditions must occur:

- The speedbrake handle is in the armed position.
- The speedbrake armed light is illuminated.
- The throttles are retarded to idle (thrust lever angle [TLA] less than $12.5 \pm 1^\circ$).
- The right main-gear strut is compressed 5 inches or the main-gear wheels, in any of the following combinations, are rotating at 60 knots or above:
 - a) two left wheels
 - b) two right wheels
 - c) left and right inboard wheels
 - d) left and right outboard wheels

A functional check of the speedbrake lever actuator control and the indicating circuits was completed using the antiskid-autobrake-autospeedbrake tester (F80129-100) and in accordance with the Boeing 737 maintenance manual. No functional discrepancies were identified. The microswitches that control the autocommand for ground-spoiler retraction triggered at a TLA of 12.5° . To estimate if the power levers were forward or aft of the 12.5° TLA position at 1.34 EPR, the flight crew of a fleet sister ship was asked to mark the quadrant frame position that represented 1.34 EPR in the landing configuration on approach to Yellowknife. The crew marked the console at two inches forward of the end of the slot. This placed the power levers at approximately one inch forward of the point at which the microswitches engaged.

Analysis

The approach profile, based on data from the flight data recorder, was normal until the aircraft reached 200 feet on the radio altimeter. At this point, the pilot flying decreased the body angle and the descent rate increased to about 1080 fpm. The landing flare or rotation was then

completed late (about 45 feet above the touchdown zone) with power being applied to try to reduce the sink rate. The aircraft touched down with a high sink rate, and, because of the TLA position, the ground spoilers did not deploy. The combination of power application, high sink rate, and the lack of spoiler deployment resulted in the aircraft rebounding. The actions taken to correct the bounce resulted in a rebound. When the captain took control, retarded the throttles, and lowered the nose to minimize the bounce, the nose-down control deflection resulted in the aircraft landing nosewheel first.

The following TSB Engineering Laboratory reports were completed:

LP 036/2001—FDR/CVR Analysis

LP 066/2001—Pilot Seat Load and Stress Analysis

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

Findings as to Causes and Contributing Factors

1. Incorrect bounced landing recovery procedures were carried out when the captain pushed forward on the control column to prevent a further bounce, and the aircraft landed nosewheel first.
2. The high sink rate on the initial flare was not recognized and corrected in time to prevent a bounced landing and a subsequent bounced landing.

Other Findings

1. The power increase during the flair resulted in the speedbrake/spoilers retracting.
2. The captain had not received a line check of at least three sectors before returning to flight duties, although this check was required to regain competency after pilot proficiency check expiry.

Safety Action

As a result of this occurrence, the company has amended the operational control procedures to ensure that a crew member who is unavailable for normal operations scheduling is removed from the operations database. The crew member cannot be reinstated until the chief pilot verifies that all qualifications are up to date.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 19 June 2002.