AVIATION OCCURRENCE REPORT

LOSS OF CONTROL AND RUNWAY EXCURSION

PROPAIR INC.
SWEARINGEN SA226-TC C-GKFS
PUVIRNITUQ, QUEBEC
23 OCTOBER 1996

REPORT NUMBER A96Q0176

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Summary

Propair flight 450, a Swearingen SA226-TC (serial number TC-215E) with 13 persons on board, was on a charter flight from La Grande Rivière, Quebec, to Puvirnituq, Quebec. The co-pilot was in the right-hand seat and was flying the aircraft. Following an instrument approach to runway 19, the aircraft broke through the cloud layer and the co-pilot switched to visual for the final approach. As soon as the nose gear touched down on landing, the aircraft veered left. The co-pilot applied full right rudder and throttled back to GROUND IDLE in preparation for reversing thrust. A short time later, the pilot-in-command took the controls of the aircraft and left the throttle levers on GROUND IDLE. He then observed that the aircraft was drifting further to the left and that, even when he applied full right rudder, he was unable to correct the drift. As a last resort, he pressed the PARK button for the nosewheel steering system, but the aircraft continued its course toward the runway edge and crashed at the bottom of the embankment. The investigation established that the aircraft left the runway about 2,000 feet from the threshold after turning left 90 degrees relative to the runway centre line. The nose gear and main landing gear separated from the aircraft when the aircraft fell from the runway shoulder to the bottom of the embankment.

One passenger sustained minor injuries. All occupants evacuated the aircraft without difficulty via the emergency exits. The occurrence happened during daylight.

Ce rapport est également disponible en français.

Other Factual Information

According to the crew, the weather at the time of the landing was as follows: sky overcast at 1,900 feet, no precipitation, visibility over 15 miles, and winds from 140 degrees magnetic at 15 knots.

The runway is 5,000 feet long by 100 feet wide, and has a gravel surface. The surface is hard-packed and rough. The runway has shoulders about 30 feet wide and is built up in places. Where the aircraft left the runway and came to rest, there is a drop-off of about 6 feet from the level of the runway. At the time of the landing, the runway was wet, but the surface was uniformly compacted and hard. There was no standing water that could have affected aircraft braking.

The crew members were certified and qualified for the flight in accordance with existing regulations. The pilot-in-command had 1,050 flying hours on type and the co-pilot had 350 flying hours on type. Both pilots were familiar with gravel runway operations. Neither pilot had taken a course on cockpit resource management (CRM). CRM relates to the interaction between flight crew members during the flight. CRM training helps pilots and other members of the crew to communicate better, so as to ensure a better coordinated and more effective response in an emergency. The benefits of this training and its contribution to the advancement of aviation safety are well known in the industry. CRM training is not mandatory for commuter airlines.

The aircraft is equipped with a variable authority nosewheel steering system. An electrically controlled hydraulic servo-valve is used to steer the nosewheel. System controls include a switch to test system operation to the left and right, an ARM switch to ready the system for activation, and a PARK button. These switches are mounted on a panel in the cockpit to the left of the pilot-in-command. One switch of the nosewheel steering system is mounted on the left throttle lever, and is hard to reach from the co-pilot's seat. To activate the nosewheel steering system, the button on the left power lever must be depressed or the right speed lever retarded to LOW, while the system is armed. Nosewheel steering is then controlled by the rudder pedals. But if the system detects a malfunction or if the nosewheel is more than 3 degrees from the rudder pedal position, the system will not activate. Because of the sensitivity of the steering at higher speeds and the effectiveness of the rudder, the company recommended to its pilots that they not use the nosewheel steering system at speeds exceeding 60 knots. However, according to Fairchild Aircraft Incorporated, the steering is available and can be used to correct a drift when all other means fail. The nosewheel steering system is not used for normal take-off and landing procedures; rather, it is used to facilitate ground manoeuvres at low speed. The PARK button is used for tighter turns; the system increases nosewheel deflection from 10 degrees to the right or left to 60 degrees to the right or left. To activate the PARK button, the nosewheel steering system must be armed and the button on the left power lever must be depressed or the right speed lever retarded to LOW.

On the final approach and in accordance with the pre-landing checks, the pilot-in-command engaged the nosewheel steering ARM switch. On landing, the main gear touched down at about 110 knots and, according to the co-pilot, the nosewheel touched down about two seconds later. As soon as the nosewheel touched down, the aircraft started to veer left. The co-pilot immediately applied full right rudder, and throttled back to GROUND IDLE so that he could then move the levers to reverse thrust to correct the drift to the left, but he did not use the brakes. He did not tell the pilot-in-command he was having difficulty keeping the aircraft straight. The pilot-in-command took the controls at about 80 knots and left the throttle levers on GROUND IDLE so as not

to use the reverse thrust, in accordance with the standard operating procedures for gravel runways. He was surprised at the amount of force he had to apply to the right rudder pedal to try to straighten the aircraft. He did not try to engage the nosewheel steering system. As a last resort, he pressed the PARK button on the nose gear steering wheel and applied full reverse thrust, but the aircraft continued its course toward the embankment at the edge of the runway and crashed at the bottom.

The marks made by the aircraft tires on the gravel runway surface confirm that there was no skidding and no significant application of the brakes before the aircraft left the runway. The distance between the nose gear and left main gear was measured at 2 metres, while the distance between the nose gear and right main gear was 2.8 metres. This confirms that the nose gear was in fact deflected left during the landing roll. No sign of failure was found on the tires or brakes. The blades of both propellers were found at the same reverse pitch angle. The nose gear bent backward on impact. Part of the hydraulic servo-valve that is mounted in the nose gear and controls nosewheel steering fractured on ground impact. It was not possible to analyze the hydraulic fluid in the hydraulic servo-valve because the fluid had leaked out.

Examination of the wreckage and aircraft controls revealed no malfunctions which could have contributed to the accident. The nosewheel steering system was sent to the TSB Engineering Branch Laboratory for analysis. The hydraulic and electronic components, including the hydraulic servo-valve, were forwarded to the manufacturer, Fairchild Aircraft Incorporated, for testing. Test results revealed no pre-impact damage which could have contributed to drifting.

When the aircraft was certified, the maximum demonstrated cross-wind component was 20 knots at a 90-degree angle to the runway. No cross-wind limitations are recommended by the manufacturer. Limits are left to the discretion of the operator or pilot, and depend on the skill and experience of the individual. According to the company chief pilot, a 15-knot cross-wind from 45 degrees is considered negligible for this type of aircraft.

The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The aircraft had no known deficiencies before the flight. It was being operated within the prescribed limits for weight and centre of gravity. The Airworthiness Directives applicable to the aircraft were completed in accordance with existing regulations. In May 1995, the manufacturer issued Service Bulletin SB226-32-058, which proposed the optional replacement of the hydraulic servo-valve in the nosewheel steering system to improve system operation. Note that users are not required to comply with service bulletins. The manufacturer's index of service bulletins, which was revised in February 1996 and was in the operator's possession, indicated that SB226-32-058 had not been issued. A printing error was made by the manufacturer, but it has since been corrected. The bulletin was in fact among the operator's records, but the hydraulic servo-valve had not been changed. The history of this type of servo-valve shows that contamination of the hydraulic fluid can degrade operation of the servo-valve and cause a situation similar to the accident described here.

Emergency procedures for a nosewheel steering malfunction are provided in the aircraft manual. These procedures state that in the event of an uncommanded deflection of the nosewheel, directional control of the aircraft must be maintained using any or all of: the rudder pedals, brakes or power. In addition, the nosewheel steering system must be switched off.

According to the company chief pilot, the emergency procedures for a nosewheel steering malfunction, particularly the emergency procedure for uncommanded nosewheel deflection, were unclear and were not well understood by his pilots and several other pilots experienced on this type of aircraft. He also reported that there are no memorized checklist items indicating the actions to take in the event of an uncommanded nosewheel deflection, and that it is difficult, if not impossible, to refer to the manual when this type of emergency arises.

The emergency exits were used for the evacuation because the main door of the aircraft was jammed.

Analysis

In this accident, the aircraft's left turn on landing may be attributed to several factors. The possibility that the left brake locked up on landing was eliminated, and the runway condition was not a factor. A 15-knot cross-wind from 45 degrees can be controlled easily with the rudder pedals and was considered negligible for this type of aircraft. Application of full right rudder, as described by the crew, should have corrected the drift of the aircraft, but it did not. An aircraft may also turn because of a deflection of the nosewheel. Although such a deflection was not confirmed by analysis, the elimination of all other factors indicates that the nosewheel probably was deflected to the left during the landing. The investigation consequently focused on the actions of the crew during the landing, because the aircraft was maintained in accordance with existing regulations and the tests and analyses revealed no other malfunctions.

On the landing, the system was armed and could be used. The nosewheel touched down at a speed of about 110 knots, and the aircraft suddenly veered left. As use of the system was not recommended at speeds over 60 knots and the button used to engage the system was hard to reach from the co-pilot's seat, the co-pilot tried to correct the drift with the right rudder pedal, without telling the pilot-in-command that he had difficulty maintaining directional control of the aircraft. As he was preparing to apply reverse thrust at about 80 knots, the pilot-in-command took the controls of the aircraft. The pilot-in-command was surprised at the amount of force he had to apply to the right rudder pedal. He did not attempt to use the nosewheel steering system, but that would have been impossible without first centring the rudder pedals because they were clearly over three degrees from the nosewheel position. Also, the pilot-in-command did not use reverse thrust because the runway surface was gravel. The marks on the runway indicate that there was no significant braking. The pilot-in-command was unable to maintain directional control of the aircraft, which continued its course to the left and exited the runway.

The servo-valve was serviceable, but it was not possible to analyze its hydraulic fluid. The manufacturer merely suggested that the servo-valve be replaced and forgot to list the service bulletin in the bulletin index; consequently, the servo-valve of the aircraft was not replaced, but replacement was not mandatory. Publication of a service bulletin implies that the airworthiness of the aircraft is not in jeopardy; it is reasonable to believe, however, that replacement of this servo-valve might have prevented the accident.

The lack of clarity and understanding of the emergency procedures and the lack of communication between the co-pilot and pilot-in-command did not facilitate directional control of the aircraft during the landing roll. Had there been memorized checklist items for the emergency procedure to be followed in the event of an

uncommanded nosewheel deflection, and had the co-pilot told the pilot-in-command that he was having difficulty keeping the aircraft straight and was going to use the thrust reversers to bring the aircraft back on course, the pilot-in-command might have used reverse thrust and would not have been surprised at the amount of force he had to apply to the rudder pedal to maintain directional control of the aircraft. In addition, the pilot-in-command might have made greater use of the brakes and propellers and disarmed the nosewheel steering system to maintain directional control of the aircraft, as specified in the user manual approved by the Federal Aviation Administration (FAA). A CRM course would likely have had a beneficial effect on the crew and the actions they took in this occurrence.

The following laboratory report was completed:

LP 168/96 - Swearingen Nosewheel Steering System.

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

Findings

1. The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures.

2. The weight and centre of gravity were within the prescribed limits.

3. The pilot-in-command and co-pilot were certified and qualified for the flight in accordance with existing regulations.

4. The co-pilot did not tell the pilot-in-command that he had difficulty controlling the aircraft on the landing roll.

5. The marks made by the aircraft tires on the runway surface confirm that there was no skidding and no significant application of the brakes before the aircraft left the runway.

6. The blades of both propellers were found at the same reverse pitch angle.

7. Examination of the wreckage, and the tests on components, revealed no pre-impact malfunctions that could have contributed to the sudden deflection of the nosewheel to the left.

8. The hydraulic servo-valve was serviceable, but its hydraulic fluid could not be examined.

9. The manufacturer's index of service bulletins, which was revised in February 1996, indicated that Service Bulletin SB226-32-058 had not been issued. This bulletin proposed the optional replacement of the hydraulic servo-valve in the nosewheel steering system. The operator had SB226-32-058 in its possession, but the hydraulic servo-valve had not been changed. Replacement of the servo valve might have prevented the accident.

10. The nosewheel was probably deflected left on the landing, for reasons that could not be determined.

11. The members of the crew had not received CRM training.

12. There are no memorized checklist items indicating the actions to take in the event of an uncommanded nosewheel deflection.

Causes and Contributing Factors

The aircraft left the runway during the landing roll because the nosewheel was probably deflected left, for reasons that could not be determined. Contributing to the accident were a lack of communication in the cockpit and the actions taken by the crew to maintain directional control of the aircraft.

Safety Action

After this accident, the company took the initiative of sending all its pilots on a CRM course.

The Board made two recommendations in 1995, A95-11 and A95-12, to Transport Canada (TC) on CRM training requirements for all operators and aircrew involved in commercial aviation. TC responded by mandating CRM training for all airline operations. However, Air Taxi (CAR 703) and Commuter (CAR 704) operations are still not required to have mandatory CRM training, even though these operators are involved in the majority of occurrences where the lack of CRM is a factor. In the last two years there have been at least two other occurrences involving Air Taxi or Commuter operators where poor crew coordination may have contributed.

In addition an Aviation Safety Advisory has been forwarded to Transport Canada to review the appropriateness of the emergency operating procedures pertaining to a loss of directional control on the ground for Swearingen SA-226 aircraft.

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 19 November 1997.