

AVIATION OCCURRENCE REPORT

REJECTED TAKE-OFF/RUNWAY EXCURSION

PROPAIR INC.
BEEHCRAFT SUPER KING AIR 200 C-GCEV
SEPT-ÎLES AIRPORT (QUEBEC)
28 JANUARY 1997

REPORT NUMBER A97Q0015

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

The Propair Inc. Super King Air 200 (serial number BB-153), with two pilots and ten passengers on board, was preparing to make a charter flight under instrument flight rules from Sept-Îles to Dorval, Quebec. At 1700 eastern standard time (EST), the co-pilot, in the left seat, began the take-off roll on runway 09. At an indicated airspeed of about 90 knots, 5 knots below rotation speed (V_R), the aircraft began to drift to the left, toward the runway edge. The copilot attempted unsuccessfully to correct the take-off track using the rudder. At around 100 knots, just before the aircraft exited the runway, the co-pilot pulled the elevator control all the way back and initiated a climb. At about the same moment, the pilot-in-command throttled back, believing that a collision with the snowbank at the runway edge was inevitable. The aircraft descended until it struck the snow-covered surface to the north of the runway and slid on its belly before coming to rest on a heading opposite to the take-off heading. The pilot-in-command was slightly injured. The aircraft sustained considerable damage. The occupants used the main door to evacuate the aircraft.

Ce rapport est également disponible en français.

¹ All times are EST (Coordinated Universal Time [UTC] minus five hours) unless otherwise noted.

Other Factual Information

The aircraft was originally scheduled to depart at 1645. The flight was delayed because the pilots had difficulty taxiing to runway 09 because of the poor visibility and the blowing snow.

The take-off run began about 200 feet from the threshold of runway 09, where Alpha taxiway begins.

The co-pilot, under the supervision of the pilot-in-command, had been authorized by the pilot-in-command to perform the take-off from the left seat in accordance with the operator's policies. Before take-off, the co-pilot had given the pilot-in-command instructions on the division of tasks, the critical speeds, and the procedure in case of an anomaly. The critical engine failure speed or take-off decision speed (V_1) and the V_R were the same. The co-pilot had selected a V_1 of 105 knots, 10 knots higher than the speed suggested by Beechcraft and 5 knots higher than the speed that the pilot-in-command thought he heard and that is normally selected by the company's crews. No instruction or particular procedure concerning the existing environmental conditions was discussed during the briefing.

Just before take-off, light snow and blowing snow had been reported. The wind was blowing at 20 knots, with gusts to 30 knots from 140° magnetic. The runway visual range (RVR) at take-off was 1,600 feet. Runway 09 is 6,572 feet long by 200 feet wide and asphalt surfaced. At the time of the accident, a four-foot-high snowbank ran along the edge of the runway. The runway had been partially cleared, and a runway surface report had been made 35 minutes before the occurrence. The centre of the runway had been cleared over a width of 100 feet, and was 60% bare and dry, 15% covered with packed snow and 25% covered with snow-drifts less than one inch high; 8 to 12 inches of snow covered the remaining width on each side of the runway.

The aircraft, flaps up, was aligned on the runway centre line, and the co-pilot opened the throttles while the pilot-in-command selected take-off power when the engine torque reached 1,000 foot-pounds. At 80 knots, the pilots confirmed that the airspeed indicators were operating and that take-off power had been set and stabilized. Until that time, the take-off roll was normal, although it had been punctuated by bumps that the pilots attributed to the snow-drifts on the runway. At an indicated airspeed of about 90 knots, the aircraft began to drift to the left. The co-pilot tried to correct the track of the aircraft by pressing gradually on the right rudder control until it was fully depressed. The aircraft continued to drift rapidly toward the north edge of the runway. In the meantime, the aircraft reached 100 knots and the pilot-in-command announced V_1 . The co-pilot, who did not hear the V_1 announcement, then announced "*J'ai la vitesse*" [I have reached the speed]. He took his hand off the throttles to take the wheel, and pulled the control column all the way back to avoid a runway excursion.

At about the same moment, the pilot-in-command, who was not aware of the control problems, looked outside to check on the flight's progress. He suddenly realized that the aircraft was headed off the runway, and that the co-pilot was pulling on the control column to take off. Believing that the aircraft would not clear the snowbank at the runway edge and that a runway excursion was imminent and unavoidable, the pilot-in-command, without informing the co-pilot, immediately reduced power by throttling back. He wanted to slow the aircraft and reduce the force of the impending impact.

The aircraft, which was in flight, descended until it struck the snow-covered surface north of the runway, then slid on its belly before coming to rest on a heading opposite to the take-off heading. The stall alarm never

sounded. As soon as the aircraft came to rest, the pilots carried out the appropriate procedures and checks. The pilot-in-command was slightly injured. The aircraft sustained considerable damage.

The pilot-in-command was certified and qualified for the flight in accordance with existing regulations. He had a total of more than 1,300 hours on the aircraft. The co-pilot had taken his pilot proficiency check (PPC) as pilot-in-command in November 1996. Both pilots had little experience with take-offs with an RVR of less than 2,600 feet. The pilot-in-command, who had made five flights with the co-pilot previously, considered the co-pilot a professional and competent pilot. Neither of them had taken a cockpit resource management (CRM) course. Only operators using aircraft carrying 20 passengers or more and weighing over 19,000 pounds are required to provide CRM training. CRM covers the factors associated with effective crew co-ordination, such as communication, decision making, and workload management.

The take-off minimum for runway 09 at Sept-Îles Airport was an RVR of 2,600 feet. Transport Canada (TC) had granted Propair authorization, in the form of an operating specification, to take off with the Beech 200 when the RVR was 1,200 feet. The company was to respect the requirements of Canadian Aviation Regulations (CARs), paragraph 724.26(2)b): *Take-off Minima Reported Visibility RVR 1,200 feet (¼ mile) - Aeroplanes without Certified Engine-out Take-off and Climb Performance of the Commercial Air Services Standards.*

One of the requirements of paragraph 724.26(2)b) was that, for aircraft with uncertified performance, like the Beech 200, the pilot-in-command was to receive ground and simulator training. The pilot was to carry out a rejected take-off on a simulator for the aircraft type in question in an RVR of 1,200 feet immediately before V₁. However, after studying the supplementary operating data supplied by Raytheon Beechcraft, TC judged that initial and annual simulator training was not compulsory for Beech 200 operators. Neither the pilot-in-command nor the co-pilot had received this simulator training, and no such training was required.

It is a common practice for the role of pilot flying (PF) to alternate between the pilot-in-command and co-pilot on each flight leg, and Propair endorsed this practice. The company also encouraged its pilots-in-command to authorize experienced co-pilots, when the PF, to fly from the left seat. No operational or environmental restrictions had been specified, and the pilot-in-command had full decision-making authority in this regard. The purpose of the policy was to facilitate the co-pilots' eventual transition to pilot-in-command. In that respect, paragraph 724.115(21) of the *Commercial Air Services Standards* stipulates that, if the operator authorizes the co-pilot to conduct take-offs in lower than standard weather minima, the co-pilot must undergo the same training as the pilot-in-command. Only the pilot-in-command had the necessary training to take off in an RVR of 1,200 feet. The company and the two pilots presumed that if the pilot-in-command had the necessary qualifications for an RVR of 1,200 feet, the co-pilot was automatically authorized to perform the take-off.

Analysis of the site showed that the aircraft rolled for about 1,850 feet before taking off, that it flew for 500 feet on a track of 78° magnetic before striking the snow, and that it was nose-up at the moment of impact. The

² The take-off process is illustrated in Appendix A.

aircraft's estimated performance was slightly below that published in the flight manual take-off distance table. On a dry, firm, and horizontal surface, with a V_R of 95 knots, the Super King Air could take off after a roll of 1,650 feet.

No failure or malfunction of the aircraft systems or components was found to have contributed to the occurrence. The aircraft was certified and maintained in accordance with existing regulations and approved procedures. The aircraft weight and centre of gravity were within prescribed limits. The aircraft manufacturer had not established any maximum cross-wind component.

The *Canadian Aviation Regulations* (CAR) came into force on 10 October 1996. A new regulatory requirement stipulated that air carriers establish Standard Operating Procedures (SOP). Briefly, SOPs must clearly and precisely state the responsibilities and tasks of the pilot-in-command and the co-pilot, as well as the PF and the pilot not flying (PNF), for each flight leg and in certain specific situations. SOPs must include the following items: co-ordination between crew members; standardized instructions; standardized announcements; and, rejected take-offs.

Some CAR provisions were assessed as requiring time after coming into force to ensure compliance. Air operators were given a 60-day conditional transition period to determine the requirements for amendments to their SOPs. Since Propair had not completed its SOP manual and had undertaken to make major amendments to its operation documents, TC had extended the company's transition period.

A rejected take-off (RTO) is a take-off that is discontinued after take-off power has been set and the take-off roll has begun. Propair's rejected take-off procedure and the training related to RTO were in compliance with TC requirements. The responsibility and tasks for each pilot were defined by the check pilots during training flights on the aircraft in question. If a pilot discovered an anomaly, he was to announce it; it was the PF who was to reject the take-off when the aircraft speed was below V_1 . Although the pilot-in-command was responsible for the operation and safety of the aircraft, he was to inform the co-pilot of his intentions before taking control of the aircraft. Although those responsibilities and tasks were not specified either in the aircraft manual nor in the company's operation manual, they were recognized by Propair. Because of the risk, RTO exercises near V_1 were rarely practised by the pilots. Also, the procedure was practised only with the check pilot. Neither the pilot-in-command nor the co-pilot had carried out an RTO at high speed before.

Analysis

Because no pre-impact technical anomaly or mechanical failure that could have explained the aircraft's drift to the left was identified, it appears that the loss of directional control was due to the condition of the runway, the environmental conditions, and the late application of corrective measures.

The take-off roll took place at night, on a partially contaminated runway, in a cross-wind of 16 to 23 knots from the right, and in reduced visibility conditions in snow and blowing snow. Analysis of the weather and runway conditions suggests that, at the time of the occurrence, the surface likely was more contaminated than the latest runway report indicated, and that the available width was less than 100 feet as reported.

The pilot-in-command should have performed the take-off, since the co-pilot had not received the training required by the existing regulations for take-off in lower than standard minima. Given that the pilot-in-command had little experience in taking off with an RVR of 1,200 feet, it is probable that if he had received simulator training that included take-off exercises in these conditions, he would have been more conscious of the risks involved and that he would have performed the take-off himself. It seems that the following factors affected the pilot-in-command's decision: the flight crew and the company believed that if the pilot-in-command had the necessary qualifications, the co-pilot could take off in an RVR of 1,200 feet; the pilot-in-command considered the co-pilot sufficiently skilled to perform take-offs in the existing conditions; the company encouraged co-pilots to fly from the left seat; and, there were no published procedures for take-off in lower than standard minima.

Except for a V_1 of 105 knots rather than 100 knots, the co-pilot's briefing was completed in routine fashion, although the environmental conditions dictated a more exhaustive briefing. A more elaborated briefing would have allowed the pilots to plan the take-off in light of the existing conditions and to formulate a joint plan in case of emergency. The fact that the pilot-in-command erroneously thought that the co-pilot had selected a V_1 of 100 knots indicates that the instructions were taken for granted, at least in part, and the take-off was commenced with each pilot having a different decision speed in mind. This misunderstanding did not contribute to the accident, since the co-pilot initiated rotation at 100 knots, however, it indicates a lack of co-ordination even before the roll began. In fact, the briefing did not improve cohesiveness in the cockpit, as it should have done.

Between 90 knots and 100 knots, the co-pilot had three to four seconds to warn the pilot-in-command that the aircraft was drifting to the left. He did not consider it necessary to report the loss of control immediately, believing that he would be able to correct the turn; subsequently, he was too preoccupied by the events to inform the pilot-in-command. Thus, the pilot-in-command was deprived of information crucial to the flight. The pilot-in-command was only partially aware of what was happening around him. Since he did not have an overall and accurate understanding of the situation, he could hardly make an effective decision. Efficient interpersonal communications are crucial to crew co-ordination. The pilot-in-command might have reacted differently if he had had more time to analyse the situation.

The announcements made after the aircraft began to drift were inaudible, non-standard, or non-existent: the co-pilot did not hear the statement " V_1 " at 100 knots; the co-pilot announced "*J'ai la vitesse*" [I have reached the speed] instead of V_1 , which the pilot-in-command did not hear; and, the pilot-in-command did not announce that

he was rejecting the take-off. Thus, the crew members did not have the same understanding of what had to be done. The terms “V₁”, “V_R”, “Reject” and “Abort” are standard expressions that are unequivocal when they are pronounced clearly. It is possible that the pilot-in-command would not have cut power if the co-pilot had clearly and precisely communicated the loss of directional control of the aircraft and his intention to continue the take-off.

The pilot-in-command was surprised to discover that the aircraft was heading off the runway and that the co-pilot was attempting to take off. Because the emergency was so sudden, he had very little time to analyse the situation correctly. He concluded that a runway excursion was imminent and that the aircraft would crash in the snow. The pilot-in-command immediately decided to reject the take-off on the basis of his understanding of the circumstances, understanding that cutting the power would result in a crash. According to his understanding of the situation, cutting the power to reduce the aircraft’s speed was the safest action to take. The crew was confronted with an unusual situation for which they were not prepared.

According to company procedures and the agreements made in the preflight briefing, it was up to the co-pilot, as the PF, to make the decision to continue or reject the take-off when directional control was lost. In fact, he was the person in the best position to make such a decision. Since the co-pilot had followed the flight progression from the beginning of the take-off run, he could analyse aircraft performance more accurately.

When the co-pilot realized that he had lost directional control and that the aircraft had reached V_R, he judged that if he pulled back on the control column, the aircraft would clear the obstacles ahead. Since the aircraft did not stall before settling into the snow, and there was no obstacle along its track, it is clear that the aircraft would have continued its flight if the power had not been cut.

The crew’s actions were not coordinated the way they should have been. The following factors, although not required by existing regulations, contributed to the lack of cockpit coordination: RTO exercises with an RVR of 1,200 feet had never been practised by the crew members; they seldom practised RTO exercises; they had no experience in carrying out a RTO at high speed; the company had no published SOP ; and, the pilots had not received CRM training.

Findings

1. The co-pilot had been authorized by the pilot-in-command to perform the take-off from the left seat.
2. The pilot-in-command believed that the co-pilot had the necessary qualifications to take off in lower than standard weather minima; however, he did not.
3. The take-off roll took place at night, on a partially contaminated runway, in a strong cross-wind, and in reduced visibility conditions in snow and blowing snow.
4. During the take-off roll, at an indicated airspeed of about 90 knots, the aircraft veered to the left.
5. No pre-impact technical anomaly or mechanical failure that could have explained the aircraft’s drift

to the left was identified.

6. The loss of directional control was probably due to the condition of the runway, the strong cross-wind, and to the late application of corrective measures.
7. The decision to continue or reject the take-off when control was lost was up to the co-pilot, as the pilot flying.
8. The co-pilot decided to continue the take-off because he judged that if he pulled back on the column, the aircraft would take off and clear any obstacles.
9. The pilot-in-command decided to reject the take-off because he believed that a collision with the snowbank on the runway edge was inevitable; he wanted to slow the aircraft and reduce the force of impact.
10. The aircraft would have continued its flight if the power had not been cut.

Causes and Contributing Factors

The aircraft crashed as a result of the lack of cockpit co-ordination when the pilot-in-command took control of the aircraft as the aircraft was airborne. The following factors contributed to the occurrence: marginal environmental conditions; contaminated runway surface; poor cockpit management; ineffective briefing; and, inadequate training for rejected take-offs.

Safety Action

Since the occurrence, Propair has taken, or is in the process of taking, the following measures to improve cockpit co-ordination:

The company has initiated a study to develop a cockpit resource management (CRM) training program appropriate to its operations.

The company has developed a checklist for take-off in lower-than-standard weather minima. The checklist, in the form of a questionnaire, reiterates the requirements of the existing regulations.

The role transfer policy has been changed: co-pilots may occupy the left seat only when the pilot-in-command is a check pilot.

Propair Inc. has committed itself to revising its training program for rejected take-offs.

Propair standard operating procedures manual, which includes general procedures, procedures to be followed in normal situations, and procedures to be followed in abnormal situations and emergencies, has been published.

The company has also implemented an aviation safety program in conformity with the requirements of *Canadian Aviation Regulations* (CARs), paragraph 705.

Transport Canada is planning to increase awareness within the aviation community through safety programs, briefings on the conclusions of the report and on cockpit resource management.

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 H. Simpson and W.A. Tadros, authorized the release of this report on 30 April 1998.

Appendix A - Take-off Process

