



# National Transportation Safety Board

Washington, D.C. 20594

## Safety Recommendation

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**Date:** December 12, 2006

**In reply refer to:** A-06-83 and -84

Honorable Marion C. Blakey  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

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On August 27, 2006, about 0607 eastern daylight time,<sup>1</sup> Comair flight 5191, a Bombardier CL-600-2B19 (CRJ-100), N431CA, crashed during takeoff from Blue Grass Airport (LEX), Lexington, Kentucky. The airplane had been cleared by air traffic control (ATC) for takeoff on runway 22, which is 7,003 feet long; however, the crew mistakenly taxied onto runway 26, which is 3,500 feet long, and attempted to take off. The airplane ran off the end of runway 26, impacted the airport perimeter fence and trees, and crashed. Of the 47 passengers and 3 crewmembers on board the airplane, 49 were killed, and 1 received serious injuries. The airplane was destroyed by impact forces and postcrash fire. The flight was operating under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121 and was en route to Hartsfield-Jackson Atlanta International Airport, Atlanta, Georgia.

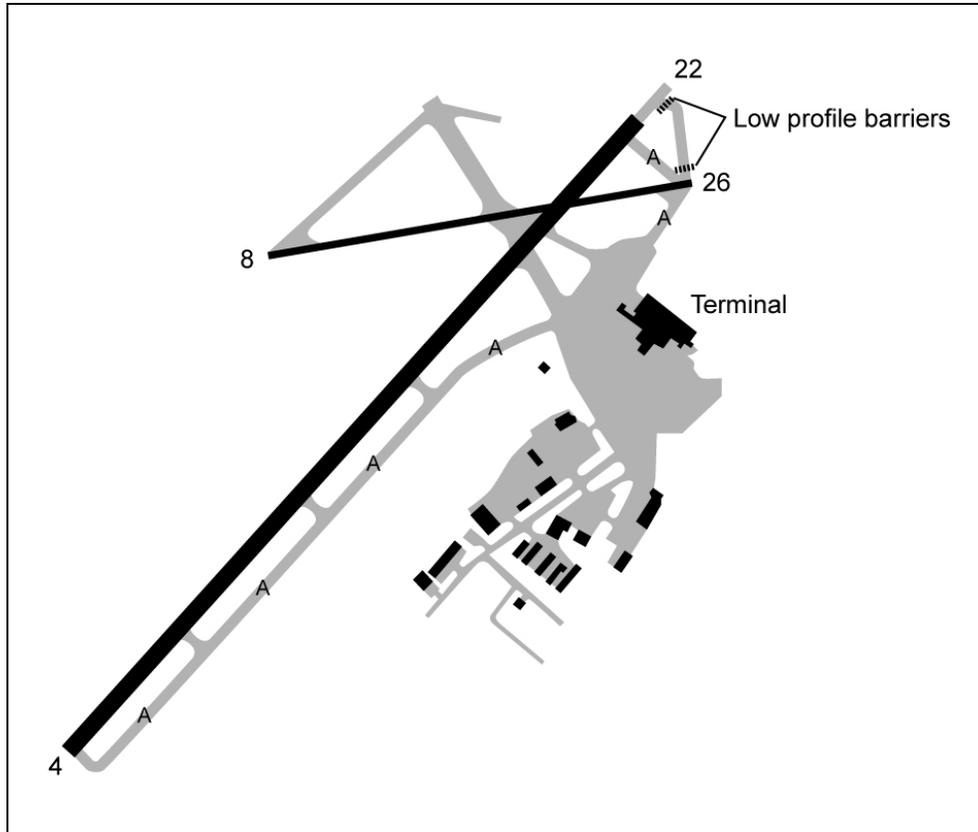
In accordance with Comair's predeparture procedures, the flight crewmembers programmed the departure runway (runway 22) into the flight management system (FMS) and set their heading bugs<sup>2</sup> to 226° to correspond with the magnetic heading for runway 22. The crew received clearance to taxi to runway 22 via taxiway A (see figure 1), which required taxiing across runway 26. After pushback from the gate, the captain taxied the airplane from the ramp onto taxiway A toward runway 22. The airplane stopped near the end of runway 26 for about 45 seconds before the flight crew requested and received clearance for takeoff. The captain then taxied onto runway 26 and aligned the airplane for takeoff before handing off the controls to the first officer, who was the flying pilot for that leg. The cockpit voice recorder (CVR) did not record any indication that either pilot was confused about the aircraft's position, but no statements were made confirming the aircraft's position. CVR and flight data recorder data indicate that, as the airplane accelerated during the initial takeoff roll, both pilots noted the

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<sup>1</sup> The accident occurred in night visual meteorological conditions before the start of civil twilight.

<sup>2</sup> A heading bug is a marker on the heading indicator that can be rotated to a specific heading for reference purposes or to command an autopilot to fly that heading. Comair pilots are required to set heading bugs for the departure runway magnetic heading, unless on-course turns are required within 400 feet above ground level after takeoff.

absence of edge lights<sup>3</sup> on the runway but continued the takeoff roll. The first statements from the pilots indicating that they saw something wrong were made immediately after the captain made the  $V_1$ <sup>4</sup>/rotate callout. Ground scar marks show that the airplane's nose gear was still on the ground as the airplane left the end of the runway.



**Figure 1.** Lexington airport diagram.

Runway 26 is 3,500 feet long and painted to indicate 75 feet of usable width.<sup>5</sup> The runway is used for general aviation aircraft, has no precision runway markings (that is, threshold bars, fixed distance markers, etc.) and no operational edge lights, and is not authorized for use at night.<sup>6</sup> In contrast, runway 22 is 7,003 feet long with 150 feet of usable width and has precision markings and operating edge lights.<sup>7</sup> At the time of the accident, both runways had appropriate

<sup>3</sup> Runway edge lights are used to outline the edges of runways at night or during low visibility conditions.

<sup>4</sup>  $V_1$ , or takeoff decision speed, is the maximum speed in the takeoff, at which the pilot must take the first action to abort the takeoff to be able to stop the airplane on the remaining runway.

<sup>5</sup> The hard surface of runway 26 is 150 feet wide.

<sup>6</sup> According to airport officials, the runway 26 edge lights were disabled because they were considered nonstandard (that is, not consistent with the usable width of the runway) after the usable runway width was reduced from its original 150 feet to 75 feet via the painting of edge lines inboard of the actual runway edge. After they were disabled, the edge lights could not be turned on by tower personnel.

<sup>7</sup> Runway 22 also had touchdown zone lighting and centerline lighting that was out of service the morning of the accident.

runway holding position<sup>8</sup> and taxiway location<sup>9</sup> signs at the taxiway entrance to each runway. Although the National Transportation Safety Board's investigation of this accident is ongoing, preliminary findings have identified safety issues that warrant the Federal Aviation Administration's (FAA) immediate attention.

## Background

### *Previous Accidents and Incidents Involving Takeoffs from Taxiways or Incorrect Runways and Related Safety Recommendations*

The Safety Board has investigated or participated in the investigation of several incidents and accidents in which flight crews used an incorrect departure runway. In 1984, the Board issued Safety Recommendation A-84-102 following its investigation of the December 23, 1983, accident involving a Korean Air Lines DC-10 in which the flight crew became disoriented while taxiing in low-visibility conditions and commenced takeoff on the wrong runway at Anchorage, Alaska.<sup>10</sup> Safety Recommendation A-84-102 asked the FAA to "require that air carriers incorporate in training of their crewmembers procedures and responsibilities during ground operations in restricted visibility conditions to enable them to operate safely in such conditions." In response, the FAA issued Air Carrier Operations Bulletin (ACOB) 8-85-1, "Crewmember Procedures and Responsibilities During Ground Operation in Restricted Visibility Conditions," on May 15, 1985. Safety Recommendation A-84-102 was classified, "Closed—Acceptable Action" on September 12, 1985.

On January 10, 1989, an Eastern Airlines DC-9 was cleared for takeoff from runway 12R at William P. Hobby Airport (HOU) in Houston, Texas, but took off from runway 17 instead. The airplane struck barricades on rotation during its takeoff roll and overflew workers and equipment on runway 17. The flight continued to its destination, and there were no injuries to any of the 67 people on board or workers on the ground. On March 23, 1989, an American Airlines DC-9 also mistakenly departed runway 17 at HOU instead of runway 12R, which was the assigned runway for takeoff.<sup>11</sup> The airplane impacted sections of wooden barriers that had been placed across runway 17. The flight continued to its destination and landed without further incident. No injuries were reported to any of the 98 occupants on board. As a result of these incidents, the Safety Board issued Safety Recommendation A-89-74 on July 17, 1989, which asked the FAA to "assure that the 'normal procedures' section of the operations manuals of all air carriers operating under ... 14 [CFR] Parts 121 and 135 requires flight crews to cross-check the heading indicator to the runway heading when the airplane is aligned with the runway for takeoff."

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<sup>8</sup> A runway holding position sign is a vertical illuminated sign that contains runway identification in white numbers on a red background.

<sup>9</sup> A taxiway location sign is a vertical illuminated sign that contains taxiway identification in yellow letters on a black background.

<sup>10</sup> For additional information, see National Transportation Safety Board, *Korean Air Lines, McDonnell Douglas DC-10-30, HL7339, Southcentral Air Piper PA-31-350, N35206, Anchorage, Alaska, December 23, 1983*, Aircraft Accident Report NTSB/AAR-84/10 (Washington, D.C.: NTSB, 1984).

<sup>11</sup> The description of this incident, FTW89IA070, can be found on the Safety Board's Web site at <<http://www.nts.gov>>.

In a September 28, 1989, letter responding to Safety Recommendation A-89-74, the FAA stated that it would revise ACOB 8-85-1 to address the need to cross-check the heading indicator with the runway heading when the airplane is aligned on the runway for takeoff. In its letter, the FAA stated that, “[a]s a matter of practice, virtually every air carrier operating under 14 CFR Parts 121 and 135 has incorporated this procedure into the normal before takeoff checks that are performed by flightcrews. In fact, American Airlines has included the instruction to compare the heading indicator to the runway heading in its MD-80 operations manual.”<sup>12</sup> The FAA issued the revision to ACOB 8-85-1 on July 23, 1990, and the Board classified Safety Recommendation A-89-74, “Closed—Acceptable Action” on December 11, 1990.

On October 31, 2000, a Singapore Airlines B-747 airplane, being operated as flight 006, crashed during an attempted takeoff from a partially closed runway at Taiwan’s Chiang Kai-Shek International Airport, killing 83 of the 179 people on board.<sup>13</sup> The Taiwan Aviation Safety Council’s (ASC) report found that the pilots failed to review the taxi route adequately to ensure that they understood that the route to runway 05L, the correct departure runway, required passing runway 05R, which was under construction and only open for taxi operations. In addition, the report stated that the pilots did not verify their position with the taxi route as they were turning onto the runway and that the company’s operations manual did not include a procedure to confirm position on the active runway before initiating takeoff. The ASC’s report concluded that the flight crew lost situational awareness and commenced takeoff from the wrong runway, despite numerous available cues that provided information about the aircraft’s position on the airport. The ASC recommended that Singapore Airlines “include in all company pre-takeoff checklists an item formally requiring positive visual identification and confirmation of the correct takeoff runway.”

On January 25, 2002, a China Airlines A340 mistakenly departed from a taxiway at Ted Stevens Anchorage International Airport, Anchorage, Alaska, instead of the assigned runway. The available distance on the taxiway was 6,800 feet, while the airplane’s calculated takeoff distance was 7,746 feet. The airplane took off, proceeded to its destination, and landed without further incident. The airplane’s main landing gear left impressions in the snow berm at the end of the taxiway.<sup>14</sup> As a result of this incident, China Airlines modified its A340 operating manual to include verbalization and verification of the runway in use.

A query of the National Aeronautics and Space Administration Aviation Safety Reporting System (ASRS) found 114 reports of incidents from March 1988 to September 2005 in which flight crews lined up on the wrong runway for takeoff. The ASRS data indicate that wrong

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<sup>12</sup> The FAA’s letter also quoted from page 19 of the Safety Board’s accident report on the Anchorage, Alaska, accident, which stated that “other airline checklists require pretakeoff runway confirmation and accepted practice is to check heading indicators before starting the takeoff.”

<sup>13</sup> The Safety Board participated in the investigation of this accident as a representative of the State of Manufacture in accordance with the provisions of Annex 13 to the Convention on International Civil Aviation. For more information, see Aircraft Accident Report, *Crashed on a Partially Closed Runway During Takeoff, Singapore Airlines Flight 006, Boeing 747-400, 9V-SPK, CKS Airport, Taoyuan, Taiwan, October 31, 2000*. Aviation Safety Council, Taiwan, Republic of China.

<sup>14</sup> The Safety Board determined that a contributing factor in the incident was inadequate airplane operator’s procedures that did not require the crew to verbalize and verify the runway in use before takeoff. The description of this incident, ANCO2IA011, can be found on the Safety Board’s Web site at <<http://www.nts.gov>>.

runway takeoff events have involved both intersecting and parallel runways.<sup>15</sup> The ASRS reports indicate that the pilots involved, ATC, or other aircraft in the area detected mistakes either before or after takeoff. For example, a report from 1993 (submitted by an air carrier pilot operating out of LEX) stated that the flight had been cleared for an immediate takeoff on runway 22, but, because of the weather, the pilots taxied onto the runway and told ATC that they “needed a moment to check [their] departure routing with [their] weather radar.” The report stated that the pilots realized their heading was not correct for the assigned runway and that “at that moment [the] tower called us to cancel takeoff clearance because we were lined up on runway 26.” The pilot who submitted the report cited poor visibility and rain as factors, along with a confusing runway intersection in which multiple runway ends are in the same general location.

#### *Part 121 Flight Crew Procedures for Confirming Correct Departure Runway Alignment*

Despite the Safety Board’s 1989 recommendation that the FAA ensure that the operations manuals of all 14 CFR Part 121 air carriers require flight crews to cross-check the heading indicator to the runway heading when the airplane is aligned with the runway for takeoff, Comair did not have any written procedures specific to runway identification before takeoff at the time of the accident involving flight 5191.<sup>16</sup> In September and October 2006, Safety Board investigators contacted several 14 CFR Part 121 operators to identify whether they had established flight crew procedures for positively verifying an airplane is on the correct departure runway before takeoff is initiated, including checking the runway heading. Investigators learned that procedures varied across operators, ranging from no written procedures to a positive challenge and cross-check between pilots upon turning onto the runway. Some of the operators that had a procedure required pilots to repeat the runway number and to receive a verifying response from the other pilot before takeoff. Others specified that the heading bug would be used as a cross-check to verify alignment on the correct runway.

#### *FAA Guidance and Recent Actions Regarding Correct Departure Runway Alignment*

FAA Advisory Circular (AC) 120-74A, “Parts 91, 121, 125, and 135 Flightcrew Procedures During Taxi Operations,” dated September 26, 2003,<sup>17</sup> contains guidelines for establishing standard operating procedures to promote safe aircraft ground operations. For example, in a section addressing crew verbal coordination on the flight deck, the AC states, “Before entering a runway for takeoff, the flightcrew should verbally coordinate to ensure correct identification of the runway and receipt of the proper ATC clearance to use it.” Appendix 2 in the AC contains information specific to runway incursion prevention and, under a section titled “Recommended Practices and Techniques,” states that flight crews should “verify that the compass heading approximately matches the runway heading and taxiway orientation” to

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<sup>15</sup> The Safety Board notes that, on October 30, 2006, an Alaska Airlines Boeing 737 with 71 passengers and 5 crew on board mistakenly departed runway 34R at Seattle-Tacoma International Airport, Seattle, Washington. The airplane had been cleared for takeoff on runway 34C. The cause of this incident is under investigation.

<sup>16</sup> A discussion of general taxi procedures in the Comair Operations Manual section on ramp and taxi operations stated, “During taxi both crewmembers shall monitor the progress of the taxi. Utilize HSI [horizontal situation indicator] diagrams, and signage to confirm position.” See Section 4.4.1 General Taxi Procedures, dated September 1, 2005.

<sup>17</sup> AC 120-74A is a revision to the original AC 120-74 issued in June 2001 and incorporated appendixes 1 through 7 as part of the September 2003 revision.

confirm proper runway or taxiway selection. Appendix 4 contains recommended normal procedures for surface operations and departure. In the guidance addressing before-takeoff procedures, the appendix states that, after being cleared onto the active runway, the crew should “verbally confirm ATC clearance onto [the] active runway with other crewmembers and confirm proper runway selection using airport signs and markings and the airport diagram.” The appendix also states that, when the aircraft is at the takeoff end of the runway, the crew should “confirm proper runway selection using HSI [horizontal situation indicator].”

On September 1, 2006, the FAA issued Safety Alert for Operators (SAFO) 06013 offering techniques, procedures, and items for consideration in training programs that emphasize safe operations in the pretakeoff and takeoff phases of flight. The two-page SAFO provides reminders of existing FAA guidance in ground operations, such as AC 120-74A, and states that crews should “confirm, using the challenge and response technique, that the aircraft is actually positioned on the assigned runway by reference to the heading indicator.” The SAFO also recommends that pilots “use all available resources to ensure that the aircraft is positioned on the proper runway” and that flight crews of FMS-equipped airplanes “verbally announce that the proper runway and departure procedure are selected in the FMS and that the aircraft heading agrees with the assigned runway for takeoff.”

## **Discussion**

The Safety Board’s identification of multiple 14 CFR Part 121 operators without procedures for positively verifying that the airplane is aligned on the correct departure runway calls into question both the effectiveness and permanence of the FAA’s actions to address Safety Recommendation A-89-74. Although the guidance documents referenced in SAFO 06013, such as AC 120-74A, outline procedures flight crews can use to verify that the airplane is on the assigned runway before takeoff, the fact that investigators found several operators that have not established such procedures clearly indicates that the FAA must move beyond providing advisory information to operators and become more aggressive in effecting change in this area. Further, as indicated by the fatal accident involving Singapore Airlines flight 006 and multiple incidents in the United States involving confusion over parallel runways (which have the same heading), runway confirmation procedures need to extend beyond referencing the runway heading before takeoff. In addition to heading, other relevant cues, such as signage, lighting, and surface markings should be referenced to ensure that the airplane is on the correct runway; these cues should be identified and confirmed before crossing the hold-short line for takeoff.

Although information contained in SAFO 06013 provides an integrated summary of available FAA advisory information relevant to the circumstances of the Comair flight 5191 accident, the Safety Board is concerned because the SAFO is not mandatory. According to FAA Order 8000.87, which governs the scope of SAFOs, the decision to implement a SAFO rests with the operator.<sup>18</sup> A standard procedure requiring pilots to cross-check and verify that they are

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<sup>18</sup> FAA Order 8000.87, dated August 29, 2005, states, in part, “This order establishing SAFOs permits the [FAA] to reclaim valuable guidance material contained in a discontinued order regarding [ACOBs], much of which is valid today. It also conveys new important safety information directly to operators as it becomes available. Significantly, SAFOs do not burden FAA inspectors with additional responsibilities not included in their work programs and not processed in accordance with the agreement between the FAA and its inspectors’ bargaining unit.

positioned at the correct runway before crossing the hold-short line and initiating takeoff would directly address the circumstances of the Comair flight 5191 accident as well as events involving parallel runways. Such a procedure would also help to improve overall flight crew situational awareness during surface operations, which would indirectly address the problem of runway incursions, a longstanding issue on the Safety Board's list of Most Wanted Transportation Safety Improvements. Therefore, the Safety Board believes that the FAA should require that all 14 CFR Part 121 operators establish procedures requiring all crewmembers on the flight deck to positively confirm and cross-check the airplane's location at the assigned departure runway before crossing the hold-short line for takeoff.

The Safety Board's investigation also learned that Comair did not provide guidance to its pilots about conducting takeoffs at night on unlighted runways (that is, runways without edge or centerline lights). The Board is concerned that, in the case of the Comair flight 5191 accident, both pilots recognized the unlighted runway during the takeoff roll but did not use that information to reevaluate whether they were on the correct runway for takeoff. Postaccident interviews with several Comair pilots revealed a belief that they were not authorized to depart on unlighted runways at night, but many were uncertain whether any company guidance existed.

The Safety Board's recent survey of 14 CFR Part 121 operators revealed inconsistency among operators regarding rules governing or prohibiting takeoff operations from an unlighted runway at night. For example, one operator prohibits takeoff unless the crew is given permission from the company's director of operations, who evaluates the risks involved. Another operator authorizes takeoffs on unlighted runways, provided the visibility is adequate and there is enough ambient light for the crew to identify the runway surface and to maintain directional control during the takeoff roll. Written policy addressing whether pilots are authorized to conduct night takeoff operations on unlighted runways and the conditions and the constraints associated with these operations would benefit flight safety. Therefore, the Safety Board believes that the FAA should require that all 14 CFR Part 121 operators provide specific guidance to pilots on the runway lighting requirements for takeoff operations at night.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require that all 14 *Code of Federal Regulations* Part 121 operators establish procedures requiring all crewmembers on the flight deck to positively confirm and cross-check the airplane's location at the assigned departure runway before crossing the hold-short line for takeoff. (A-06-83)

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Each FAA inspector is encouraged to be familiar with SAFOs generally. Each inspector should pay particular attention to any SAFO applying directly to the operator(s) that he or she oversees. Operators are encouraged to do likewise. The responsibility to implement any action recommended in a SAFO rests with the operator." (On October 24, 2006, was replaced with Order 8000.87A which contained mostly editorial changes. However, the updated order removed the requirement that principle inspectors track that the operator was notified of each applicable SAFO in the Program Tracking and Reporting Subsystem.)

Require that all 14 *Code of Federal Regulations* Part 121 operators provide specific guidance to pilots on the runway lighting requirements for takeoff operations at night. (A-06-84)

Chairman ROSENKER, Vice Chairman SUMWALT, and Members HERSMAN and HIGGINS concurred with these recommendations. Member Higgins filed a concurring statement and was joined by Vice Chairman Sumwalt and Member Hersman.

*[Original Signed]*

By: Mark V. Rosenker  
Chairman

## **Notation 7838A**

### **Member Kathryn O'Leary Higgins, Concurring:**

As we continue our investigation into this tragic accident, I have concurred in the recommendations made in this letter to improve flight deck runway and takeoff procedures for part 121 operators. My review of the NASA ASRS data, however, show that part 135 and part 91 operators also are involved in a number of "wrong runway takeoff incidents." And since the NASA data reflect only those incidents voluntarily reported, we can be certain that the numbers undercount the actual number of these events that are occurring. These data confirm my belief that pilot vigilance at takeoff is an important issue affecting all operators.

I urge staff to continue to look at options and strategies to improve runway situational awareness for all operators as they continue this accident investigation. While the recommendations we are making today are limited to 121 operators, I believe these recommendations will result in specific and timely improvements in flight crew situational awareness during takeoff. I urge the regulator and those operators not covered by these particular recommendations to take a serious look at runway and takeoff procedures and take the necessary measures to increase vigilance and awareness so that this avoidable accident will not be repeated.

Vice Chairman Sumwalt and Member Hersman joined Member Higgins in this concurring statement.