Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A06F0014

MISALIGNED TAKE-OFF

AIR CANADA
AIRBUS A319-114 C-FYKR
LAS VEGAS, NEVADA
30 JANUARY 2006

Canada

Aviation Investigation Report

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Air Canada
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Report Number A06F0014

Summary

An Airbus A319-114 (registration C-FYKR, serial number 0693) operating as Air Canada Flight 596, with 84 passengers and 5 crew members on board, was on a scheduled flight from Las Vegas, Nevada, United States, to Montréal, Quebec. The aircraft was cleared to depart Runway 25R and the crew commenced a rolling take-off at 0015 Pacific standard time. Shortly thereafter, both members of the flight crew realized that the aircraft was rolling on the asphalt runway shoulder instead of on the runway centreline. At approximately 65 knots indicated airspeed, the pilot flying applied left rudder to realign the aircraft with the runway centreline and completed the take-off. The flight continued to Montréal where an uneventful landing was carried out. During the flight to Montréal, the crew advised company dispatch of the departure occurrence. Dispatch advised the Las Vegas tower that the aircraft may have damaged some runway edge lights during the take-off roll. Three runway edge lights were found damaged. The only damage noted on the aircraft was a cut on the left-hand nose-wheel tire. There were no injuries.

Ce rapport est également disponible en français.

Other Factual Information

In accordance with the provisions of Annex 13 to the Convention on International Civil Aviation, the responsibility for investigating this incident was delegated to the Transportation Safety Board of Canada (TSB), representing the State of Registry. The National Transportation Safety Board (NTSB), representing the State of Occurrence, assigned an accredited representative to participate in the investigation.

The operator removed the digital flight data recorder (DFDR) from the aircraft following the occurrence flight. The data were downloaded at its recorder facility in Montréal and given to the TSB Engineering Laboratory for analysis.

Visual meteorological conditions prevailed at the time of the take-off. Weather was not considered a factor in the occurrence. Records indicate that the aircraft was certified, equipped, and maintained in accordance with existing regulations and had no known deficiencies before the flight.

The flight crew was certified and qualified for the flight in accordance with existing regulations. The captain had been working for the company since July 1989. He had accumulated about 11 000 flight hours, including 1500 hours on the Airbus 319/320/321 series as captain and 1500 hours as co-pilot. At the time of the incident, he was sitting in the left seat and was acting as pilot flying (PF). The co-pilot had been working for the company since November 2000. He had flown approximately 10 500 flight hours, including 1900 hours as co-pilot on the Airbus 319/320/321 series. At the time of the incident, he was sitting in the right seat and was acting as pilot not flying (PNF).

The flight crew was assigned to a four-day pairing starting from Toronto, Ontario, on 28 January 2006. It was the first time that the pilots were crewed together. They reported for work in Toronto at 1300 eastern standard time for the flight to Las Vegas. The aircraft arrived at the Las Vegas McCarran International Airport (KLAS) at 2041 Pacific standard time[1] on the same day. The flight crew had a rest period of approximately 25 hours before the scheduled return flight to Montréal at 2355 on January 29.

The flight crew arrived approximately 1 hour and 15 minutes before departure for the occurrence flight. It was the captain's third flight and second night flight from KLAS. It was the co-pilot's first time flying out of KLAS. The flight crew received the taxi clearance for a departure on Runway 25R from the Taxiway B (see Appendix A). As the aircraft approached the runway threshold on Taxiway B, the flight crew received the take-off clearance, with the requirement to maintain visual separation with another aircraft that was departing ahead of them on the same runway.

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[1] All times are Pacific standard time (Coordinated Universal Time minus eight hours) unless otherwise noted.

While the PF was aligning the aircraft to what he thought was the runway centreline, his attention was focused on the departing aircraft, which was about 5000 feet down the runway, and he did not perceive the lateral displacement from the centreline. During the turn onto the runway, the PNF completed the before–take-off checklist by switching on the strobe lights, the runway turn-off lights, and the nose take-off light. At 0014:38, the PF initiated a rolling take-off as recommended by the standard operating procedures manual (SOPs) and turned the aircraft onto an initial heading of 256° magnetic (M).[2]

At this time, the PNF was unaware that the aircraft was not aligned with the runway centreline because he was scanning the airspeed and the engine instruments as required by the SOPs. As part of the take-off procedure, the PNF must also observe that the aircraft is on the runway centreline when the thrust levers are advanced and the take-off phase is activated.

After completing his internal scan, the PNF looked outside and saw a red light in front of the aircraft. He then realized that the aircraft was not on the runway centreline. He informed the PF, who had already started to correct to the left. According to the DFDR, the left correction corresponded to a six-degree heading correction and was made approximately 11 seconds into the take-off run, at a speed of 64 knots. At this time, the aircraft was approximately 800 feet from the threshold, about 30 feet to the right of the runway edge lights,[3] and about 115 feet right of the centreline. During the initial take-off roll, the flight crew felt a sensation similar to the aircraft going over pavement joints. This was considered unremarkable. The acceleration data downloaded from the DFDR suggested that there were no significant vibrations during the entire take-off roll. The aircraft regained the runway surface in the vicinity of the displaced threshold. At this point, the aircraft had accelerated through 113 knots and the take-off was continued.

The flight crew could not confirm whether they had hit any lights. However, at 0216, they advised the company dispatch of that possibility. The dispatcher informed the KLAS tower personnel who requested a runway inspection. The inspection, conducted about two hours after the event, revealed that three runway edge lights had been damaged, but all other lights were operative, with no anomalies found. The aircraft continued to Montréal where an uneventful landing was carried out. The aircraft was inspected, and a cut was observed on the left-hand nose-wheel tire. The nose-wheel tire assembly was changed, and the aircraft was returned to service.

According to the company flight operations manual (FOM), flight dispatch must be informed as soon as operationally suitable (by radio, ACARS,[4] or telephone) of any accident, incident, or irregularity affecting flight. In this occurrence, the flight crew reported the incident to the dispatcher via ACARS at 0216, two hours after take-off.

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2 The published Runway 25R centreline heading was 255° M.

3 The runway edge lights were located off the runway surface, approximately 10 feet from the edge line, or 85 feet from the centreline.

4 ACARS is the acronym for aircraft communications addressing and reporting system, an onboard communication method.

Pilots can use a variety of visual aids to ensure that an aircraft is aligned with the runway centreline: runway designation markings provided at the threshold of the runway, aircraft heading, runway centreline lights or markings, and runway edge lights. Pilots can also use the localizer signal as guidance by selecting the frequency of the departing runway localizer and making sure that the yaw bar index is centred on the primary flight display. However, this technique is usually used during take-off in low visibility and was not used in this occurrence.

The SOPs list several factors that could lead to a decision to abort a take-off. Below 100 knots, the decision to reject a take-off is at the captain's discretion, dependent upon take-off parameters. The SOPs state that, although all causes cannot be listed, the captain should seriously consider discontinuing a take-off if any electronic centralized aircraft monitoring (ECAM) warning is activated. If, during the take-off roll, a condition or situation that may affect the safety of flight is observed, it will immediately be voiced. If a rejected take-off is not required, the captain will call "continue." In this occurrence, there was no ECAM warning, no abnormal vibration, and the aircraft was accelerating normally. The crew continued the take-off and proceeded with the standard departure procedures.

KLAS is a busy airport with an average of 1468 aircraft operations per day. It has four runways: two parallel runways on the south side of the terminal buildings and two on the west side (see Appendix A). The surface of Runway 25R was dry at the time of the occurrence. The runway is 14 510 feet long by 150 feet wide and has a displaced threshold of 1397 feet. It has asphalt runway shoulders capable of supporting an aircraft if it runs off the side of the runway.

To provide good visual contrast with the runway, a white runway side stripe marking is painted along both sides of Runway 25R (see Figure 1). In accordance with Federal Aviation Administration Advisory Circular (AC) 150/5340-1J and International Civil Aviation Organization (ICAO) Annex 14, Volume 1, Aerodrome Design and Operations, the side stripe marking is a continuous line that is unbroken where the taxiways join the runway. In Canada, TP 312, Section 5.2.1.3, allows for the runway side stripe markings to be interrupted at an intersection of a runway and taxiway. In fact, all Canadian runways marked with side stripes have them interrupted at the intersection of their runways and taxiways.

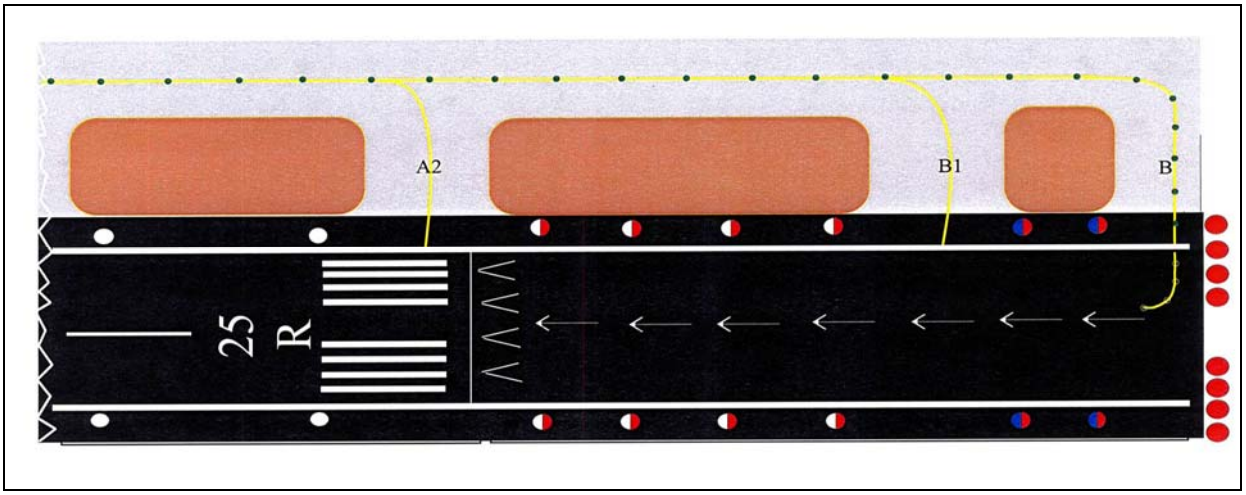

Figure 1. Runway 25R threshold markings

Runway 25R is not equipped with runway centreline lights, but has white runway centreline markings. In accordance with ICAO Annex 14, Volume 1, the portion of the runway before the permanently displaced runway threshold has the centreline marked with arrows. The runway is equipped with white runway edge lights except for the runway edge lights between Taxiways B and A2, which are red in the take-off direction due to the displaced threshold. The edge lights are raised lights except in the taxiway merge areas, where they are flush.

The displaced threshold area is fed via Taxiways B and B1 (see Appendix A). Taxiway A2 feeds Runway 25R in the threshold marking area. On Taxiway B, the one used during this occurrence, the taxiway centreline and the green centreline lights continue past the runway hold position along the curved taxiway centreline, across the white runway side stripe marking until it merges with the runway centreline marked by the displaced threshold arrows. At Taxiways B1 and A2, the taxiway centrelines continue past the runway hold position and curve onto the runway edge line. The green taxiway centreline lights for Taxiways A2 and B1 also continue past the runway hold position and stop at the runway edge line but do so in a straight line.

The airport lighting system is usually kept at stage two intensity (out of a possible five stages) except during periods of inclement weather or unless otherwise requested. At the time of the occurrence, the lighting system was set to stage two. The Taxiway B centreline lights were on. However, the lead-in lights from the runway hold position to the centreline on Runway 25R did not catch the flight crew's attention.

The investigation revealed no other adjacent lighting conditions that could give the erroneous perception that the right (north) runway edge line and lights could be the runway centreline. There are only blue taxi edge lights and green centreline taxiway lights to the north of Runway 25R.

There were two previously documented events during which aircraft damaged the runway edge lights on Runway 25R. One additional event took place subsequent to this occurrence. Only the Air Canada event was reported. The other events were discovered when airport operations personnel conducted the required runway and taxiway inspections (see Table 1). Three of the events happened at night.

Table 1 Summary of excursion events

Date	Time of Runway Inspection	Airline	Number of Lights Damaged	Location	Weather
25 February 2006	0317 PST	Unknown	13	Runway 25R (north side) between Taxiways A2 and A3	Clear
30 January 2006	0212 PST	Air Canada	3	Runway 25R (north side) between Taxiways B1 and A2	Clear
23 January 2006	0240 PST	Unknown	4	Runway 25R (north side) between Taxiways B1 and A2	Clear
03 December 2004	0803 PST	Unknown	4	Runway 25R (north side) between Taxiways B1 and A2	Sunny

Air Canada considered this event a Category F incident. According to the FOM, Category F includes an accident or incident, occurring while the aircraft is in operation, which results in minor damage to an aircraft and/or injury to passengers or company personnel. This category includes damage to company or non-company property caused by the aircraft while in operation.

A search of the TSB database revealed that only one similar event had been reported in the last 10 years. On 24 September 1997, during a night take-off out of Moncton, New Brunswick, a Beechcraft 200 was aligned with the runway edge lights and carried out a take-off during which one light was struck and broken. This event was not investigated, and the database did not provide enough information to identify the contributing factor(s). A similar search was done using the aviation query tool on the National Transportation Safety Board Web site with no similar events revealed.

Analysis

The database search to find similar events shows that this type of occurrence either happens rarely or is not consistently reported as an incident. Because the other three events that happened on Runway 25R at KLAS were not reported, the investigators were deprived of important data that could have helped to identify contributing factors leading to this event.

Neither aircraft airworthiness nor environmental conditions contributed to this event. The analysis will cover the factors that led a certified and qualified flight crew to misalign the aircraft and initiate a take-off roll from the side of the runway.

Although the flight crew travelled through three time zones, there is nothing to indicate that fatigue played a role. They had adequate crew rest, and the event happened in the early phase of their duty day.

Neither pilot had flown regularly from KLAS. It was the captain's second night departure and the co-pilot's first departure from this airport. Taxiing an aircraft at night at a large and unfamiliar airport, such as KLAS, can be confusing and complex, requiring a high degree of attention. Maintaining visual contact with the aircraft departing in front of them may have reduced the captain's attention to the ground visual aids while he was aligning the aircraft for take-off. It is likely that the captain relied on peripheral vision to align the aircraft and may have perceived the white runway side stripe marking, which intersected the taxiway centreline, as the runway centreline marking. This would explain why the aircraft was initially aligned to the right of the right runway edge lights.

Had the runway side stripe been interrupted at the runway and Taxiway B intersection, it could have prevented the misalignment. Since the flight crew was more familiar with Canadian airport markings, where side stripes are interrupted at the intersection between the taxiway and the runway merging point, they probably were not expecting to see a white runway side stripe marking.

The lead-in lines from Taxiways B1 and A2 may cause confusion because they lead directly to the runway edge line rather than to the runway centreline. In contrast, the Taxiway B centreline marking continues across the white runway side stripe marking until it merges with the runway centreline. During the day, this marking would provide a strong visual cue to the location of the runway centreline. However, in this occurrence, the taxiway centreline lead-in lights did not catch the flight crew's attention, resulting in a lack of visual guidance toward the runway centreline. The pilot may also have misinterpreted the runway edge line as the runway centreline.

The flight crew could not rely on the runway designation marking to ensure that the aircraft was properly aligned with the runway centreline because it is located nearly 1400 feet down the paved surface at the displaced threshold area. In addition, there were no runway centreline lights. The low-visibility take-off practice consisting of selecting the localizer frequency of the departing runway would have confirmed to the flight crew that the aircraft was not on the runway centreline.

The captain initiated a rolling take-off as per the SOPs. Even though a rolling take-off is a recognized practice, it reduces the time for the PNF to complete the departure checks and for the crew to complete a thorough outside visual check before initiating the take-off roll. Had the aircraft been completely stopped on the runway before take-off, it may have given the flight crew an opportunity to notice that the aircraft was not aligned between the two rows of the red runway edge lights.

During the rolling take-off, the co-pilot's attention was directed inside the cockpit as he was completing the before–take-off checklist and scanning the engine instruments as per the SOPs. It was not until he had completed these tasks that he noticed that the aircraft was not aligned with the runway centreline.

When the flight crew realized that they were not properly aligned with the runway centreline, the aircraft speed was well below 100 knots and sufficient runway remained to complete a rejected take-off. The crew decided to continue the take-off because there was no ECAM warning, there was no significant vibration, and the aircraft was accelerating normally. The only sensation the crew noticed was that of an aircraft going over pavement joints. The flight crew had no way of knowing if the landing gear had been damaged during the take-off roll. Although the expectation of damage in this occurrence might be low, retracting a damaged landing gear poses a hazard to the exposed lines in the wheel well should a tire burst after retraction.

Although this incident was not a situation warranting the declaration of an emergency, it would have been appropriate to inform the company and air traffic services sooner. Considering the traffic volume at this airport, potential debris from either the aircraft or broken lights could have been a hazard for other aircraft using Runway 25R during that time.

The following TSB Engineering Laboratory report was completed:

LP012/2006 – Flight Data Recorder

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

Finding as to Causes and Contributing Factors

1. The pilot flying likely relied on peripheral vision to taxi the aircraft because of the requirement to maintain separation with the aircraft departing ahead. This, combined with the aerodrome markings, resulted in the misalignment of the aircraft and the initiation of the take-off from the asphalt runway shoulder instead of the runway centreline.

Findings as to Risk

1. A rolling take-off reduces the crew's time for conducting a thorough outside visual check and verifying runway alignment before initiating the take-off roll.

2. Taxiways B1 and A2 centrelines curve onto the runway edge line. At night, this could result in pilots aligning their aircraft with the runway side stripe marking instead of with the runway centreline.

3. This occurrence was reported to company dispatch and air traffic services two hours after the event. During that time, debris left by the broken lights could have posed a hazard for other aircraft using Runway 25R.

Other Finding

1. The other three similar events that happened on Runway 25R at the Las Vegas McCarran International Airport (KLAS) were not reported. Failure to declare such events deprives investigators of important data that could help to identify the contributing factors that lead to this type of event.

Safety Action Taken

The Las Vegas airport authority made modifications to the taxiway markings following the occurrence. At Taxiway B1, the radius of the taxiway centreline was extended past the runway edge line and now meets with the runway centreline in the displaced threshold arrow area. At Taxiway A2, the radius of the taxiway centreline that curves to the runway edge line was erased, and the taxiway centreline now extends to the threshold markings.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 01 February 2007.

*Visit the Transportation Safety Board's Web site (**www.tsb.gc.ca**) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.*

Appendix A – KLAS Aerodrome Map

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