



# National Transportation Safety Board

Washington, D.C. 20594

## Safety Recommendation

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**Date:** June 25, 2004

**In reply refer to:** A-04-48 through -50

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

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On January 19, 2004, about 1138 Pacific standard time, the flight crew of Air Canada Jazz flight 8093, a de Havilland DHC-8, C-GTAQ, landed on taxiway T at Seattle-Tacoma International Airport (SEA), Seattle, Washington, after being cleared to land on adjacent runway 16R.<sup>1</sup> There were no injuries to the two flight crewmembers, the flight attendant, or any of the 32 passengers, and the airplane was not damaged. The incident occurred in visual meteorological conditions. The scheduled air carrier passenger flight was conducted under the provisions of 14 *Code of Federal Regulations* (CFR) Part 129.

According to the flight crew, Seattle Center cleared the flight for a visual approach to runway 16R, which both pilots had landed on numerous times before. They stated that they contacted the tower at SEA when they were near Elliot Bay and were cleared to land on runway 16R behind a Boeing 737 that was touching down. The pilots later reported that because of the distance between their position and the preceding 737, neither saw the preceding airplane. The captain, who was flying at the time, aligned the airplane with what he believed was runway 16R, continued on the approach, and completed what he described as an uneventful landing. Shortly after the airplane touched down, the tower advised the flight crew that they had landed on taxiway T. At the time of the event, visibility was reported as 10 miles with a broken ceiling at 4,100 feet above ground level.<sup>2</sup> The terrain and paved surfaces were dry, but the crew reported that the general area around the approach end of the runway was shadowed by the overcast and that there was a glare created by light from south of the airport, where it was clear.

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<sup>1</sup> The description for this incident, SEA04IA035, can be found on the Safety Board's Web site at <<http://www.ntsb.gov>>.

<sup>2</sup> All altitudes are above ground level unless otherwise noted.

## Background

The January 19, 2004, incident at SEA is one of six instances since 1999<sup>3</sup> of a flight crew landing or almost landing on taxiway T when intending to land on runway 16R.<sup>4</sup> In three events (all involving 737s and occurring in December 1999, January 2004, and February 2004), the flight crews almost landed on taxiway T but did not because they either executed a last-minute go-around or diverted to land on runway 16R. The first of two other incidents in which an airplane mistakenly landed on the taxiway occurred on December 2, 2000, and involved a Cessna 208 (operated by Harbor Air as scheduled passenger flight 4506). The surface observation at the time reported 10 miles visibility with a broken ceiling at 2,200 feet.

The second landing on the taxiway occurred on March 14, 2003, and involved an MD-80 operating as American Airlines flight 1763. The flight crew stated that they were established on the localizer for an instrument landing system approach to runway 16R but transitioned to visual navigation once they broke out of the clouds at about 3,500 feet and about 5 miles from the runway. Neither the captain nor the first officer was aware that they had landed on the taxiway until advised by the tower. The surface observation at the time reported 10 miles visibility and a broken cloud layer at 6,000 feet, with a 3,000-foot scattered layer below. The terrain and paved surfaces were wet, and pilot reports indicated that sunlight reflecting off of the wet paved surfaces created a glare.

SEA, a 14 CFR Part 139-certificated airport, is located about 10 miles south of Seattle and is positioned at 47°26'56.4"N and 122°18'33.5"W, at an elevation of 433 feet mean sea level. As shown in figure 1, the airfield consists of two runways: runway 16L/34R, which is 11,901 feet long, and runway 16R/34L, which is 9,426 feet long. Both runways are 150 feet wide. Runway 16L/34R is constructed of grooved asphalt and is accessible by parallel taxiway B on the western (terminal) side of the pavement. Runway 16R/34L is constructed of concrete and is accessible by full-length, parallel taxiway T, which is also constructed of concrete and is the westernmost paved aircraft movement surface from the ramp side of the airport. Taxiway T is 100 feet wide; however, including the shoulder, taxiway T pavement is about 180 feet wide. Both runways have a precision approach path indicator and in-pavement centerline and touchdown zone lights. Except for runway 16L, all runway ends have an approach lighting system.

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<sup>3</sup> Taxiway T was commissioned in October 1999 as a full-length parallel taxiway. Before this, the taxiway consisted of two (northern and southern) disconnected taxiway sections.

<sup>4</sup> All six incidents occurred during daylight hours.



during November through February at SEA, there are instances in which glare or reflection from the sun may make it difficult for flight crews arriving from the north to clearly discern the surface markings on any of the airport's paved surfaces because of the relationship between the airport's northerly latitude (47 26.9N) and the sun's low elevation during these months.

The configuration of the two runways and taxiway T may be another consideration. On their northern end, the threshold for runway 16R and the beginning of the hard surface associated with taxiway T (as well as the threshold for 16L) are all flush with the northern edge of taxiway C (see figure 1), likely giving flight crews the illusion that this part of taxiway T (again, the westernmost aircraft movement surface) is the threshold of the westernmost runway. Finally, the lack of an approach lighting system at runway 16L may lead flight crews to mistake runway 16R (which does have an approach lighting system) for 16L and, in turn, taxiway T for 16R (again, because of their similar appearance).

Management at SEA has made several attempts to address this issue, including the installation of a small nonstandard<sup>5</sup> "X" about 200 feet off the north end of the taxiway (see figure 2) in May 2000 and the installation of a larger 24-foot-wide bright yellow "X" about 80 feet off the north end of the taxiway (see figure 3) in May 2003. The airport also added a note to the Airport Facility Directory advising pilots, "do not mistake Txy Tango for runway." Other corrective actions include a note stating, "caution...do not mistake Taxiway Tango for Runway 16R" being added to the automatic terminal information service (ATIS) and the centerline lights on runway 16R being set to operate 24 hours a day. Most recently, on January 26, 2004, the airport installed an additional lighted "X" (see figure 4) in front of the 24-foot-wide "X." However, despite the airport's efforts, flight crews continue to mistake taxiway T for an active runway (as evidenced by the most recent February 2004 near-landing incident<sup>6</sup>).

Federal Aviation Administration (FAA) guidance to airport operators regarding the standards for markings used on runways, taxiways, and aprons and the circumstances under which these markings should be used is contained in Advisory Circular (AC) 150/5340-1H, "Standards for Airport Markings." Any runway, taxiway, or apron markings not included in this AC (such as the "Xs" installed at SEA) are nonstandard. During meetings with Safety Board staff about this issue, FAA staff indicated that it does not advocate the use of nonstandard markings to address the taxiway landing problem at SEA and believes that no changes to the existing standards are needed.

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<sup>5</sup> Advisory Circular 150/5340-1H, "Standards for Airport Markings" provides that an "X" is used to designate a closed runway, not a closed taxiway; therefore, SEA's use of the "X" in this instance is considered nonstandard.

<sup>6</sup> According to the flight crew from the February 2004 incident, the lighted "X" was not visible until about 1/2 mile from the end of the taxiway, the centerline lights on runway 16R were on dim and "could not be seen" during their approach and landing, and the ATIS note was not being broadcast at the time of the event (which the Federal Aviation Administration flight standards district office confirmed).



**Figure 2.** Aerial photograph of first “X” placed near taxiway T at SEA in May 2000



**Figure 3.** Second “X” placed near taxiway T at SEA in May 2003



**Figure 4.** Third “X” placed near taxiway T at SEA in January 2004

Although the Safety Board recognizes that inadvertent taxiway landings are essentially the result of operational factors, both the frequency with which these events have occurred and the fact that they have involved crews from several airlines indicates that the airport environment and, specifically, the taxiway markings (both standard and nonstandard) at SEA also play a role. The Board is aware of several instances in which airports that were experiencing a similar problem with inadvertent taxiway landings successfully used nonstandard markings to address the issue. These airports experimented with various markings until finding that the combination of painting the word “TAXI” or “TAXIWAY” and a serpentine line on the taxiway surface in question appeared to stop the inadvertent landings.

For example, after adding a second parallel runway in 1991, Palm Springs International Airport (PSP), Palm Springs, California, began experiencing inadvertent landings on taxiway C. Over several years, PSP made many efforts to correct the problem, including painting the word “TAXIWAY” about 4,000 feet down the 10,000-foot taxiway, widening the runway centerlines, adding fixed-distance markings to the new runway, printing larger runway identification numbers, outlining runway markings in black borders, and repainting runway and taxiway markings whenever they lost their brightness or color. Although airport personnel noted some improvement, the landings continued to occur, reaching almost 20 taxiway landings by 1995. In that year, PSP personnel added the word “TAXI” in large block letters in the taxiway area that pilots had mistaken for the touchdown zone and repeated the word about 1,000 feet further down the taxiway (see figure 5). In addition, the airport applied serpentine lines, each of which runs for about 1,200 feet, over the top of the standard taxiway centerline markings in two sections in the area where aircraft had been touching down on the taxiway (see figure 6). Since these additions, according to the airport’s Deputy Director of Operations, the rate of aircraft inadvertently landing on the taxiway has been reduced, and no such events have occurred in the last 4 years.





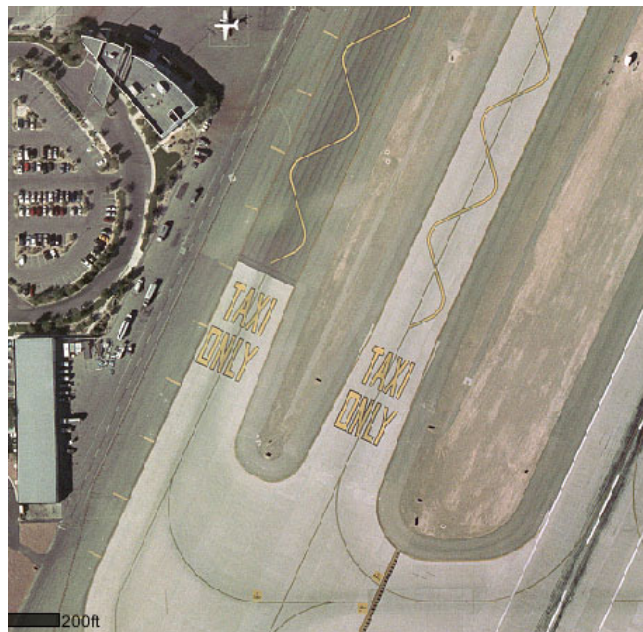
**Figure 5.** Aerial photograph of taxiway markings at PSP



**Figure 6.** Serpentine line on a taxiway at PSP

According to a representative of airport operations at McCarran International Airport (LAS), Las Vegas, Nevada, the airport first experienced a problem with airplanes landing on a taxiway (which was parallel to a general aviation [GA] runway) in the 1970s. LAS addressed the problem by painting “TAXI ONLY” and a serpentine taxiway centerline on the taxiway. The airport experienced a similar problem again in 1997 when it replaced the GA runway and parallel taxiway with a full-length runway parallel to existing runway 19L. The LAS representative stated that five airplanes landed on a parallel taxiway within the first 2 weeks after installing the second full-length runway. Again, the airport decided to paint “TAXI ONLY” and a serpentine centerline on the taxiway (see figure 7). According to the LAS representative, an average of one airplane a day lined up on the taxiway on approach during the 2-week period that the airport was coordinating the process to add the taxiway markings. Landings on the taxiway were eliminated once the nonstandard taxiway markings were completed.

Operations personnel at Tucson International Airport (TUS), Tucson, Arizona, stated that after about five airplanes mistakenly landed on a taxiway, the airport attempted to correct the problem by installing runway end identifier lights in 1991 to aid pilots in locating the correct runway. However, the taxiway landings continued to occur. TUS representatives stated that the word “TAXI” was then painted on both ends of the taxiway, which seemed to reduce the number of incidents but did not eliminate the problem. In 1997, the airport painted a serpentine line on the southeast end of the taxiway, north of the approach end of the parallel runway. Operations personnel stated that, since the addition of the serpentine line, the problem appears to have been solved with a combination of air traffic controllers’ diligence and the use of the nonstandard safety enhancements.



**Figure 7.** Taxiway Markings at LAS



The Safety Board notes that although the words “TAXI” or “TAXIWAY” and the serpentine line employed by the airports in the previous examples are not FAA standard markings for taxiways, it appears that those airports currently operating with such markings have eliminated taxiway landing problems. Because taxiway T at SEA continues to be mistaken for a runway and the airport’s attempts to address the issue have not worked, the Safety Board believes that the FAA should allow SEA, as an interim solution, to apply a) large nonstandard taxiway identification markings (such as the word “TAXIWAY”) at regular intervals to the full width of the taxiway T surface, starting near the approach end and continuing for one-half the length of the taxiway; and b) a continuous serpentine line over the taxiway centerline, between each of the aforementioned nonstandard taxiway identification markings.

The Safety Board recognizes that the use of the nonstandard markings discussed in this letter to address the problem of inadvertent taxiway landings may need further examination to better understand the reasons for their apparent effectiveness and human factors or other considerations associated with their use. In addition, other countermeasures may exist that are also effective in addressing this issue. Therefore, the Safety Board believes that the FAA should conduct research to establish marking standards for use on taxiways at airports with a recurring taxiway landing problem. The research and standards should include, but not be limited to, the dimensions, placement, and conspicuity of such markings under various weather, lighting, and visibility conditions. The Board also believes that the FAA should revise AC 150/5340-1H, “Standards for Airport Markings,” based on the findings of this research.

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

Allow Seattle-Tacoma International Airport, as an interim solution, to apply a) large nonstandard taxiway identification markings (such as the word “TAXIWAY”) at regular intervals to the full width of the taxiway T surface, starting near the approach end and continuing for one-half the length of the taxiway; and b) a continuous serpentine line over the taxiway centerline, between each of the aforementioned nonstandard taxiway identification markings. (A-04-48)

Conduct research to establish marking standards for use on taxiways at airports with a recurring taxiway landing problem. The research and standards should include, but not be limited to, the dimensions, placement, and conspicuity of such markings under various weather, lighting, and visibility conditions. (A-04-49)

Revise Advisory Circular 150/5340-1H, “Standards for Airport Markings,” based on the findings of the research conducted in response to Safety Recommendation A-04-49. (A-04-50)

Chairman ENGLEMAN CONNERS, Vice Chairman ROSENKER, and Members CARMODY, GOGLIA, and HEALING concurred in these recommendations.

By: Ellen Engleman Connors  
Chairman