Runway overrun, Trans World Airlines, Inc., Boeing 707-331C, N15712, San Francisco International Airport, San Francisco, California, September 13, 1972

Micro-summary: **This Boeing 707-331C overran the runway during a rejected takeoff.**

Event Date: **1972-09-13 at 2243 PDT**

Investigative Body: **National Transportation Safety Board (NTSB), USA**

Investigative Body's Web Site: **http://www.ntsb.gov/**

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FILE NO. 1-0022

AIRCRAFT ACCIDENT REPORT

TRANS WORLD AIRLINES, INC.

BOEING 707-331C, N15712

SAN FRANCISCO INTERNATIONAL AIRPORT

SAN FRANCISCO, CALIFORNIA

SEPTEMBER 13, 1972

ADOPTED: MARCH 14, 1973

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D. C. 20591
REPORT NUMBER: NTSB-AAR-73-4

TRANS WORLD AIRLINES, INC.
BOEING 707-331C, N15712
SAN FRANCISCO INTERNATIONAL AIRPORT
SAN FRANCISCO, CALIFORNIA
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AIRCRAFT ACCIDENT REPORT

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SYNOPSIS

A Trans World Airlines, Inc., Boeing 707-331C, crashed into San Francisco Bay at approximately 2243 Pacific daylight time, September 13, 1972, following a rejected takeoff from Runway 01R at the San Francisco International Airport, San Francisco, California. Flight 604 was a regularly scheduled cargo flight from San Francisco, California, to the John F. Kennedy International Airport, Jamaica, New York. There were no injuries to the three crewmembers, the only persons on board. The aircraft was substantially damaged.

The investigation disclosed that the aircraft failed to stop on the remaining runway following a rejected takeoff initiated by the captain. This action was taken after the takeoff roll had traversed approximately half the 9,500-foot runway to the vicinity of the intersections of Runway 01R with parallel Runways 28L and 28R. The action was initiated when the crew detected an aircraft vibration and a reduction in aircraft acceleration, after passing V_1 speed. Crew action included the use of wheel braking, spoiler operation, and reverse engine thrust. However, the aircraft overran the departure end of the runway and a breakwater and came to rest in San Francisco Bay, approximately 50 feet from the shoreline.

Following the accident, numerous pieces of tire tread and shredded tire casings from the disintegrated No. 3 and No. 4 rear tires were found along the runway. Dual wheel rim marks from these wheels were also evident.

The National Transportation Safety Board determines that the probable cause of this accident was the initiation of rejected takeoff procedures, beyond V_1 speed, with insufficient runway remaining in which to stop the aircraft. The crew action was prompted by the failure of the two right truck rear tires which produced a noticeable aircraft vibration and a reduction in aircraft acceleration.

As a result of the investigation of this accident, the Safety Board recommends reconsideration of recommendations previously made to the Federal Aviation Administration.

INVESTIGATION

Trans World Airlines, Inc., Boeing 707-331C, N15712, arrived in San Francisco as Flight 667 at 0655 P.d.t. 1/ on September 13, 1972. During ground time in preparation for departure as Flight 604, the aircraft received layover service maintenance which included an inspection of the landing gear assembly, the tires, and the engines. A security check was completed 18 minutes prior to ramp departure. The computed takeoff reference speeds 2/ for a takeoff at 308,844 pounds with a 14° flap setting were V_1-125 knots; V_R-148 knots and V_2-165 knots. These calculations were based on a wind from 290° at 10 knots, and a temperature of 55°.

The crew boarded the aircraft and completed the necessary checklists, and the flight was cleared to taxi to Runway 01R at 2233. Flight 604 departed from the cargo gate with 77,714 pounds of cargo and 98,000 pounds of fuel. During the taxi operation there was conversation between the captain and the first officer concerning heavy takeoffs and takeoff abort procedures. The captain stated, "It's your takeoff." He later remarked, "If there's an abort, I'll do it Sandy." The aircraft was taxied into takeoff position by following the taxi guideline to the runway centerline. This point was located 300 feet from the runway threshold. At 2241:49.5, the flight was cleared for takeoff.

The takeoff was normal until approximately 3 seconds after the captain called "V_1". By this time the aircraft had progressed approximately halfway down the runway to the vicinity of the intersection of Runway 01R with Runways 28L and 28R. At this time, a vibration was noted. The vibration intensified and continued throughout the remainder of the takeoff roll. According to the crew, the runway is uneven throughout this intersection and some vibration is expected.

The captain stated that the noise and vibration were associated with the landing gear. There were several other loud "clunking" sounds during the next several seconds and the aircraft's acceleration diminished. The captain reported, "The runway markings at the north end of the runway were about to pass under us (the first painted runway surface marking is located approximately 2,000 feet from the north end of the runway). We had not yet reached V_R - the speed was under 140 knots. I was convinced we were not going to clear the runway and approach lights. I immediately initiated abort procedures, using full brakes, spoilers and reverse thrust."

1/ All times are Pacific daylight time based on the 24-hour clock.

2/ V_1 --Critical engine failure speed.

V_R --Rotation speed.

V_2 --Takeoff safety speed.

At 2242:46.7, the sound of engine noise decreased as the power was reduced, and the captain initiated abort procedures. Approximately 2 seconds later, the engineer stated, "Gotta blown tire." At 2242:49.4, the sound of engine noise increased as the captain applied reverse thrust. As the end of the runway was nearing, the captain turned the aircraft to the right to avoid making contact with the approach lights.

The aircraft continued past the overrun, to the right of the Runway 19L approach light structure, and over the breakwater. The aircraft came to rest in about 10 feet of water, approximately 50 feet offshore.

The aircraft fuselage broke around its entire circumference, forward of the wings. The nose gear assembly, the No. 2 engine, and approximately 6 feet of the left wing tip separated from the aircraft.

The crew launched a liferaft and boarded it through the main cabin door. They were subsequently picked up and brought ashore by a U. S. Coast Guard rescue helicopter. There were no injuries to the crewmembers.

An examination of Runway 01R revealed numerous pieces of tire casing and tread of varying sizes strewn along the runway, starting at a point 4,700 feet from the threshold, through the intersections of Runways 28L and 28R, to a point 6,800 feet down the runway. Evidence of right landing gear wheel rim imprints were found 6,450 feet down the runway. These marks, which were later identified as having been made by the No. 3 and No. 4 rear wheels, along with the scuff marks of the six remaining tires, continued to the San Francisco Bay shoreline, which is 316 feet beyond the runway end. Approximately 300 feet short of the runway end, all tracks veered to the right half of the runway.

The San Francisco hourly weather report available to the crew of Flight 604 at briefing time was clear skies, visibility 12 miles, temperature 55° F., dew point 52° F., wind 300° at 12 knots, altimeter 30.02 inches H_g. The runway was reported to be dry.

The aircraft was equipped with a Lockheed Air Service Model 109-C Flight Data Recorder (FDR), Serial No. 759. Examination of the recorded traces disclosed that all parameters had been recorded in a normal manner with no evidence of recorder malfunction or recording abnormalities.

The FDR readout showed that coincident with the final turn onto Runway 01R, the airspeed trace began to move upward from zero as the heading became stabilized at about 009°. At approximately 134 knots, the airspeed trace showed a reduction in aircraft acceleration. The maximum speed attained was 142 knots which was reached 49 seconds after the start of the takeoff. From this point, the speed decreased to 27 knots within 11.5 seconds.

The extensively damaged aircraft was removed from San Francisco Bay. Examination of the main landing gear wheels and tires disclosed that all tires were properly inflated, except Nos. 3 and 4 which exhibited only the tire bead bundles. The fuse plugs on these wheels were intact and had not melted. There was no evidence of milling of the wheel rims.

The two failed tires were No. 3 and No. 4 rear. Both tires were installed at John F. Kennedy International Airport, New York, on September 5, 1972, and each had been subjected to 26 landings prior to the accident. No. 3 rear tire, General Tire S/N 92520279N3, had been recapped three times, whereas, the No. 4 rear tire, Firestone International S/N 11R040234, had been recapped four times. Both tires had been recapped by the McDowell Tire Co., Kansas City, Missouri. An examination of the records of McDowell's facility showed that it met or exceeded the minimum standards established by the Federal Aviation Administration for recapping aircraft tires.

All landing gear wheel brakes, except those on the two right landing gear rear wheels, showed evidence of high stopping energies. The No. 3 and No. 4 rear wheel brakes displayed only normal braking wear. None of the brakes leaked during testing.

The antiskid system valves, wheel transducers, and the electronic control shield were subjected to tests and found to be within allowable tolerances and capable of normal operation.

The engines, and the thrust reversing system operated normally until the aircraft entered San Francisco Bay.

The crewmembers were employed by Trans World Airlines, Inc., were certificated for the type equipment and operation involved, and were qualified in accordance with existing company and Federal regulations. (See Appendix A for detailed information.)

Estimated takeoff performance was prepared for Flight 604, based on the gross weight of the aircraft, the takeoff runway conditions, weather, and the use of four-engine reverse thrust to zero velocity. An approximation of the runway length used in each segment of the takeoff was then derived from the Boeing Company performance data and the Flight Data Recorder as follows:

Condition	Distance
Normal Acceleration (0-120 knots)	3,790 feet
Degradation of acceleration due to blown tires (120-142 knots)	2,550 feet
Deceleration (142-0 knots)	3,740 feet
Total distance traveled	10,080 feet

ANALYSIS AND CONCLUSIONS

The aircraft performance capability and the physical dimensions of Runway 01R were adequate for the operation involved.

Examination and testing of the wheel brakes and the antiskid system and examination of tire scuff marks on the runway disclosed that the aircraft braking system was in operational condition and had operated normally throughout the takeoff roll and the subsequent rejected takeoff rollout.

All rubber debris from the failed tires was found in the general vicinity of the intersections of Runway 01R with Runways 28L and 28R, indicating that tire disintegration took place in this area. The tire remains were examined and portions were tested. The No. 4 rear tire showed sections of tire tread rubber attached to sidewall material, which is indicative of sidewall failure. Remains of the No. 3 rear tire exhibited evidence of rubber reversion and rough texturing. This phenomenon is typical of tires failed in overload. It is concluded that the No. 4 rear tire blew out first, due to sidewall failure, and that the No. 3 rear tire then blew out as a result of overload.

The No. 4 rear tire failure occurred at 4,700 feet, which is 600 feet short of the intersection of parallel Runways 28L and 28R. During the disintegration of this tire, the adjacent No. 3 rear tire failed, and disintegration of both tires continued as the aircraft passed through the intersection. The runway surface in this 1,000-foot long intersection is uneven and passage through it is normally accompanied by roughness.

As a result, the vibration caused by the blown tires was masked as the aircraft traversed the intersection, and the vibration was not considered a problem until the aircraft passed beyond the intersection. At this point, a slowdown in aircraft acceleration was also detected. Considering the diminished acceleration, the increasing vibration, and the fact that the aircraft was about to pass over the painted runway surface markers (2,000 feet from the end of the runway), the captain was convinced that the heavy aircraft would not reach V_R speed (148 knots) and become airborne within the confines of the remaining runway, even though the airspeed was approaching 140 knots.

The Trans World Airlines flight manual states that the takeoff will be continued if an engine failure or other abnormal condition occurs after V_1 speed; however, the captain exercised his prerogative of emergency authority and rejected the takeoff. In view of the combination of factors which confronted the pilot during the critical phase of the takeoff, his decision to reject the takeoff is understandable.

The takeoff was made in darkness, and there were fewer visual cues to enable the captain to judge accurately either the acceleration of the aircraft

or the amount of remaining runway. Evidence of clean wheel rim imprints on the runway surface starting at a point 6,450 feet down the runway, the absence of tire debris beyond this point, and the intact condition of the six remaining tires show that there was no abnormal drag during the takeoff roll. There seems no doubt that the aircraft would have accelerated the additional 8 knots to V_R speed in the remaining runway had the captain continued the takeoff. However, it is equally true that if he had conserved part of the 300 feet of runway used in maneuvering the aircraft into takeoff position and had not lost 25 percent of his brake effectiveness, he would have been able to stop the aircraft within the confines of the airport. This would have undoubtedly minimized any aircraft damage.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of this accident was the initiation of rejected takeoff procedures, beyond V_1 speed, with insufficient runway remaining in which to stop the aircraft. The crew action was prompted by the failure of the two right truck rear tires which produced a noticeable aircraft vibration and a reduction in aircraft acceleration.

RECOMMENDATIONS

Subsequent to the investigation of an accident at Anchorage, Alaska, November 27, 1970, involving the takeoff of a Capitol International Airways, Inc., DC-8-63F (NTSB-AAR-72-12), the Safety Board recommended to the Federal Aviation Administration the implementation of takeoff procedures which would provide flightcrews with time or distance reference to associate with acceleration to V_1 speed. This recommendation was again made 8 months later as the result of a Pan American World Airways, Inc., Boeing 747 accident at San Francisco, California, on July 30, 1971 (NTSB-AAR-72-17). In the preceding investigations, the Board also recommended that the FAA require the installation of runway distance markers at all civil airports where air carrier aircraft are authorized to operate. These recommendations apply equally in this case. Therefore, the Board recommends that the FAA reconsider its position relative to these recommendations.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JOHN H. REED
Chairman

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

/s/ WILLIAM R. HALEY
Member

Francis H. McAdams, Member, did not participate.

March 14, 1973.

APPENDIX A

CREW INFORMATION

Captain Richard C. Bogatko, aged 46, held Airline Transport Pilot Certificate No. 1161694, multiengine land. Captain Bogatko held type ratings for the Lockheed Constellation, Martin 202/404, and the Boeings 707/720/727. His first-class medical certificate, dated June 19, 1972, listed no limitations. He was employed by Trans World Airlines, Inc., on October 27, 1952, and was upgraded to Boeing 707 captain on July 28, 1958. As of September 13, 1972, he had accumulated a total of 14,591:28 hours, of which 3,400:30 hours were flown in the Boeing 707 aircraft; his last proficiency flight check was completed on March 7, 1972; the date of his last line check was June 14, 1972; and September 5, 1972, was the date of his last emergency procedure refresher training.

First Officer Taylor H. Sanford, aged 38, held Commercial Pilot Certificate No. 1466998, with airplane multiengine land and instrument privileges. He was type rated in the Lockheed Constellation aircraft. His first-class medical certificate dated May 5, 1972, listed no limitations. He was employed by Trans World Airlines, Inc., on December 7, 1964, and was upgraded to Boeing 707 first officer on June 5, 1965. As of September 13, 1972, his total flying time was 7,349:00 hours, of which 320:00 hours had been accumulated in the Boeing 707 aircraft; his last proficiency flight check was completed on June 3, 1972; the date of his last line check was July 5, 1972; and his last emergency procedure refresher training was on June 1, 1972.

Flight Engineer Stephen L. Phillips, aged 30, held Flight Engineer Certificate No. 1778626, with a turbojet powered rating. His second-class medical certificate, dated December 11, 1971, listed no limitations. He was employed by Trans World Airlines, Inc., on February 17, 1967, and was assigned as a flight engineer on August 29, 1967. Flight Engineer Phillips possessed a total of 1,050:00 flying hours as a military pilot as of the date of hire. On September 13, 1972, his total flying time as a flight engineer was 2,820:00 hours of which 2,666:00 hours had been accumulated in the Boeing 707 aircraft; his last proficiency flight check was completed on March 18, 1972. The date of his last line check was March 8, 1971; and his last emergency procedure refresher training was on March 13, 1972.

APPENDIX B

AIRCRAFT INFORMATION

The aircraft was a Boeing 707-331C, S/N 20068, N15712, owned and operated by Trans World Airlines, Inc., 605 Third Avenue, New York, New York 10016. It had operated a total of 9,424:43 hours, including 659:52 hours since the last major check and 156:01 hours since the last station service check. The aircraft was maintained in accordance with applicable Federal Aviation Regulations and the Trans World Airlines-approved maintenance manual.

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