

AIRCRAFT ACCIDENT REPORT

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AMERICAN AIRLINES, INC., CONVAIR 240, N 94213,
NEW HAVEN, CONNECTICUT, MARCH 1, 1958

The Accident

An American Airlines Convair 240, N 94213, aborted a takeoff at the New Haven Municipal Airport on March 1, 1958, about 1024.1/ The aircraft, with the landing gear retracted and the left nacelle and wing burning, skidded to a stop on the runway. Considerable damage resulted and two of the five passengers received minor injuries; the three crew members were uninjured.

History of the Flight

This was scheduled passenger Flight 535 of March 1 from Boston, Massachusetts, to New York, New York, with stops planned at New Haven and Bridgeport, Connecticut. The crew, consisting of Captain Edward W. Johnson, First Officer Norman A. Paquette, and Stewardess Marian Sullivan, reported to company operations at Boston well ahead of scheduled departure time.

Departure from Boston at 0927 was on time and was in accordance with an IFR clearance to cruise at 6,000 feet via airways to New Haven. The flight was routine and on schedule to New Haven.

The aircraft was not refueled during the five-minute stop at New Haven, during which time both engines were stopped. The flight departed the terminal with five passengers and 1,600 gallons of fuel. Gross weight of the aircraft was well under the maximum allowable and its center of gravity was located within prescribed limits. The wind was calm and runway 14 (4,116 feet), one of two macadam runways, was selected for takeoff. There is no air traffic control tower at New Haven.

After completion of the takeoff checklist, the aircraft moved onto the runway and takeoff was initiated from a taxi start without delay. This segment of the flight was being flown by First Officer Paquette who occupied the right seat. Captain Johnson, on the left, maintained directional control during the initial acceleration of the aircraft. Before the aircraft reached the intersection of runways 14 and 19, the landing gear was retracted. The aircraft then skidded down runway 14 near its center and came to rest 1,050 feet from the far end. Captain Johnson, Stewardess Sullivan, and three passengers left through the right emergency escape hatch over the wing. First Officer Paquette and the two remaining passengers left through the partially opened front entrance door. Fire, around the left engine and the left outboard wing area, caused considerable damage and was extinguished by the local fire department.

1/ All times herein are eastern standard based on the 24-hour clock.

Investigation

Captain Johnson testified that just before reaching V_1 speed^{2/} he saw the left engine fire warning light come on and simultaneously heard the fire warning bell. He was watching the runway and the terrain beyond, occasionally glancing in the cockpit for airspeed indications. His left hand was on the nose wheel steering control, his right hand at the landing gear selector location. He further said that following the observation of this fire warning, he looked back at the left engine and saw fire in the vicinity of the outboard residual heat door. He immediately called this to the attention of the first officer, remarking, "We're on fire, put it back down" or words to that effect, and then retracted the landing gear for a fast deceleration. The left firewall shutoff valves were then closed and the CO₂ fire extinguisher for this engine was discharged. Retracting the wing flaps and accomplishing the remaining engine shutdown duties continued until the aircraft came to rest.

First Officer Paquette testified that he observed the airspeed indicator at 85 knots, at which time everything was normal and the aircraft was in a nose-up attitude ready to become airborne. He further testified he saw the left engine fire warning light and heard the warning bell after the captain remarked that the engine was on fire. At this time he had back pressure on the control yoke and was prepared to increase the angle of attack of the aircraft in anticipation of V_2 speed.^{3/} He held back pressure on the control yoke until the captain informed him of the fire, at which time he retarded the throttles, pulling them into the reverse position. Immediately thereafter the aircraft settled to the ground.

None of the five passengers observed fire until just before the aircraft stopped. Only one of the four ground witnesses said he saw fire during the early part of the takeoff roll. Another ground witness, positioned near this witness, said that he first saw smoke and fire when the aircraft passed the runway intersection, several hundred feet further on.

The first impact marks on the runway were made by the tail skid and the bottom skin of the fuselage immediately forward of it. These marks started 1,380 feet from the beginning of the takeoff roll and continued a distance of 1,686 feet. Propeller slash marks started about 120 feet beyond the initial impact marks and continued for a distance of 343 feet and 378 feet for the left and right propellers, respectively. Initial slash marks were spaced 2 feet, 6 inches apart. The calculated ground speed of the aircraft at the time of ground impact, based upon the propeller slash marks and r. p. m. governor settings, was approximately 93 knots, 7 knots below the V_1 speed of 100 knots.

The left and right landing gear doors were worn through. The skin around the forward lower cargo compartment was badly damaged and the lower portions of

^{2/} V_1 is the critical-engine-failure speed or the speed at which a sudden engine failure is assumed to occur and is the basis for determining the minimum required takeoff and acceleration-stop distance. This speed is the minimum speed at which the pilot has, in the case of engine failure, the choice of continuing or aborting the takeoff without exceeding the minimum required distances.

^{3/} V_2 is the takeoff-climb speed or the minimum safe takeoff-flight speed, with one engine inoperative.

the structural frames were pushed upward and bent. Contact with the runway had also worn down the fuselage tail skid approximately one-half inch. An area just ahead of the tail skid and below the aft cargo compartment, from station 628 to 741, was also badly damaged. The fuselage belly was severely abraded due to sliding on the runway.

The left wing and the outboard side of the nacelle of No. 1 engine were extensively damaged by fire. Portions of the inner wing from just outboard of No. 1 engine to the wing outer panel were extensively damaged. The entire left wing outer panel, which includes the left aileron, was burnt away. The upper wing surface from stations 188 to 323 was badly buckled because of heat. A section of a propeller blade, approximately 4" by 4", had penetrated the lower wing surface forward of the front spar, cutting through the front spar web and the No. 10 rib and puncturing the fuel tank. Fuel from this tank ignited and caused the fire. The right wing was essentially undamaged.

All of the blades of both propellers were bent rearward in varying amounts from runway contact, and approximately four inches of the No. 2 blade and five inches of the No. 3 blade of the No. 1 propeller were broken off. The No. 3 blade of the No. 2 propeller had approximately 12 inches broken off from the tip. Investigation revealed that the left propeller dome piston was positioned at minus 13 degrees, or full reverse relative to the blade angle, and the right propeller dome piston was positioned at 29 degrees, the low pitch stop position. Shim plate indentations indicated blade angles at impact of 29 degrees for both propellers. The difference in blade angle between the propeller dome piston position of the left propeller and that of the shim plate indentations indicates that this propeller continued into reverse after ground impact.

The left engine and its propeller were found intact on the aircraft. Examination of this engine showed there was light fire damage in the areas of cylinders 2, 3, 16, 17, and 18. All engine accessories were in place and undamaged.

The left engine was removed intact from the aircraft and installed on a test stand where it was operated at 1,000, 2,200, and 2,800 r. p. m. These three r. p. m. settings were selected because they represented, in order, an average slow engine speed, an r. p. m. giving a manifold pressure equal to the standard barometric pressure, and the maximum takeoff r. p. m. All temperatures and pressures were found to be normal. The engine was shut down after each run and examined for oil and fuel leaks and none were noted. The engine was then operated at dry takeoff power for approximately 30 minutes and a corrected brake horsepower of 2,095 was obtained. The engine was also operated for 15 minutes at wet takeoff power and a corrected brake horsepower of 2,330 was obtained. Fuel flow and ADI (anti-detonation injection) flow rates were normal during these tests. During the entire test stand operation, which totaled approximately 1 hour and 40 minutes, there were no indications of fluid leakage, engine roughness, or below normal performance.

The fire warning system on the left engine was checked for continuity and was found to be intact and capable of normal operation. Heat checking of the fire warning detectors revealed there was correct polarity. The fire warning control relay box was removed and installed in another Convastr 240 and the fire warning system of that aircraft, when tested, operated normally. The control box was also tested for relay sensitivity and was found to be properly adjusted.

All tests of the fire warning system showed it to be capable of normal operation. The operational checks of this engine and its fire warning system, together with the minor damage found, precludes the possibility of fire having occurred prior to ground impact.

During the functional testing of the fire warning system in the cockpit, the landing gear safety solenoid was observed to be continuously energized. The solenoid is normally de-energized when the landing gear is extended and the weight of the aircraft is on the landing gear. The function of the safety solenoid is to prevent inadvertent retraction of the landing gear when the aircraft is on the ground. The safety switch cover plate was removed and it was found that the circlip on the switch shaft, which positions the switch actuator arm, was missing. This missing circlip allowed the actuator arm to move 7/16 of an inch from its normal position, permitting the switch contacts to remain closed. In this condition, the defective safety switch energized the landing gear safety solenoid withdrawing the latch pin, thus allowing the gear selector handle to be placed in the "UP" position and the landing gear to retract even though the weight of the aircraft was on the gear. Normally, the landing gear cannot be raised while the landing gear strut is compressed by the weight of the aircraft on the ground unless the latch pin, which protrudes through a hole in the landing gear selector handle, is depressed manually, permitting the handle to be raised. Neither the captain nor the first officer was aware of this unsafe condition. The switch cover plate was polished by contact with the displaced actuator arm, indicating that this condition had existed for an extended period of time. There were several entries in the pilot flight reports covering a period from January 27, 1958, to February 26, 1958, denoting that the safety switch had malfunctioned and had been repaired.

Since testimony of the flight crew and witnesses reflected that there had been no indications of maloperation within the right engine, no test stand operation was conducted. Visual examination of this engine indicated that all components were intact and that the engine was not damaged by impact or fire.

Weather was not a factor in this accident.

Analysis

The captain said that before reaching V_1 speed in the takeoff roll he observed the fire, heard and saw the fire warnings, and decided to scuttle the aircraft to bring it to a quick stop. It is difficult to reconcile these statements with at least three facts. The first is that having been a captain of Convair aircraft for more than two years and having acquired a total flying time of 4,660 hours on this type aircraft, of which 1,322 were acquired as captain, it was his responsibility and therefore he should have known how the landing gear retraction system functioned; also, that under normal operating conditions, the landing gear selector handle could not be raised to retract the landing gear until the gear no longer carried the weight of the aircraft.

The second fact is that the statements of passengers and eyewitnesses, which are substantiated by the examination of the physical wreckage, do not support the presence of fire prior to ground impact. The third and equally important fact is that at the time of gear retraction more than ample runway remained to brake to a successful stop and even had there been a fire in the left engine no necessity existed for scuttling the aircraft.

The testimony of the captain is inconsistent with the clear and substantiated evidence of record in this investigation. Under the circumstances, the Board cannot accept the statement of the captain. The Board therefore concludes that fire did not occur until after the aircraft settled; that the captain, instead of intentionally raising the gear as he stated, not knowing that the safety switch was malfunctioning, actually caused the gear to be raised unintentionally. Poor piloting technique was displayed by the captain in placing and keeping his hand on the landing gear selector handle and by his uncalled for action in applying an upward pressure on this lever in anticipation of the first officer's command to raise the gear. This accident would not and could not have occurred without the captain's improper procedure in applying upward pressure to the landing gear selector handle and malfunction of the landing gear safety switch.

As a result of this accident American Airlines issued a "Fleet Campaign Directive" which required an immediate one-time inspection of the landing gear safety switch assemblies on all of their Convair aircraft. Several other corrective measures designed to preclude further maintenance difficulties were also instituted with regard to the switch overhaul procedures. As an additional precaution the company restricted Captain Johnson from flying as pilot in command for a period of six months.

Findings

On the basis of all available evidence the Board finds that:

1. The crew, aircraft, and carrier were currently certificated and the flight was properly dispatched.
2. The aircraft load was well below maximum allowable and properly distributed.
3. Weather was not a factor.
4. The first officer made the takeoff with the captain performing the duties of copilot from his left seat.
5. The aircraft operated normally up to 85 knots in the takeoff roll.
6. The captain prematurely applied upward pressure on the landing gear selector handle.
7. A defective landing gear safety switch allowed the landing gear selector handle to be unlocked during ground operation of the aircraft, and permitted the landing gear to retract.
8. Fire did not develop in the left nacelle and fuel tank area until the aircraft skidded to a stop on the runway.
9. The company's inspection of the safety switch was inadequate.

Probable Cause

The Board determines that the probable cause of this accident was the improper technique of the captain resulting in the unintentional retraction of the landing gear prior to V_1 speed, which was made possible by a malfunctioning left gear safety switch. A contributing factor was inadequate inspection by the carrier.

BY THE CIVIL AERONAUTICS BOARD:

/s/ JAMES R. DURFFE

/s/ CHAN GURNEY

/s/ HARMAR D. DENNY

/s/ G. JOSEPH MINETTI

/s/ LOUIS J. HECTOR

S U P P L E M E N T A L D A T A

Investigation and Taking of Depositions

The Civil Aeronautics Board was notified of the accident immediately after occurrence. Investigation was started immediately in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. Depositions, ordered by the Board, were taken at New York, New York, on March 27 and 28, 1958.

Air Carrier

American Airlines, Inc., is a Delaware corporation with general offices in New York, New York. It operates as an air carrier under currently effective certificates of public convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Civil Aeronautics Administration. These certificates authorize the carrier to transport by air persons and property over numerous routes within the continental limits of the United States, including the route being flown in this instance.

Flight Personnel

Captain Edward W. Johnson, age 37, was properly certificated for the flight. He had been employed by American Airlines for more than seven years. His total flying time was 7,453 hours, of which 4,660 hours had been in Convair 240-type aircraft, 1,322 as captain. His required periodic examinations and checks were current and his rest period prior to the flight had been in compliance with CAA requirements.

First Officer Norman A. Paquette, age 32, was also properly certificated for the flight. He had flown approximately 5,300 hours, of which approximately 3,205 hours had been in Convair 240-type aircraft. All of his required periodic examinations and checks were also current and his rest period prior to the flight had been in compliance with CAA requirements.

Stewardess Marian Sullivan was employed by the company on May 18, 1956. Her last emergency procedures refresher training was on November 20, 1957.

The Aircraft

Convair 240, N 94213, serial number 23, was acquired by American Airlines January 18, 1949. Since that time it had been flown 20,857 hours. The aircraft had 63 hours since the last periodic check, and 1,868 hours since the last continuous airworthiness check at Tulsa, Oklahoma.

The engines were Pratt and Whitney R-2800-83A124. Engine No. 1, serial number 56710, had a total of 15,761 hours; engine No. 2, serial number 54505, had a total of 17,037 hours. Both engines had 157 hours since last overhaul.

The propellers were Hamilton Standard, model 43E60, blade model 6895A-12. Propeller No. 1 had 1,866 hours since last overhaul and propeller No. 2 had 1,868 hours since last overhaul.