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CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted: September 23, 1949 Released: September 26, 1949

PAN AMERICAN AIRWAYS, INC., HAVANA, CUBA—DECEMBER 9, 1948

The Accident

At approximately 1725,[1] December 9, 1948, a Convair 240, NC-90665, owned by Pan American Airways, Inc., a scheduled air carrier, and operated by its Latin American Division, crashed at Rancho Boyeros Airport, Havana, Cuba, during an attempted takeoff. The stewardess was slightly injured; all of the other forty-three occupants were unhurt.

History of the Flight

Pan American Airways' Flight 428 was the return portion of a trip originating at Miami, Florida, December 9, 1948, and scheduled to fly to Havana, Cuba, and return. The crew consisted of Captain Thuel V. Schuhart, First Officer Henry W. Brotherton, Purser Richard Abbott, and Stewardess Betty Jean Poe. The gross weight at the time of takeoff was 38,821 pounds which was within the allowable limits and properly distributed. Taxi clearance was obtained from the tower to Runway 5 with instructions to hold at the intersection while another aircraft was landing. On arrival at the intersection the engines were run up and the pre-flight check accomplished. At this time when operating the right engine on the right magneto there was fluctuation of 30 BMEP (Brake Mean Effective Pressure), and the engine backfired several times. The engine was operated at 30 inches of manifold pressure until the cylinder head temperature increased from 130 to 200 degrees Centigrade. At this temperature the magnetos were tested again and the engines were operating within normal limits. When cleared for takeoff, the first officer, who was seated on the right hand side, started the takeoff run.

At an air speed of approximately 95 knots (109 mph), back pressure was applied to the controls to take off. The captain, sensing an unusual vibration at this time, took over control, closed the throttles and applied the brakes. Runway 5 on the Rancho Boyeros Airport is 4,500 feet long and the aircraft had progressed down the runway about 2,600 feet when the brakes were applied. The left outboard and the right inboard tires blew out within a short distance. As the speed of the aircraft was still fairly high, the captain used the emergency air brakes. However, the aircraft rolled off the end of the paved runway, continued 300 feet to the boundary of the airport where it struck a ditch and skidded to a stop 315 feet beyond the airport boundary. At the time of the accident, the weather was high overcast, visibility unlimited, ceiling unlimited, wind ENE 6 miles per hour, temperature 82 degrees Fahrenheit.

Investigation

Investigation disclosed that the aircraft was extensively damaged.

The nose landing gear drag link had failed, allowing the gear to fold rearward. As this occurred, the gear buckled at the fork and moved slightly to the right, forcing the nosewheel to strike the edge of the well and compressing the fuselage upward. Failure of the left main landing gear allowed it to fold directly rearward. The right landing gear was extended and locked. Examination of the main landing gear showed that the left outboard tire and the right inboard tire had blown out. The left inboard tire showed little indication of wear. Both tires on the right side were damaged by fire.

The left wing was severly damaged in the vicinity of the broken landing gear. The trailing edge of the wing, the rear of the left engine nacelle and the left engine augmentor tubes were bent upward approximately 16 inches; the rear spar was cracked. The outer section of the

[1] All times referred to herein are Eastern Standard and based on the 24-hour clock.

wing near the wing tip was badly damaged by sliding over the surface of the ground. Investigation disclosed that the right wing was severed just inboard of the engine nacelle. It lay in an inverted position and was held to the center section by means of control cables. Fire had substantially destroyed the right engine nacelle and a large portion of the leading edge of the right wing.

Examination of the electrical plug which is attached to the flap selector valve disclosed a broken wire in the control circuit for lowering the flaps and the plug itself was partially out of its receptacle. The flaps were fully up, which corresponded with the position of the flap control.

The tip of a blade on the left propeller was broken and the blades of both propellers were bent rearward.

The captain stated that during the takeoff run a vibration occurred causing him to reduce power and apply brakes. In an effort to determine the source of vibration, hydraulic units, pertinent parts of the flap system, landing gear assemblies and brake units were shipped to Miami for examination. The left brakes were bench checked and there was no indication of defective braking. Tests of the right brakes were inconclusive as they had been exposed to the fire which had destroyed the piston and cylinder head seals.

The left inboard and right outboard brake linings were badly worn and pitted. The linings of the other two brakes showed only moderate wear. The hydraulic system accumulator, the brake system valves and the flap hydraulic drive motor were examined and functioned properly. At Havana, all hydraulic and air lines in the fuselage were capped and tested under a minimum of 4,000 pounds per square inch hydraulic pressure; no malfunctioning was found. Another Convair was test flown using the nosewheel assembly of NC-90665, and also using main landing gear tires which were worn in a similar manner to those found on the damaged aircraft. No vibration occurred.

Company records disclosed that on December 8, 1948, all brake assemblies of this aircraft were inspected and checked. At this time assemblies with new linings were installed on the two left wheels and the right inboard wheel.

Air brakes (for emergency use) are standard equipment on the Convair 240. The pilots had not received any training in their use other than written instructions.

NC-90665 was equipped with Hamilton Standard Propellers with the reversible feature made inoperative by the carrier; however, the aircraft was certificated by the CAA for operation by Pan American over this route without the use of the reversible feature.

The runway, as previously stated, is 4,500 feet long and the surface is slightly irregular, described "as like a washboard." Heavy marks were made by the left outboard wheel starting 2,600 feet from the southwest end of the runway and they extended approximately 550 feet; from this point to the end of the runway were two narrow black lines. Light marks, made by the left inboard wheel appeared adjacent to those of the left outboard and continued to the end of the runway. Heavy marks made by the right wheels appeared at a point 2,650 feet from the takeoff end of the runway and continued for 250 feet. From this point and in line with the track of the right inboard wheel two narrow black lines continued to the end of the runway. Light marks made by the right outboard wheel appeared for the next 1,060 feet, followed by heavy marks to the end of the runway. Light marks, made by the left inboard wheel together with heavy marks made by the right outboard wheel, appeared on the ground beyond the runway and extended to the drainage ditch, a distance of 300 feet.

Analysis

Though both the captain and the first officer sensed an unusual vibration during the takeoff run, the cause and nature of the vibration was not learned. A nosewheel shimmy or an unbalanced tire are among the possible causes of the vibration. However, during a test of another Convair, equipped with the identical nosewheel assembly including the tires from the damaged aircraft and using tires on the main wheels similar in wear, no vibration occurred.

Although the right engine was heard to backfire during the run-up period, it was determined that this was due to the cylinder head temperature being below prescribed limits. When normal

operating temperature was reached, the engine functioned properly. This is substantiated by both the captain and the first officer.

After the accident the flaps were found fully retracted with the actuating switch in neutral. However, the crew stated that prior to takeoff, the flaps were lowered and they did not remember raising them. They may have been raised unconsciously since the training procedure for this aircraft includes the retraction of flaps when brakes are applied. The electrical cannon plug to the flap motor control valve had a broken wire and was partially out of its receptacle. Scratches indicated that it had been loose for sometime. Had the wire been broken prior to the accident the flaps could not have been lowered.

As previously stated two tires blew out within a short distance after the brakes were first applied. Although there was evidence of braking action throughout the entire run, the aircraft was not greatly retarded. At an approximate speed of 95 knots (109 miles per hour), the aircraft was nearly airborne with most of its weight off the wheels. Under these circumstances it would have been easily possible to lock the wheels, causing the tires to skid sufficiently to blow out. All but the left inboard tire indicated a skidding action at some time during the run as evidenced by marks on the runway and this tire showed moderate braking action throughout. Even though air was applied to the brakes during the emergency, the aircraft failed to stop. However, the fact that most of the run was completed with only two wheels capable of producing normal braking action may have contributed to the failure of the brakes to stop the aircraft within the required distance. The brake linings of the left inboard and the right outboard wheels were badly worn and pitted, indicating that they had been subjected to intense frictional heat. These were the two wheels whose tires did not blow out. The additional weight placed on these wheels, together with the attendant increased tire friction, prevented them from further skidding. Also, the heavy application of the brakes could have caused them to overheat and thus become less effective.

In 1947 and 1948, accelerate stop tests were conducted by the CAA on the Convair 240 as a part of its type certification tests. These tests were conducted with gross weights between 33,150 pounds and 39,500 pounds (the subject aircraft grossed 38,821 pounds) and at speeds up to 117 knots. All tests were conducted without reversing the propellers and with 24 degrees of flap. The test data indicate that with a weight of 38,900 pounds and a speed equal to 95 knots, the aircraft could have been stopped in a distance of 1,552 feet with the use of the brakes only. From a summary of all the tests, it is concluded that this stopping distance would be somewhat increased by the blowing out of a tire on each side. It must be realized that these figures were obtained under test conditions of uniform tires, uniform brakes and no pilot apprehension as to sufficient runway remaining in which to stop.

Evaluating all the evidence from the investigation of this accident, together with facts observed through day-by-day scheduled operation, Pan American Airways, Inc., concluded that "the braking system of the Convair 240 aircraft is critical under certain operating conditions." As a result, the company instituted the following: (a) *Propeller reversing* was changed from a regular modification to an immediate campaign modification; (b) high capacity brakes, under test at time of accident (although not installed in NC-90665), are now installed in the company's CV-240 aircraft. These high capacity brakes retain their braking effectiveness somewhat better under increased heat and therefore have a higher degree of efficiency than the brakes installed at the time of the accident; (c) the pilot training curriculum was enlarged to include checking each pilot in the actual use of the air brakes.

A thorough examination of the company maintenance records revealed that maintenance of NC-90665 was satisfactory. The weather was not a contributing factor.

Findings

1. The carrier, the aircraft, and the crew were properly certificated.

2. The initial airworthiness certification of the aircraft did not require the incorporation of the reversible propeller feature, and the carrier elected to operate the aircraft without such feature since the certification tests indicated the aircraft could be stopped by the use of the wheel brakes only.

3. The crew sensed an unusual vibration during the takeoff run at an approximate speed of 95 knots, immediately throttled the engines and applied brakes.

4. The left outboard and the right inboard tires blew out within 550 and 250 feet of travel respectively, after the brakes were applied.

5. The aircraft failed to stop within the required distance because of inadequate braking effectiveness.

6. A test flight of a similar airplane using the nosewheel and tire assemblies of NC-90665 did not reveal any unusual vibration.

— 15618

7. The aircraft maintenance records indicated that the brakes were inspected on December 8, 1948, and that new brake linings were installed on both left wheels and the right inboard wheel of the main landing gear assembly.

8. Investigation disclosed no evidence as to the cause or nature of the unusual vibration.

Probable Cause

The Board determines that the probable cause of this accident was inability to stop the aircraft under marginal conditions of stopping distance because of inadequate braking effectiveness.

BY THE CIVIL AERONAUTICS BOARD:

/s/ JOSEPH J. O'CONNELL, JR.
/s/ OSWALD RYAN
/s/ JOSH LEE
/s/ HAROLD A. JONES
/s/ RUSSELL B. ADAMS

Supplemental Data

Investigation and Hearing

The Civil Aeronautics Board was notified at 1815, December 9, 1948. An investigation was begun immediately in accordance with the provisions of Section 702 (a)(2) of the Civil Aeronautics Act of 1938, as amended. A public hearing was ordered by the Board and held in Coral Gables, Florida, February 15 and 16, 1949.

Air Carrier

Pan American Airways, Inc., a New York corporation with headquarters in New York City, is a holder of a certificate of public convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Civil Aeronautics Administration.

Flight Personnel

Captain Thuel V. Schuhart, age 29, possessed a valid airline transport rating and had logged a total of 4,210 flying hours, of which 387 were in Convair 240 type equipment. His last CAA physical examination was passed June 25, 1948. First Officer Henry W. Brotherton, age 27, possessed a valid airman certificate with a commercial pilot and instrument rating. He had logged a total of 2,516 flying hours, of which 6 hours were in Convair 240 type equipment. His last CAA physical examination was on August 30, 1948. The other two members of the crew were the purser, Richard Abbott; and the stewardess, Betty Jean Poe.

The Aircraft

NC-90665, a Consolidated Vultee CV-240 aircraft, had flown a total of approximately 392:44 hours. It was currently certificated by the CAA.

The aircraft was equipped with two Pratt & Whitney R2800CA-18 engines and with Hamilton Standard Hydromatic propellers. No. 1 engine had a total of 393:29 hours, and No. 2 engine a total of 197:27 hours.