

CIVIL AERONAUTICS BOARD

AIRCRAFT ACCIDENT REPORT

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PAN AMERICAN WORLD AIRWAYS, BOEING 707, N 707PA
NEW YORK INTERNATIONAL AIRPORT
JULY 11-12, 1959

SYNOPSIS

At 0029 e.s.t., on July 12, 1959, Pan American World Airways Flight 102 made a successful emergency landing at New York International Airport after losing two of the four wheels of the left main gear. The airplane, a Boeing 707, N 707PA, received major damage to the left main landing gear. Four of the 102 passengers aboard were injured during deplaning.

The loss of the two wheels was caused by a failure of the forward truck beam. This failure was induced by undetected damage to the beam when it contacted the lower torsion link assembly antirotation bolt. This could only have occurred on one of two previous flights. On one of the previous flights the snubber failed on takeoff and on the other flight the snubber had been removed. Either condition would have permitted the truck beam to pitch up sufficiently to cause this contact. The manufacturer has prepared several engineering changes which will prevent recurrence of this type of failure. These changes are discussed in the report.

During the emergency, which lasted approximately four hours, radio and television announcements attracted to the airport large crowds of curiosity seekers who seriously hampered the work of emergency rescue personnel.

Representatives of the Port of New York Authority, New York Fire Department, and the Police Department are reviewing emergency procedures on a continuing basis to improve them whenever possible.

Investigation

Pan American World Airways (PAA) Flight 102 is a regular nonstop flight from New York International Airport (Idlewild) to London, England. The trip of July 11 carried 102 passengers and a crew of 11.

Routine preparations for the flight were completed. Takeoff was planned on runway 25L with a gross weight of 244,805 pounds, of which 94,547 pounds consisted of fuel.

The flight, which had been delayed approximately 30 minutes for a wheel change, took off at 2037¹/₂. Immediately after the aircraft became airborne,

¹/₂ All times herein are eastern standard based on the 24-hour clock.

one of the Idlewild tower controllers saw what he believed to be wheels separate from the undercarriage and fall into the bay at the end of the runway. He immediately notified the flight and called the office of the Port of New York Authority to have personnel investigate and report the identity of the object. About one hour was required for crews to retrieve the part from shallow water about 50 feet from the shore. The object was then identified as two wheels from the aircraft with a portion of the truck beam attached.

The crew stated that their takeoff was completely normal and that when they were airborne the landing gear handle was raised to the "up" position. The three green indicator lights went out and the red, "gear in transit," light came on. This light remained on indicating that the gear did not retract properly. It was about this time that the tower notified the flight concerning the object which had fallen from the aircraft.

The flight remained in the local area circling at low altitude to determine what damage had been sustained. A visual inspection by the crew revealed that the left gear was extended but not locked down, and that the two forward wheels of the four-wheeled truck were missing, along with a major portion of the forward truck beam.

After a careful appraisal of the situation the captain decided to land at Idlewild with the landing gear extended. He requested that the last 3,000 feet of runway 13R be foamed as a precautionary measure. It was estimated that the foaming operation would require about two hours. The aircraft had enough fuel remaining to circle for about three hours more at low altitude. Remaining aloft until the foaming operation was complete would also enable the captain to reduce the fire hazard and to lighten the aircraft to the desirable landing weight through fuel burnoff rather than by dumping.

While preparations on the ground were being accomplished, the flight made ready for the landing. The landing gear was lowered manually and locked down. Passengers were instructed in the proper emergency procedures and aircraft evacuation methods. Crew members were assigned to each exit to actuate the emergency slide chutes. Everything was in readiness prior to the landing attempt.

On the ground, preparations were carried out under the direction of Port Authority officials. About 2136 an emergency alarm was actuated and equipment and personnel from the New York City Fire and Police Departments responded in accordance with established agreements with the Port Authority. These mutual agreements set out procedures and responsibilities for each of the three organizations to follow in coping with emergencies at the airport.

Radio and television broadcasts of the emergency attracted thousands of sightseers to the airport. All access roads were blocked by the traffic congestion. The police established barricades to access points to the airport allowing only emergency equipment and authorized personnel admittance.

A considerable number of unauthorized persons gained entrance to the runway area and hampered the work of the Port Authority and Fire Department personnel.

The foaming operation was completed about 2325 and the emergency vehicles were recharged with foam and water. By 0010 the emergency equipment was made ready and positioned for the landing. A final check was made to make certain that the runway was clear of personnel. After insuring that all unauthorized persons were north of taxiway Q, which is 850 feet north of runway 13R, the control tower was notified that preparations were complete.

The captain, after receiving landing clearance from the tower, made his final preparations for the landing. Based on the gross weight of the aircraft, which was estimated to be 155,000 to 158,000 pounds, reference speed was calculated to be 130 knots and the approach was made.

Flaps were fully extended and touchdown was made within the first 1,000 feet of the runway with the right main gear. Spoilers were raised immediately and as the left main gear and nose wheels made contact full reverse thrust was applied. It was possible to hold the aircraft straight using differential reverse thrust until the full weight settled on the left gear and the left strut began to drag on the runway. Right brake was sufficient to maintain directional control and at 0029 the aircraft came to a stop on the runway about 1,200 feet short of the foamed area.

Although the strut end scraping on the runway generated heavy sparking throughout the landing roll, no fire occurred. Immediately after the aircraft stopped, the exit doors were opened and emergency slide chutes were released.

The Port Authority emergency vehicles surrounded the aircraft to assist in evacuating the passengers. Several people left the aircraft via the chutes; however, within a short period of time the chutes were cut away and the remaining passengers were evacuated via emergency stairs placed in position by Port Authority personnel. All 102 passengers were out of the aircraft in approximately three minutes. It was estimated that approximately 400 to 600 people surrounded the aircraft after it stopped. Most of these persons were the curious whose presence seriously hampered the efforts of the rescue workers. As there was danger of tires blowing out or the collapse of the damaged landing gear, the sightseers were repeatedly asked to "move out of the danger area." These warnings were ignored and finally a Port Authority fire truck sprayed the crowd and cleared the area.

Examination of the forward section of the hollow steel truck beam for the left landing gear revealed the presence of a flat peen mark on its top face 7-1/2 inches forward of the truck fulcrum. A crack extending longitudinally approximately 1-1/2 inches each way from the peen mark was evident. Although the clamshells and polishing normally associated with metal fatigue were not present, there were the well-defined end lines of a fatigue-like crack which started at the inside surface of the truck beam. The end lines and the lack of ductility indicate the probability of more than one cycle of loading. Beyond these end lines the longitudinal crack was extended in instantaneous fractures 3-1/2 inches forward and 1-3/8 inches behind.

A second less well-defined peen mark was found about one-half inch forward of the above-described peen mark. Although this second mark appeared to have been made by a sharper edge, no evidence of fatigue was present. A peripheral

helical fracture originated at this peen mark and ran completely around the truck beam to the left, terminating at the longitudinal crack. This peripheral fracture ended 1-1/2 inches forward of its point of origin.

At the forward end of the longitudinal crack, another instantaneous fracture ran helically to the right completely around the beam and beyond to a point on the bottom of the beam three inches to the rear of the front axle centerline. A third instantaneous fracture occurred at the rear of the longitudinal crack and ran peripherally to the left. The terminus of this fracture was ground off by the sliding action on the runway

The left main gear lower torsion link assembly antirotation bolt was still in place but its nut was missing. Some threads were damaged and the end was slightly bent. The bolt end surface had two peened areas, each the same size and shape as the peen mark on the truck beam. The lower spacer was also peened on the edge of its lower surface.

In a metallographic examination conducted by the National Bureau of Standards numerous cracks were found, some of which appeared to be intergranular. Indications of intergranular cracking were also found on the main fracture, suggesting the possibility that hydrogen embrittlement contributed to the cause of the failure.

The microstructure was typical of quenched and tempered steel but in some areas the nonmetallic inclusions were more numerous than is considered normal for aircraft quality steel.

Hardness testing of the steel near the fracture produced a Rockwell number of 53C, showing that the beam had been heat-treated to the specified tensile strength range of 260,000 to 280,000 pounds per square inch.

The truck beam is considerably harder than the antirotation bolt and any contact between the two which would deform the truck beam would also damage the softer bolt.

During takeoff and landing the landing gear truck may be subjected to extreme and violent vertical oscillation over runway pavement at high speeds. In addition, it has been determined that unequal braking during the retraction cycle may also cause similar violent oscillations. Therefore, the landing gear truck is fitted with a "hydraulic shock absorber" snubber assembly. Its purpose is to damp these oscillations of the truck beam around its single pivot point at the lower end of the oleo strut. It also serves to limit displacement at the truck beam to a maximum of 10 degrees above the 15 degrees below the horizontal. Without this limiting action by the snubber the truck beam is free to pivot to an angle at which it will contact the antirotation bolt in the lower torsion link assembly. Investigation disclosed that the position of the peen marks on the truck beam of N 707PA corresponded precisely with the point at which the beam would contact the antirotation bolt during over travel of the truck beam.

A review of the history of the landing gear on this aircraft revealed that a snubber failure had occurred on takeoff from Boston on July 7, 1959. After landing in New York, the snubber was replaced. The antirotation bolt was damaged but the nut which was missing was replaced. On July 9, 1959, at Paris, it was noted that the snubber terminal attach bolts were sheared. They were

replaced with temporary bolts and the aircraft proceeded to Santa Maria. On landing, inspection showed that the temporary bolts had sheared. At this time the snubber was removed and the aircraft was flown to Idlewild where the same snubber was reinstalled. Testimony of Pan American representatives at the public hearing indicated that no damage occurred to the antirotation bolt on either the Boston takeoff or the Santa Maria takeoff. They also stated that the damage inflicted on the bolt in this accident was the result of the contact between the truck beam and the bolt after the beam had failed. One additional round trip between New York and London was made, without incident, before trip 102.

Analysis

The Board believes that the landing gear truck beam on N 707PA was damaged on a previous flight by contact with the lower torsion link assembly anti-rotation bolt.

The design of the landing gear is such that this damage can occur only if the snubber is removed or is broken from one of its end fittings. The beam could have been peened during the flight from Boston, July 7, after the snubber failed, or on its flight from Santa Maria, July 9, when the snubber had been removed. Also, since the examination of the fracture indicates multiple loading, the damage may have been done during both of the flights.

Because the beam and the end of the antirotation bolt are angled 15 degrees from each other at the point of their contact, the end of the bolt must be deformed to that angle to leave a flat mark on the beam surface. If, as PAA claimed, the bolt installed at the time of the accident was damaged during the accident, another bolt would have had to have been installed previously. This bolt would have had to have been flattened as mentioned before in order to peen the truck beam in the manner it did. This previously damaged bolt, if there was one, was either replaced without appropriate notation in the records or was the bolt in place at the time of this accident. Either action indicates improper maintenance practice.

The longitudinal fatigue-like crack originated at this flat peen mark. As the snubber was properly installed at takeoff, no contact between the beam and the bolt was possible until the forward truck beam had separated from the aircraft as a result of forces to which the weakened beam was subjected on takeoff.

Although a considerable number of unauthorized persons were on the landing area during the emergency, none was closer to the runway than taxiway Q, which is 850 feet north, during the actual landing. The Board takes cognizance of the fact that the normal Saturday night visitor population of Idlewild is upwards of 10,000 people. In addition, there are over 200 doors by which these persons could gain entrance to the aircraft operating areas.

It is to be noted here that there was no interference by spectators during the actual landing of the aircraft. The runway was cleared of all personnel during this time and it was not until the aircraft had come to rest that the numerous persons crowding around became a serious problem. Ground preparations were adequate and well executed.

Conclusion

Results of the investigation indicate that the failure of the truck beam was due to a crack produced by impact loads on its top surface. The initial crack was propagated to complete fracture by additional impact and normal service loads. Some hydrogen embrittlement and an unusually large number of non-metallic inclusions in the area where the fracture started may have contributed to the failure by decreasing the ductility of the steel.

As a result of a study of snubber failures, the manufacturer has prepared several changes which it is anticipated will eliminate further difficulty. The size of the orifices in the hydraulic piston of the snubber assembly are to be reduced to increase its load rate, and the pressure relief setting is to be increased from 8,000 p.s.i. to 12,500 p.s.i. These modifications will increase the effectiveness of the damping action of the snubber assembly. The automatic wheel braking valve setting is to be reduced from 450 p.s.i. to approximately 175 p.s.i. This should decrease the tendency of unequal braking causing the oscillation of the truck beam. In addition, the pressure in the leveling cylinder assembly is to be increased from 925 p.s.i. to 1,500 p.s.i.

These changes should prevent excessive oscillation of the truck beam caused by either unequal braking during retraction or by displacement of the truck during taxi or takeoff roll.

The Board concludes that the agreements between the Port Authority and New York Fire and Police Departments, which have been in existence for a number of years, are sound. Many emergencies have been covered in the past following the practices established in these agreements. While improvements, alterations, and modernization of the procedures are indicated from time to time, it is believed the policy of mutual assistance can and will continue to operate successfully. Subsequent to this accident, representatives of the National Association of Broadcasters have advised that when radio and television coverage of emergency news is being broadcast, a specific request will be made to listeners "to refrain from doing anything that would hamper the efforts of the authorities whose responsibility it is to cope with the emergency."

The Board realizes that an aircraft emergency is news and that news reporting media constantly monitor aircraft radio frequencies. It is not to be inferred that this practice is in any way improper. It is a fact, however, that the public broadcasts in this case attracted large crowds of persons to the scene. The resulting traffic completely choked the access highways to the airport boundaries. This could give rise to a serious problem affecting air safety and one which will be given further study by the Board.

Probable Cause

The Board determines that the probable cause of this accident was the failure of the forward truck beam of the left landing gear.

BY THE CIVIL AERONAUTICS BOARD:

/s/ JAMES R. DURFEE
Chairman

/s/ WHITNEY GILLILAND
Member

/s/ CHAN GURNEY
Vice Chairman

/s/ ALAN S. BOYD
Member

/s/ G. JOSEPH MINETTI
Member

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

Investigation

The Civil Aeronautics Board was notified of this accident at 2045 e.s.t., July 11, 1959. Investigators were on the scene during the emergency and immediately initiated an investigation in accordance with the provisions of Title VII of the Federal Aviation Act of 1958. A public hearing was held in New York City on July 30 and 31, 1959.

Air Carrier

Pan American World Airways, Inc., is a New York corporation with its main offices in New York, New York. The corporation operates as an air carrier under a certificate of public convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Federal Aviation Agency (formerly Civil Aeronautics Administration). These certificates authorize the carrier to engage in air transportation between various points in the United States and foreign countries, including the route involved in this instance.

Flight Personnel

Captain Edward F. Sommers, age 44, was employed by Pan American World Airways on November 29, 1939. He holds a valid FAA airline transport pilot certificate with a rating for the Boeing 707. He had a total of 17,100 flying hours, of which 170 were in the Boeing 707. He completed his latest emergency class and ground refresher course May 11, 1959. His latest FAA (formerly CAA) physical examination was passed April 8, 1959.

Flight Officer William H. Riester, age 42, was employed by Pan American World Airways on March 16, 1942. He holds a valid FAA airline transport pilot certificate with a rating in the Boeing 707. He had a total of 11,270 flying hours, of which 144 were in the Boeing 707. He completed his latest ground refresher course May 20, 1959, and his last emergency class April 14, 1959. His last FAA physical examination was passed March 21, 1959.

Navigator Walter E. Hoffman, age 37, was employed by Pan American World Airways on December 26, 1951. He holds a valid FAA commercial pilot certificate and navigation certificate. He had a total of 3,424 flying hours, of which 249 were in the Boeing 707. His last physical examination was passed October 4, 1958. His latest emergency class and periodic refresher courses were taken April 5, 1959.

Flight Engineer August G. McKinney, age 47, was employed by Pan American World Airways May 11, 1936. He holds a valid flight engineer certificate with airplane and engine ratings. He had a total of 14,090 flying hours, of which 733 were in the Boeing 707. His latest FAA physical examination was passed December 1, 1958. He completed his latest emergency class July 21, 1958.

The flight service crew, consisting of Purser Edmund Trudelle and Mario De Minices; Stewardesses Muriel Orvidson, Mona Nordby, and Ursula Kempin; and Steward John Treadwell, were all properly qualified in the Boeing 707.

The Aircraft

N 707PA, a Boeing 707, serial number 17587, was owned and operated by Pan American World Airways, Inc. The aircraft was equipped with Pratt & Whitney JT3C turbo-jet engines.