CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted: June 13, 1949 Released: June 14, 1949

DELTA AIR LINES, INC.—CHICAGO, ILLINOIS, MARCH 10, 1948

The Accident

At approximately 2258,* March 10, 1948, Delta Air Lines' Flight 705, a DC-4, airplane NC 37478, crashed and burned 150 feet beyond the north boundary of the Municipal Airport, Chicago, Illinois. Eight of the nine passengers and the four crew members were killed, and one passenger was seriously injured. The aircraft was destroyed.

History of the Flight

During the day of March 10 the airplane had been flown from Miami to Chicago, and had operated normally. The landing at Chicago was accomplished at 2106, at which time the temperature was 12 degrees Fahrenheit, and there was dry snow and ice on the field. During the one hour and 51 minutes that the airplane was parked, it was serviced with fuel and given a routine turn-around inspection.

At approximately 2245 the aircraft departed from the ramp with the following crew: Captain Grover L. Holloway, First Officer John S. Disosway, Purser Marvin Glenn Hairston, and Stewardess Sue Lou Young. The aircraft carried nine passengers, 1,800 gallons of fuel, and 628 pounds of cargo. The total weight of the airplane, 55,087 pounds, was less than the maximum allowable, and the load was properly distributed with respect to the center of gravity. A light, dry snow was falling. The ceiling was reported to be 5,500 feet and the visibility seven miles. The wind was north-northwest at 14 miles per hour.

Flight 507 was parked near the end of the right north-south runway for approximately eight minutes during which time observers heard the engines being "run-up" for the "pre-takeoff check." Take-off on the right north-south runway was started at 2257. The take-off roll and the first part of the climb appeared to be normal until the aircraft had progressed three-quarters of the way down the runway, at which time it had reached an altitude between 150 and 200 feet. Then, while still within the airport boundaries, it assumed a very steep, near vertical, climbing attitude. Airport, tower, and flight personnel observing from the ground believed the flight to be in difficulty, and though no distress signal was received from the airplane, the tower promptly telephoned the crash and fire facilities on the field. At an altitude between 500 and 800 feet the airplane appeared to stall, and the nose and right wing dropped. A partial recovery from the stall was made before the aircraft crashed to the ground and burst into flames.

Investigation

The aircraft struck the ground at about a 23 degree angle from the horizontal. An impression of the bottom part of the four engine nacelles and the landing gear was made in the frozen earth 150 feet north of the end of the right north-south runway and 218 feet east of its center line. Approximately 70 feet forward from where the engines struck the ground, the tail assembly was found in an upright position. It had broken from the rest of the airplane 72 feet aft of the nose.

The main section of the wreckage, consisting of fuselage, wings, and engines, came to rest 90 feet forward of the tail assembly. It had been largely destroyed by impact and fire. Nothing remained of the fuselage except the bottom skin and flooring. Both the right and left wings were almost entirely consumed by fire. The nose and cockpit sections of the fuselage were completely crushed. The main and nose wheel landing gear assemblies were in an extended and locked position. The flap extension cylinder was in a position of 12 degrees flaps

*All times referred to herein are Central Standard and based on the 24-hour clock.

down. Bodies of both pilots were in their respective seats with safety belts securely fastened.

The pattern of the engine and propeller damage was similar in that all four engines had fractured cylinder heads on the lower side, and all four propellers had one fractured blade at the shank end. Furthermore, all four engine nose sections were broken free of the power sections with the propeller reduction gear assemblies remaining with the propellers. All propeller blades were badly bent and twisted. No evidence of in-flight fire was found either in the powerplant induction systems or engine nacelles, nor were there any indications of engine malfunctioning.

The examination of the tail section disclosed that the spars and the horizontal surfaces had not been displaced in the structure. Though the control cables for the elevators, and elevator trim tab, and the rudder were broken, they were still capable of operation. The settings of the trim tabs and all flight controls were normal for take-off. The elevator trim tab control was between 3/4 and 1-1/4 degrees nose down. All the servo-unit engaging controls for the automatic pilot were found in the "off" position. These units were bench-checked, and the overriding valves found to be in good condition. The elevator gust lock mechanism in the empennage with spring and lock nuts intact operated normally, and was in the unlocked position. The cockpit gust lock quadrant, however, was in the raised or locked position. Fresh marks and abrasions on the quadrant indicated that the gust lock control had been raised from either the force of impact or the activities of crash and rescue personnel.

The internal mechanisms of the elevator controls and elevator trim tab controls were closely inspected for evidence of foreign matter which might have restricted their movement; however, no indication was found that their movement had been restricted by any foreign matter. The entire elevator and elevator trim tab control systems in a similar airplane were inspected from the control pedestal to the point where the cables leave the fuselage to determine whether these cables could become fouled by ice. Particular attention was given to areas around fair-leads and pulleys to determine whether snow tracked into the cabin might have melted, dripped onto the cables, and frozen. This did not appear possible.

A study of the synoptic weather charts indicated that during the time of the flight from Miami to Chicago a cold front extended northeast from central Texas to Arkansas and Tennessee and then into New England. There was a movement of warm, moist air northward from Texas that resulted in an area of overcast skies and snow through Oklahoma, eastern Kansas, Missouri, Iowa, and Indiana. Across central Florida there was a stationary front accompanied by rain.

After departure from Miami, the flight was conducted in above-freezing temperatures as far as Atlanta. North of Atlanta, the only precipitation encountered would have been dry snow for short periods of time. The flight landed at Covington, Kentucky, where no precipitation was falling or had fallen. From Covington northward, sub-freezing temperatures existed, and there were areas where dry snow was falling. Snow was not falling at Chicago when the flight arrived at 2106. However, there was snow and ice on the field, but since freezing temperatures had prevailed for some time, the landing area was dry.

A light dry snow began falling at Chicago Airport at 2136, and continued while the airplane was given a turn-around inspection and serviced with fuel. There was no evidence that snow, ice, or slush had adhered to any part of the airplane, or had been tracked into the cockpit by the servicing personnel while the aircraft was at Chicago.

Weather at the time of take-off from Chicago was reported to be: Ceiling 5,500 feet overcast, lower scattered clouds at 2,700 feet, visibility seven miles, light snow, wind from the northwest at 14 miles per hour, temperature 10 degrees, dew point six degrees. No turbulence was reported in the vicinity of the airport immediately before or after the accident.

Captain Holloway, age 36, held an airline transport pilot rating. At the time of the accident he had a total of approximately 9,830 flying hours, 1,611 of which were in DC-4 type airplanes. First Officer Disosway, age 25, also held an airline transport pilot rating. At the time of the accident he had a total of approximately 2,976 flying hours, 1,366 of which were in DC-4 type airplanes.

Analysis

The possibility of mechanical or structural failure as a cause of this accident appears to be extremely remote. No evidence was found to indicate that the control cables or control surfaces had been restricted by foreign matter, nor was any indication found of structural defect except that which resulted from impact. The bent and twisted propeller blades showed that all engines had been developing power, accordingly, engines could not have been a contributing factor. There was also a lack of evidence that ice had formed on or around any of the control surfaces or on their actuating cables or mechanisms. At the time that the flight landed at Chicago and during the period that the airplane remained on the ground, subfreezing temperatures prevailed. Conditions were not conducive to the formation of ice for the air and runway surfaces were dry. Furthermore, the inspection of a similar airplane disclosed no possibility that water from melted snow which might have been tracked into the cabin could have dripped and frozen on any of the control cables.

There is a possibility that the accident resulted from taking off with the elevator trim tabs set for nose high flight. Had this been true, excessive control column pressures would have built up rapidly as air speed increased during the take-off and climb. However, the adjustment of the elevator trim tab control to a take-off position would have been a simple and routine operation. It should also be noted that the elevator trim tab was found in approximately the neutral position. Therefore, though there is the possibility that the airplane took off with the elevator trim tab set for nose high flight, it does not appear to be a probable cause of the accident.

Since all the servo-unit engaging controls for the automatic pilot were found in the "off" position, it is believed that the automatic pilot was not a contributing cause. Even had the automatic pilot been inadvertently engaged before or during take-off it would not account for the accident. The overriding valves were found in good condition, and the crew could have overpowered the automatic pilot before the airplane reached a dangerous climbing attitude.

There is also a possibility that the elevator gust lock mechanism was locked during the take-off roll and initial climb, then released too late to permit regaining control of the airplane. The elevator locking mechanism may have been engaged either because the crew neglected to unlock it; or because, having released the control handle from the locked position, the handle was not placed completely down, and the elevator locking mechanism remained locked. There might have been a brief case or some similar object on the floor of the flight deck which prevented the control handle from completing its full travel to the down or "off" position. An airworthiness directive dated August 16, 1947, was issued by the Administrator of Civil Aeronautics which required that the gust lock handle be equipped with a positive latch to hold it in the full down or "off" position. Compliance was required to be made not later than April 1, 1948, which was three weeks after the date of this accident. NC 37478, the airplane involved in this accident, was the only one in Delta's fleet which had not been modified in compliance with the airworthiness directive.

The possibility of the gust lock being engaged is suggested by the results of test flights during which a DC-4 was flown off a runway with the elevator controls held in the locked position. Flaps were extended 15 degrees and the elevator trim tabs set for normal take-off. In all of these tests the airplane performed similarly. At approximately 110 miles per hour indicated air speed the main wheels left the ground, and at approximately 120 miles per hour the nose wheel left the ground. The first part of the climb was normal but at approximately 130 miles per hour the climb angle steepened. At 145 miles per hour the climb angle had increased in excess of 35 degrees. The change of attitude was not excessively violent but was a positive change from a normal climb angle to one extraordinarily steep, which would have resulted in a power on stall if the elevators had not been used to correct the steep climb angle. The steep climb noted in the test flights suggests that the elevators may have been locked in the Delta airplane. However, there were dissimilar characteristics between the flight pattern of the Delta airplane and the pattern noted in the tests. First, the nose of the Delta airplane was raised

before the main landing gear left the ground, whereas the main landing gear wheels left the ground before the nose wheel in the test flights. Secondly, the Delta airplane was observed in a near vertical degree of climb, while the climb angle in the test flights was observed only to be in excess of 35 degrees. Because of these differences in the flight patterns, the tests do not materially support the theory that the gust lock mechanism was engaged in the Delta airplane.

It should also be noted that the complete execution of the Delta Airlines' "before take-off check list" would have included not only the placement of the gust lock control in the "off" position but also the testing of the controls for full and free travel. In view of the fact that the weather conditions were not conducive to the formation of ice, and that no evidence was found to indicate structural or mechanical failure or the restricting of the cables or control surfaces by foreign matter or ice, it would be reasonable to assume that if the controls operated normally before take-off they should have operated normally during the take-off roll and climb. Furthermore, a complete execution of the "before take-off check list" would have included the setting of the trim tab controls for take-off which would have eliminated the possibility of the flight taking off with the elevator trim tab set for nose high flight.

In summary, no evidence was found to indicate that structural or mechanical failure was involved in the cause of this accident. The flight pattern indicated clearly that there was a loss of longitudinal control of the airplane. But there is not sufficient evidence from which to make a determination that any of the three possibilities discussed was the probable cause of the loss of control of the aircraft.

Findings

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

1. The airplane, crew, and carrier were properly certificated.
2. There was no evidence to indicate that there was mechanical malfunctioning or structural failure of the airplane prior to the time of impact.
3. Weather before and at the time of the accident was not conducive to the formation of ice.
4. The total weight of the airplane was less than the maximum gross and was properly distributed with respect to the center of gravity.
5. The take-off and initial climb appeared normal.
6. Approximately three-fourths of the way down the runway at an altitude of between 150 and 200 feet, the airplane assumed a very steep climbing attitude.
7. At an altitude between 500 and 800 feet, the airplane stalled, crashed to the ground, and was destroyed by impact and fire.

Probable Cause

The Board determines that the probable cause of this accident was the loss of longitudinal control of the airplane. The cause for the loss of control remains undetermined.

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

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Supplemental Data

Investigation and Hearing

The Civil Aeronautics Board received notification of the accident on the morning of March 10, 1948, from the Chicago Municipal Airport Tower and immediately initiated an investigation in accordance with the provisions of Section 702 (a)(2) of the Civil Aeronautics Act of 1938, as amended. As part of the investigation the hearing was held April 8, 1948, at Chicago, Illinois.

Air Carrier

Delta Air Lines, Inc., is a Louisiana corporation with general offices in Atlanta, Georgia. The company was granted the authority to operate into Chicago by the Civil Aeronautics Board in 1945.

Flight Personnel

Captain Holloway, age 36, held an airline transport pilot rating; and at the time of the accident had a total of approximately 9,830 flying hours, 1,611 of which were in DC-4 type airplanes. Excluding a period of military leave, he had been employed by Delta Air Lines since 1939. For more than two years he had flown the Chicago-Miami route of Flight 705. His last CAA physical examination was on June 20, 1947. First Officer Disosway, age 25, held an airline transport pilot rating; and at the time of the accident had a total of approximately 2,976 flying hours, 1,366 of which were in DC-4 type airplanes. After obtaining flying experience in the U. S. Army Air Forces, he was employed by Delta Air Lines as a first officer in 1946. His last CAA physical examination was on June 4, 1947, at which time he was found qualified to act as a first officer.

The Aircraft

NC 37478, a Douglas C-54-DO, was a C-54B manufactured November 14, 1944, and subsequently modified to a DC-4. The aircraft was owned and operated by Delta Air Lines and was currently certificated by the Civil Aeronautics Administration. It had been flown a total of 6,509 hours since the time of its manufacture, and had accumulated 164 hours since the last 1,000-hour overhaul. The four Pratt & Whitney twin wasp engines, one through four respectively, had been flown 4,078; 3,784, 3,625; and 4,128 hours. At the time of departure from Miami the total weight of the aircraft was less than the certificated gross weight, and the load was distributed within approved limits with respect to the center of gravity.