

CIVIL AERONAUTICS BOARD
ACCIDENT INVESTIGATION REPORTAdopted: March 12, 1954Released: March 17, 1954RESORT AIRLINES, INC. - NEAR DES MOINES, IOWA,
MAY 22, 1953The Accident

At approximately 0413,¹/ May 22, 1953, a Resort Airlines C-46F, N 1669M, disintegrated in flight while flying through a thunderstorm. The main wreckage fell in a field approximately 11 miles northeast of Des Moines. Both pilots, the sole occupants, were killed.

History of the Flight

The aircraft arrived at Cheyenne, Wyoming at 0038, May 22, on a Civil Air Movement flight (military contract) from New York International Airport. The incoming pilots had no mechanical or radio discrepancies to report. After the aircraft was serviced, Captain Bowen F. Marshall and Copilot Samuel B. Aronson relieved the incoming crew for the purpose of ferrying the aircraft to Chicago, at which point the pilots were to turn it over to another crew. Both pilots visited the U. S. Weather Bureau Airport Station at Cheyenne for weather briefing; all current weather information through 2330 (including three severe weather warnings) was on file and available to them.

The aircraft departed Cheyenne at 0132, on an instrument flight plan to O'Hare Airport, Chicago, via Green Airway 3 and Red Airway 42 at 7,000 feet. Neither passengers nor cargo was carried and the center of gravity was within permissible limits.

Routine position reports were made over Sidney, North Platte, Grand Island, and Omaha, Nebraska. In the last position report, at 0337, the flight reported to Omaha INSAC (Interstate Airways Communication Station) that it was over Omaha at 7,000 feet, estimating over Des Moines at 0409. Three minutes later, the pilot again contacted Omaha INSAC and requested a change of altitude to 3,000 feet. Air Route Traffic Control, through Omaha INSAC, advised the flight that the 3,000-foot altitude was unavailable until arrival over Des Moines owing to a westbound flight proceeding at 2,600 feet between Des Moines and Omaha, and the request for descent would have to be disapproved. The flight was given the latest weather information between Omaha and Chicago, and the Des Moines 0327 weather, and there were no further radio contacts after this. Des Moines tower personnel received a telephone call at 0517 notifying them of the crash.

Investigation

Numerous pieces of the tail surfaces and the right outer wing panel were found scattered over a considerable area. Prior to impact, the right aileron, front and center fuel tanks, and portions of the leading edge and lower surface skin near the root end separated from the right outer wing panel.

¹/ All times referred to herein are Central Standard and based on the 24-hour clock.

The main wreckage consisted of the fuselage, left wing, center section, movable surfaces from the left tip to the right end of the center section, power plant installations, right horizontal tail, and parts of the left horizontal and vertical tails. Damage to the structure and markings on the ground indicated that this assembly struck while in near-vertical descent, with the nose of the aircraft and right end of the wing center section striking almost simultaneously. Ground impact shattered the fuselage and the wing center section. Fire following impact melted considerable portions of the wreckage. The left outer wing panel received relatively minor damage.

Examination of the right outer wing wreckage disclosed that the upper surface attach angle failed in tension and bending. The lower surface buckled in compression along a chordwise line several feet outboard of the lower attach angle. Downward buckling of the right outboard flap and downward deformation of the rear fuel tank, which remained in the wing, were observed. The outer panel leading edge from the attach angles to a point approximately nine feet outboard was severely damaged and much of the deicer boot in this area was missing. There was evidence that battering of the leading edge near the root was due to contact with some object or portion of structure not associated with the wing.

Evidence of one item of malfunctioning prior to disintegration was found. This occurred at the attachment of the right aileron trim tab motor to the support bracket. At this point, two studs in the bracket acted as trunnions about which the tab motor pivoted. The outboard trunnion had backed out of the threaded sleeve in the bracket without stripping any threads; it was not found. The tab motor had then rubbed against the inner surface of the outer support arm and gouged the inner surface of the inner support arm; this damage indicated that the tab motor had been insecure for a considerable period of time after the outboard stud was lost, since the threads of the outboard insert were coated with a rust-colored deposit approximately two-thirds the length of the insert. Some of the threads were worn and rounded. When the tab motor separated from the support bracket, the inboard trunnion was bent approximately 15 degrees. The safety wire through the drilled head of this trunnion was broken at about the point where it would normally be anchored to the support bracket by means of a drilled hole. The remaining trunnion was found backed out about one turn and had a loose fit in the threaded sleeve. The threads in this trunnion and its sleeve were clean and in good condition. The support bracket was still bolted to the rear face of the rear spar.

Directly above the tab motor support bracket, a hole approximately 18 inches long had been punched through the top skin of the wing from the interior. This damage was caused by the tab motor, obviously before the right aileron separated from the wing panel. The tab motor was not found.

Portions of the left stabilizer, elevator, and spring tab remained attached to the fuselage. The stabilizer failed downward along a diagonal line extending aft and outward from the attach angles at the leading edge and rotated through nearly a 180-degree arc until the lower surface of the stabilizer struck the bottom of the fuselage with sufficient force to produce pronounced deformation of the fuselage.

The leading edge of the left stabilizer was flattened rearward and downward through most of its length in a manner which indicated that it was caused by impact with some object other than the fuselage, and that it occurred before

the stabilizer failed downward. There were numerous cuts and abrasions in the leading edge deicer boot.

Evidence presented by four detached portions of the left horizontal tail indicated that they were snapped off by inertia forces when the stabilizer struck the bottom of the fuselage. Just inboard of the second hinge from the tip, one of the detached pieces of the elevator had a hole punched through both the top and bottom skin by a gray-painted object entering from above and moving rearward. Since the gray-painted portions of the aircraft consisted of the wing, the horizontal tail surfaces and parts of the fuselage, the direction in which the hole was made indicated that it could have resulted only from impact with a portion of the right wing.

All balance weights for the elevator tabs, except one, were still attached. The left elevator flying tab weight was torn off by interference with the edges of the elevator cutout for the balance weight horn.

Six pieces of the vertical tail surfaces were found scattered over a wide area. The dorsal fin, the lower half of the rudder, and the lower third of the rudder spring tab were found at the main wreckage site. The upper half of the rudder trim tab was not found. The top half of the rudder, extending from the tip to midway between Nos. 2 and 3 hinges, had its rudder balance weight still firmly attached.

A wide trough-shaped depression, centered approximately two feet below the tip of the fin, extended rearward from the leading edge on the left side. In this area there were numerous tears in the skin, scratches running rearward, and several black-smudged areas on the exterior surface. A sliver of black and tan deicer boot rubber six and three-quarters inches long was found wedged in one of the tears in the left skin of the fin. This sliver could not be matched with tears in the stabilizer or fin deicer boots or in the recovered portions of the right wing deicer boots, but the material was the same as that composing the wing deicer boots. Therefore this sliver probably came from the unrecovered portion of the boot. The left side of the detached portions of the rudder bore numerous black smudges in the area aft of similar markings on the fin.

In the cockpit, the throttles were found advanced halfway, both propellers advanced one-fourth of the travel from low r.p.m., trim tabs neutral, left mixture control in cruising lean, right mixture control in full rich, left magneto switch "off," and right magneto switch "on." Safety belt buckles for both pilots were found fastened; the belts were destroyed by fire. One clock had stopped at 4:12 and the captain's watch was stopped at 4:13. Both altimeters were set at 29.76 inches. No reading could be obtained from the air speed indicator. The VOR frequency selector was found set on 113.1 megacycles (Des Moines frequency) and the bearing indicator showed 88 degrees. The left ADF was in "antenna" position and the tuning control was found at 212 kilocycles (Des Moines frequency); the right ADF was on the 200-400 kilocycle band and "antenna" position, but no reading on the frequency could be determined.

The company maintenance manual showed that maintenance of equipment was to be accomplished on a contractual basis with certificated repair agencies; Slick Airways, Inc., was the only such agency listed in the manual. Maintenance checks were to be performed at intervals of 70 hours for a No. 1, 125 hours for a No. 2, 250 hours for No. 3, 500 hours for No. 4, and 1,000 hours for No. 5.

The aileron trim tab motor support bracket was to be inspected on each No. 4 and No. 5 check in accordance with AD 49-12-1.

Resort Airlines records revealed that the right aileron was last overhauled by Slick Airways on August 9, 1952 at Miami, Florida, when the total aircraft time was 5,729 hours. Investigation further revealed that the last No. 5 check on the aircraft (total time 5,962 hours) was made by Slick on October 12, 1952 at Burbank, California, and the last No. 4 check (total time 6,433 hours) was performed by the same agency on February 18, 1953 at Miami, Florida. Maintenance records for the aircraft revealed that the item relating to the aileron support bracket inspection was signed off by a Slick mechanic on each of the above inspections as having been accomplished, with no comment of discrepancy noted. At the time of the accident, the right aileron had accumulated 1,143 hours since overhaul. When the No. 5 check was performed it had 233 hours since overhaul, and at the time of the No. 4 check had acquired 705 hours since overhaul. The aircraft was flown 910 hours after the No. 5 check and 438 hours after the No. 4 check.

Company maintenance records pertaining to the aircraft disclosed no discrepancies. All CAA airworthiness directives and notes applicable to the aircraft and engines had been complied with. The aircraft was currently certificated.

Examination of the engines and propellers revealed no indication of malfunctioning or failure in flight.

The company and the crew were currently certificated.

Investigation relative to communication with the flight revealed that all radio contacts were routine and no emergency was declared by the pilot. There was no request for Flight Advisory Weather Service (FAWS) assistance.

A cold front extended from west to east across central Colorado, Kansas, and Missouri, thence northward into southern Ohio, northwestern Pennsylvania, and Canada. A low pressure center and active frontal wave was in central Kansas, moving eastward. Showers and thunderstorms were occurring north of the front, from the wave apex eastward.

The latest weather reports showed clear to scattered high clouds from Cheyenne to central Nebraska and a scattered to overcast condition from central Nebraska to Chicago, with scattered thundershowers whose bases were at 3,000 - 4,000 feet. Forecasts indicated that a squall line in central Nebraska was moving eastward, with heavy thundershowers and possibly tornadoes in south-central and southeastern Nebraska expected as the squall line traveled eastward. The thundershowers were expected to extend into southwestern Iowa.

Forecasts, including two severe weather bulletins and a severe weather forecast, indicated that a squall line in central Nebraska was moving eastward and would be accompanied by thunderstorms extending into southwestern Iowa. In south central and extreme southeastern Nebraska the thunderstorms were expected to be locally severe with occasional hail, severe turbulence aloft, gusts 55 to 65 miles per hour, and the possibility of a few tornadoes.

The Meteorological Aide on duty at the Cheyenne Weather Bureau Airport Station when Captain Marshall and Copilot Aronson came into the office stated that she was out taking a weather observation when they came in. Upon returning,

one of the pilots was in the Weather Bureau office and the other was in the adjoining CAA office. She asked the pilot if he had obtained all the weather information he needed and he replied in the affirmative. The current en route weather reports, winds aloft, regional and terminal forecasts, and two severe weather bulletins and a severe weather forecast were displayed and available to the crew. The CAA provided one of the pilots with copies of the two severe weather bulletins.

Analysis

Study of weather conditions along the route indicated that the Visual Flight Rule conditions existed to about North Platte, after which the flight encountered intermittent instrument conditions and scattered thundershowers. The instability line moved more rapidly than anticipated, and crossed into Iowa by the time the aircraft reached that state. The thunderstorm which the flight encountered near Des Moines was connected with the line of instability. It is probable that the aircraft was in clouds at 7,000 feet, and therefore the pilots would have found it difficult if not impossible to ascertain, from observation alone, that they were entering such a violent storm area.

Through weather information given to them at Cheyenne and while en route, the crew had warning of thunderstorm activity, severe turbulence, hail, and possible tornadoes. Although the most severe conditions were forecast for south-central and southeast Nebraska, these warnings should have alerted them to the possibility of thunderstorm activity in a wider area. Two westbound flights avoided the more severe storm areas in the vicinity of Des Moines without difficulty. The storm in which the aircraft disintegrated was located on a squall and pressure jump line.^{2/} It has been found that squall clouds forming on a pressure jump line are often accompanied by violent turbulence of such severity that loss of control can be experienced.

When disintegration of the aircraft occurred, the high wind from the northeast carried the less dense pieces of wreckage to the southwest. The mingling of parts from various components of the aircraft indicated disintegration of the wing and tail surfaces within such a short interval of time that the sequence of disintegration was not apparent from the wreckage distribution alone.

Damage to various pieces of wreckage appeared to be the more reliable basis for ascertaining the sequence of failure. The flattening of the left stabilizer leading edge, the hole punched through the left elevator by a gray-painted object entering from above and driving rearward, the trough-shaped depression, tears and scratches on the left side of the fin due to an object moving rearward, and the sliver of deicer boot rubber found in one of these tears, all indicated

^{2/} A pressure jump line is a fast-moving line of sudden rise in barometric pressure, maintaining a higher pressure level than that which preceded the jump. Under suitable moisture conditions, sudden instability of the atmosphere conducive to the formation of thunderstorms can result. A study by the U. S. Weather Bureau of the distribution of severe local storms (including tornadoes) has disclosed that these storms, for the most part, occur only with the passage of pressure jump lines.

impact by some portion of the aircraft prior to failure of the tail group. Only the detached right wing panel could have caused this damage, since no other part forward of the tail surfaces separated from the aircraft in flight.

The manner in which the failure of the right wing occurred was therefore significant. It was learned in study of the wing that the failure occurred due to compression buckling of the lower surface several feet outboard of the splice angles, accompanied by tension and bending failure of the upper surface in the splice angle. This combination indicated that the lower surface buckled first under loads which were in excess of the design strength of the wing.

Since the airplane was lightly loaded, it was apparent that the wing failure could not be attributed solely to down gusts with the airplane operating at cruising speed. Excessive air speed and in all probability maneuvering loads in combination with the gusts would have been necessary. These could have resulted from loss of control in the severe turbulence.

Progressing from failure of the right wing panel to the cause of its failure, analysis of the evidence presented by portions of the right tab motor assembly indicated that in all probability the outboard trunnion had been lost for some time. Under normal operating conditions, the remaining trunnion and interference with the tab motor bracket were evidently sufficient to retain the motor in place. However, when the aircraft met the extreme turbulence of the thunderstorm, the loads on the trim and balance tab were probably great enough to force the tab motor out of the housing and as evidence shows, it was displaced and pierced the wing. Displacement of the tab motor from its normal position, and interference with other parts inside the wing would have actuated the tab in an erratic manner. This in turn would have produced a strong tendency to erratic rolling of the aircraft. This tendency to roll erratically, in conjunction with the extremely turbulent weather conditions, very likely caused loss of control and subsequent overloading of the wing to point of failure. It has been noted in this report that the mechanical discrepancy had existed for some time, but it is not known whether or not it existed at the time of the last No. 4 or No. 5 inspections.

As a result of the accident the Board verbally advised CAA on June 25, 1953 and by letter on July 1, 1953, of the salient facts, recommending that an Air Carrier Maintenance Alert Bulletin be issued in order that operators of the C-46 might be apprised of the importance of an inspection of the aileron, rudder, and elevator tab motor trunnions. The CAA acted favorably on the recommendation by issuing Bulletin No. 145 on August 21, 1953.

Findings

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

1. The company, the aircraft, and the crew were currently certificated.
2. The pilots had knowledge of expected weather conditions between Cheyenne and Chicago, including severe thunderstorms.
3. The aircraft flew into a severe thunderstorm in the vicinity of Des Moines, and structural failure occurred in flight.
4. Prior to impact the outboard trunnion supporting the right aileron tab motor backed out of the support bracket due to inadequate safetying.

5. The right aileron tab motor tore loose from its bracket, punched through the wing, and was lost when the aileron tore loose.

6. The right wing panel failed at the attach angles to the center section due to a strong downward force which exceeded the design strength of the wing.

7. The tail group was struck by the right wing panel prior to the tail disintegration.

8. All radio contacts were routine and no declaration of emergency was received from the flight.

9. There was no malfunctioning or failure of the engines or propellers.

Probable Cause

The Board determines that the probable cause of this accident was separation of the right aileron tab motor from its support bracket due to loss of its outboard trunnion while the aircraft was in the severe turbulence of a thunderstorm. These conditions resulted in a tendency to roll erratically, and in conjunction with the extreme turbulence, caused loss of control and subsequent overloading of the wing to the point of failure.

BY THE CIVIL AERONAUTICS BOARD:

/s/ CHAN GURNEY

/s/ HARMAE D. DENNY

/s/ OSWALD RYAN

/s/ JOSH LEE

/s/ JOSEPH P. ADAMS

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 0615, May 22, 1953. An investigation was immediately initiated in accordance with the provisions of Section 702 (a)(2) of the Civil Aeronautics Act of 1938, as amended. In lieu of a public hearing, depositions were taken at Coral Gables, Florida on June 9, 1953, and at Kansas City, Missouri on June 19, 1953.

Air Carrier

Resort Airlines is a North Carolina corporation with its principal offices at International Airport, Miami, Florida. It engages in both irregular and scheduled operations. The company possesses a letter of registration issued by the Civil Aeronautics Board, and an air carrier operating certificate issued by the Civil Aeronautics Administration.

Flight Personnel

Captain Bowen F. Marshall, age 33, was employed by Resort Airlines on February 18, 1951. He held a valid airman certificate with an airline transport rating, and was rated for C-46 aircraft. Captain Marshall had a total of 8,106 flying hours, of which 3,622 were in C-46 equipment, and 625 hours of instrument flying time. His last instrument competency check was accomplished on March 23, 1953, his last route check on February 9, 1953, and his last physical examination on May 4, 1953.

Copilot Samuel B. Aronson, age 29, was employed by Resort Airlines on August 18, 1952. He was the holder of a valid airman certificate with ratings as a commercial pilot, instrument, and flight instructor. Mr. Aronson had a total of 2,593 flying hours, of which 393 were in C-46 equipment, and 40 hours instrument flying time. He completed his last instrument competency check on February 20, 1953, and his last physical examination on May 1, 1953.

The Aircraft

N 1669M, a Curtiss C-46F, serial number 22536, was owned by the U. S. Air Force and operated under lease by Resort Airlines. The aircraft had 6,867 flying hours upon departure from Cheyenne and was currently certificated by the Civil Aeronautics Administration. It was equipped with Pratt & Whitney R-2800-75 engines and Hamilton Standard 23E50-505 propellers.