

CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted April 20, 1948

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NAVION—ADA, OKLAHOMA,—APRIL 13, 1947

The Accident

At approximately 1210,* April 13, 1947, a North American Navion, aircraft NC 8707-H, crashed and burned near Ada, Oklahoma. The four occupants were killed, and the aircraft was destroyed.

History of the Flight

The flight departed from Hot Springs, Arkansas, at approximately 1000, April 13, 1947. It is not known who actually flew the aircraft, however, the occupants consisted of Mr. and Mrs. Tom Norris, and Mr. and Mrs. Frank Norris. Since Tom and Frank Norris were both pilots, and qualified to fly this particular airplane, it is probable that either Tom or Frank was at the controls, and that their wives occupied the rear seat of the aircraft. The exact flight path from Hot Springs to Ada is not known, for though the aircraft was equipped with a two-way radio, no reports from the flight were received by any Civil Aeronautics Administration's communication stations. The day before departure the aircraft had been completely serviced with full tanks of fuel which was more than ample for the non-stop flight from Hot Springs to Ada, a distance of 205 miles, assuming a straight line course.

Between 1205 and 1210, the aircraft was heard over Walker Field, Ada, Oklahoma, but was not visually observed because of a low overcast condition and restricted visibility which prevailed in the vicinity. The aircraft circled to the left, and was first seen a few minutes later below the overcast, flying approximately straight and level at an altitude of about 100 feet, and clearly above all obstructions. At this time the aircraft was two miles northeast of Walker Field, in position for an approach for landing on Walker Field. Witnesses

in the nearby vicinity observed the nose wheel of the landing gear extend, and almost simultaneously, they saw smoke around the fuselage, and heard an explosive sound. The right wing appeared to disintegrate in the air. The aircraft crashed into farmland one mile northeast of Walker Field, and was immediately enveloped in flames.

Investigation

The right wing tip was found approximately 1/4 mile from the main body of the wreckage. Other parts of the right wing were scattered along the flight path of the aircraft to the main body of the wreckage. The root of the right wing, which contained the ruptured right fuel tank, remained attached to the fuselage. The left wing was found intact though the leading edge had been severely damaged by impact. The right stabilizer was located approximately 300 yards to the right of the fuselage. Intense heat from the fire, which resulted immediately after impact, damaged or consumed much of the fuselage, the center section of the wing, and attaching parts.

At the time of take-off from Hot Springs the weather over a straight line course to Ada was good. The ceiling was above 4,000 feet, and the visibility was 10 miles or better as far as Fort Smith, Arkansas. From Fort Smith westward ceiling lowered to about 1,500 feet, and visibility to about 5 miles. At the time of the accident, however, a cold front was located approximately 10 miles east of Ada, and was moving eastward. It resulted in the ceiling in the vicinity of Ada being reduced to approximately 200 feet, and the visibility being restricted to about one mile by light rain and mist.

The area surrounding the crash was carefully examined for trees or other obstacles with which the aircraft could have collided. None was found, nor were any indications found of mechanical

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

failure in the power plant, propeller, or aircraft structure other than the right wing. Since the wing was observed to fail in the air, the investigation was concentrated in a study and analysis of the parts of the right wing which were recovered.

The portion of the right wing comprising the top skin in the area ahead of the wing flap was found detached from other parts of the wreckage. The stringers at both ends of this portion of the wing panel had failed from tension. Between rib stations the legs of several stringers had failed from buckling. The sixth outboard rib from the fuel tank was found still attached. Nine rivet heads in the top skin had pulled through the top flange of the rib, and 14 rivets in the bottom skin had pulled through the lower flange of the rib. The rib itself was found bowed toward the wing tip. At other rib stations parts of rib flanges were attached. These pieces of rib flanges were retained under the rivet heads, and showed that the ribs failed outboard, i.e., in the direction of the wing tip. Parts of the rear closure web were also attached to this section of the top skin. This web had been forced rearward, and the attaching rivets had failed uniformly in shear in a rearward direction.

The top skin portion of the right wing in the area ahead of the aileron still had attached 3 ribs. All of these ribs were bent and flattened against the skin in the direction of the right wing tip. All rivet heads attaching the rear web to this portion of the top skin had been pulled through the skin uniformly in a rearward direction.

The last rib outboard in the right wing was found attached to the tip. It had been forced outboard from the fuselage, and pushed into the wing tip. The entire wing tip had been ballooned, and its periphery expanded beyond its normal contour. The top and bottom surfaces of the wing tip had sheared through the top and bottom attachment screws in an outward direction. Nine attaching rivets holding the leading edge skin to the bottom skin, just inboard from the wing tip, had sheared through the bottom skin in a forward direction, showing that this portion of the leading edge skin had also failed outward, in this case in a forward direction.

The wing of the Navion is of a shell type construction, i.e., it has no spars.

A part of the bottom skin is formed so as to constitute the rear closure web of the wing panel and is attached to the top skin. This web contains 10 two and three-quarter inch holes in the area ahead of the wing flap, and 2 one inch holes in the area ahead of the wing aileron. There is also a vertical oblong hole in the web to accommodate the actuating arm of the aileron. This hole is approximately two and one-half inches long, and one inch wide.

Discussion

Three possibilities of wing failure were considered in this case—failure as a result of flutter, failure from excessive air loads, and failure as a result of an explosion in the wing panel. Tests made during the designing of the aircraft showed that an air speed necessary to induce flutter was in excess of 300 miles per hour. In view of the fact that the aircraft was observed in an attitude approximating straight and level flight, it would have been virtually impossible for an air speed at the rate of 300 miles per hour to have been present at the time of the accident. Therefore, the possibility of wing failure resulting from flutter is extremely remote.

The second possibility, that the wing failed from air loads, is eliminated by the fact that all breaks at the ends of the skin-stringer portions of the top surface of the wing which were found were tension failures. Had this wing failed from excessive air loads, the wing would have been bent in a positive or upward direction. The bottom skin and stringers would have failed from tension, and the top skin and stringers would have failed from compression, thus, no tension breaks would have been found in the top portions of the wing skin-stringer combinations.

The third possibility, that the wing failed as a result of an explosion in the wing panel, is consistent with the appearance of all parts of the right wing which have been examined. The uniform outward distortion of the wing ribs could result only from the existence of an excessively strong internal pressure. The uniform pattern of the skin rivet failures, all of which were in an outward direction, can be explained only by the fact that all parts of the wing were forced outward by the presence of an excessively strong pressure in the wing panel. The buckling of the stringer legs

between the rib stations was also a result of internal pressure in the wing panel. As the stringers were bowed outward, while still attached to the ribs, the legs of the stringers were compressed. Likewise, the tension breaks in the top and bottom attachments of the wing tip, and the ballooning effect indicates a result of excessive internal pressure.

There are no means available from which it can be determined directly that a fuel-air mixture suitable to support an explosion was present in the wing panel at the time of the accident. And, it is likewise impossible to determine directly the source of ignition. Yet, the type of wing failure admits of no explanation other than explosion. Accordingly, an explosive gas must have been present, and ignited. It remains to determine the most probable source of these two factors.

Fuel may have entered the wing panel through leaks in the fuel tank or fuel lines, and then mixed with the air. It is also possible that fuel may have seeped into the panel at the time of servicing. Providing that there is adequate ventilation in the wing panel, free fuel in the wing panel does not in itself constitute a hazard. The holes in the rear closure web, described above, provide the only means of egress for air which may enter the wing panel through the openings in the wheel well. Whether these holes furnish sufficient ventilation for the wing panel to assure proper evacuation of any fuel-air mixture which may form can best be answered by the fact that an explosion occurred in this case.

Several sources of ignition may have existed—organic substances in the wing panel may have acquired an electrostatic charge, an insulated wire may have grounded as a result of frictional wear, breakage, or detachment from its terminal, and operation of electrical equipment, such as switches or relays, may have afforded a spark. The switch, located in the wheel well, to indicate the wheel-up position was a simple aircraft toggle switch. It was not vapor proof, and hence, not explosive proof. Since the aircraft at the time of the accident was at a position when the landing gear would be normally extended, and since the disintegration of the wing was observed to be nearly simul-

taneously with the extension of the nose gear, it appears probable that the source of ignition in this case was the operation of this particular aircraft toggle switch.

Findings

Upon due consideration of all available evidence, the Board finds that

1 The aircraft immediately prior to the accident was being flown in an attitude approximating straight and level flight, at an altitude of about 100 feet above all obstructions, and below a ceiling of 200 to 250 feet.

2 The aircraft immediately before the accident was in a position where the landing gear would have been normally extended for a landing on Walker Field, Ada, Oklahoma.

3 The landing gear position switch which was installed in this particular aircraft was a simple aircraft toggle switch, not explosive proof.

4. Immediately prior to the accident smoke was seen around the airplane, an explosion was heard, and the right wing was observed to disintegrate in the air.

5. All breaks at the ends of the skin-stringer combinations of the top surface of the right wing which were found showed failure from tension.

6 All parts of the right wing showed evidence of having failed in either an outboard or outward direction.

7 Following the failure of the right wing the aircraft crashed into farmland one mile northeast of Walker Field, Ada, Oklahoma.

Probable Cause

The Board determines that the probable cause of this accident was the disintegration of the right wing resulting from an explosion of a fuel-air mixture in the right wing panel. Ignition may have resulted from the operation of the landing gear position switch.

BY THE CIVIL AERONAUTICS BOARD

/s/ JOSPEH J O'CONNELL, JR

/s/ HARLLEE BRANCH

/s/ JOSH LEE

/s/ HAROLD A JONES

Ryan, Vice Chairman, did not participate