

## CIVIL AERONAUTICS BOARD

**ACCIDENT INVESTIGATION REPORT**

Adopted: November 15, 1955

Released: November 15, 1955

BRANIFF AIRWAYS, INC., CHICAGO MIDWAY AIRPORT,  
CHICAGO, ILLINOIS, JULY 17, 1955

The Accident

At 0624,<sup>1/</sup> July 17, 1955, while completing an instrument approach to the Chicago Midway Airport, Braniff Airways Flight 560, a Convair 340, N 3422, struck an advertising sign located at the intersection of 55th Street and Central Avenue, Chicago, Illinois. The aircraft continued through the airport boundary fence and stopped inverted on the airport. Of the crew of 3 and 40 passengers, the captain, the hostess, and 20 passengers received fatal injuries, the first officer and 11 passengers sustained serious injuries, and the remaining 9 passengers received minor or no injuries. The aircraft was demolished by impact and fire.

History of the Flight

Flight 560 is a Braniff daily scheduled flight between Dallas, Texas, and Chicago, Illinois, with intermediate stops at Oklahoma City, Oklahoma; Wichita, Kansas; and Kansas City, Missouri. On July 17 the flight crew, assigned at Dallas for the entire trip, consisted of Captain Allen R. Tobin, First Officer Orbin W. Hanks, and Hostess Mary E. Teel.

Captain Tobin and First Officer Hanks arrived at the airport more than an hour before the scheduled departure. During this time preflight preparations were made in a normal and routine manner. The pilots were briefed and furnished the latest weather forecasts and reports over the route and for the scheduled stops. No weather conditions of consequence were indicated except that fog was forecast for the Chicago area, and the visibility was expected to be restricted to possibly one-half mile, on arrival. Flight 560 departed Dallas on schedule at 0100.

The flight segments between Dallas and Wichita were uneventful; however, while starting the No. 1 (left) engine at Wichita prior to departure a small carburetor intake manifold fire occurred which was immediately extinguished. There was no damage incurred and the engine started easily on the second attempt. The flight proceeded to Kansas City where it landed at 0416.

As the aircraft taxied to the terminal several persons noted that the No. 1 propeller was feathered and stopped. Captain Tobin told Braniff personnel that it feathered while being returned to positive pitch after reverse thrust had

<sup>1/</sup> All times herein are central standard and are based on the 24-hour clock.

been used during the landing roll deceleration. The captain unfeathered the propeller before deplaning and maintenance personnel checked it for malfunction; none was indicated. No other mechanical service was requested or performed. The aircraft was serviced to 1,000 gallons of fuel while Captain Tobin and First Officer Hanks received supplemental weather information and completed other preparations for the last segment of the route to Chicago.

Flight 560 departed Kansas City at 0435 in accordance with a VFR (Visual Flight Rules) flight plan. The aircraft, according to company records, was loaded to a gross weight of 45,622 pounds. This amount was less than the maximum allowable of 47,000 pounds and the load was properly distributed with respect to the center of gravity limitations. The flight climbed to 15,000 feet m. s. l. (mean sea level). At 0519 it requested and received an IFR (Instrument Flight Rules) flight plan for the remainder of the trip; accordingly, routine en route reports were made. This segment, as well as the previous, was described as very pleasant, smooth, and conducted primarily above or clear of the clouds.

At 0547 ARTC cleared the flight as follows: "ATC clears Braniff 560 to the Naperville Omni via Peoria, Victor 116 over Joliet, maintain at least 1,000 on top, tops reported 2,000 m. s. l., contact Chicago Center on 118.9 mc. passing Peoria." This clearance was acknowledged and the flight reported accordingly. At 0556 Chicago ARTC broadcast a Chicago special weather observation which was: "Thin obscuration, visibility one-half mile." At approximately 0609 the flight was asked by ARTC if it could land with one-half mile visibility and 1,000 feet thin obscuration. Braniff 560 replied that it could. At 0611 the flight reported over Joliet, 1,000 on top, whereupon ARTC advised it to contact the Chicago Midway Approach Control. Immediate contact was made and the flight was given the same weather and the latest altimeter information. The crew reported at 0618 over Naperville and was radar vectored by Approach Control to the outer marker for an ILS (Instrument Landing System) approach to runway 13R for landing. At 0624 the aircraft hit the sign and crashed through the airport boundary fence onto the airport. Another flight, holding off the runway before takeoff, saw the wreckage stop and immediately notified the tower; crash emergency procedures were promptly initiated.

The weather conditions reported at the time of the accident were: Partial obscuration; visibility one-half mile, fog, and smoke; sea level pressure 1014.2; temperature 71; dewpoint 68; wind south 6; altimeter 29.94; remarks, fog .8.

### Investigation

The commercial sign struck was located on the northeast corner of the intersection between 55th Street and Central Avenue where they bound the northwest corner of the Chicago Midway Airport. The sign was mounted near the top of a steel post 11 inches in diameter and 18 feet, 2 inches high. The sign was located approximately 82 feet from the nearest airport boundary fence and 1,000 feet from the threshold lights of runway 13R. Relative to the ILS glide path and localizer course centerlines the top of the sign was about 84 feet below and 122 feet left, respectively. The height of the sign at its location was also approximately 12 feet lower than the allowable height as determined by the

obstruction clearance criteria.<sup>2/</sup> The glide path intersects the runway 1,600 feet past the sign. A single row of red high intensity approach lights are installed on the left side of the runway centerline and extend 1,300 feet outward into the approach area. These lights slope gradually higher toward the outward end and opposite the sign are nearly its height.

The right wing of the aircraft struck the sign about 18 inches below the top. Impact marks showed that this wing was down about 11-1/2 degrees at this instant and the aircraft was on a magnetic heading of approximately 140 degrees. The impact caused failure of integral wing structure just outside of its engine nacelle and the wing quickly separated upward and rearward into the right horizontal stabilizer. The aircraft then rolled progressively to the right as it crashed through the fence and struck several approach light installations. Nearly inverted, the aircraft slid through raised concrete runway identification markers onto the north-south taxiway where it stopped inverted on a magnetic heading of 290 degrees. Fire broke out during this time and rapidly increased in intensity until it was quickly extinguished by airport firemen who reached the scene less than a minute after the accident.

Impact forces with the sign, ground, light installations, and runway markers were severe. They mutilated the nose section of the aircraft, caused extensive damage to the fuselage, and tore off the empennage. In several areas the top and bottom of the passenger cabin were crushed close together, preventing several passengers from escaping until freed by the efficient efforts of the emergency personnel.

The investigation disclosed that the landing gear was down and the flaps were extended equally about 15 degrees when the accident occurred. Complete and exhaustive examination of the severely damaged aircraft structure failed to disclose evidence of fatigue cracking, structural failure, or control malfunction prior to impact.

The left engine was free of impact or fire damage. Its combustion chambers, oil and fuel screens disclosed no evidence of malfunction or failure. The undamaged condition of the engine permitted it to be functionally tested without significant alteration or repair. The results of the tests indicated normal operation.

The right engine was separated from its nacelle and extensively damaged. Its propeller shaft, nose case, and front accessory case were separated from the engine near the forward support plate. Disassembly of the engine and subsequent examination did not disclose evidence of operating distress, malfunction, or failure before the initial impact. Areas of fire damage were clearly those caused by fire following impact.

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<sup>2/</sup> In the establishment of instrument approach procedures as outlined in the ANC Manual, criteria have been developed with respect to obstruction clearance between objects on the surface and the flight path of the aircraft. In the case of ILS procedures the minimum clearance in feet is a function of the distance outward from the glide path unit. In order to adhere to the obstruction criteria the effective length of the runway may be reduced.

The shim plates of the left and right propellers bore impact markings which indicated that both propellers were in positive pitch and positioned about 38 degrees. Measurements of the propeller governor speeder spring racks showed that governors of both propellers were set for about 2,400 engine r. p. m. This evidence indicated that both engines were developing nearly equal power at impact and the amount was normal for the aircraft during the latter portion of the approach.

The radio and ILS receivers were damaged but capable of being tested without significant alteration. Test results showed that this equipment operated within allowable tolerances and indicated normal operation could have been expected before impact. Positive evidence revealed that this equipment was properly tuned to the Chicago ILS facilities. The associated cockpit indicators and flight instruments were so severely damaged that their indications could not be determined.

There were two models of the Bendix omni-mag indicators installed in N 3422. According to company and manufacturer's records the model installed on the captain's panel was an MN97-G-1 and incorporated an expanded localizer range feature. The first officer's indicator was an MN97-B and did not have the expanded range. The instruments are designed to indicate to the pilots the position of the aircraft with respect to the ILS glide path and localizer course during an ILS approach. Bench and flight tests were conducted to determine whether or not course deflections were different between the two models. The results of these tests showed that during the approach of Flight 560, as indicated by radar, including its position at initial impact, the indications of both instruments would have been alike and the deflection of the captain's instrument would not be within the area affected by the expanded scale feature. Notice of the installation of the expanded type indicator was placed in the aircraft log of N 3422 and several Braniff pilots stated that they had read and understood it.

Pertinent ground radio and navigation facilities were checked immediately following the accident and all were operating normally. During the investigation the possibility of interference affecting the performance of the ILS components was considered. Tests were made attempting to induce malfunctioning of the system by interference but these failed to produce any significant effect on it. Lighting facilities for the approach and landing on 13R were on and set next to the highest intensity, the position most commonly desired during IFR conditions. Commercial lights and street lights below the approach zone had been turned off at daylight and were off at the time of the accident.

A regular crew was on duty in the Chicago Midway tower, located about one mile east of the accident scene. In accordance with normal procedure the approach controller gave advisories to Flight 560 during the ILS approach. Such advisories are for the purpose of giving the pilots their position as observed on radar relative to the glide path, localizer course, and distance to touchdown. They are intended to supplement the cockpit information during an ILS approach which is made with reference to instruments. A two-way recorder made a permanent record of the advisories. A study of these advisories, together with explanatory testimony of the controller, was a phase of the investigation. Its purpose was to reconstruct and evaluate the probable flight path of the flight as accurately as possible.

Before the approach was started positive radio and radar contact was established and at this time the flight was given the latest weather information and altimeter setting.

The radar advisories and testimony of the radar controller revealed that the flight was initially vectored onto the ILS course and was properly aligned with it before reaching the outer marker (located 5.8 statute miles from touchdown). Advisories began five miles from touchdown and continued periodically until the flight was observed one-half mile out. In each advisory until it was 1-1/2 miles from touchdown the flight was told that its course and glide path were good. In explanation the controller stated that he noted minor deviations but generally the ILS approach was very good. As the flight approached and reached the 1-1/2-mile position the controller advised, "Braniff 560 slightly left of on course, 20 feet low on the glide path . . . mile and one-half out." The next advisory was given one mile from touchdown and again the aircraft was observed "on course, on glide path." While it approached the one-half mile point the controller transmitted, "Going to the left now Braniff 560 - 75 feet to the left." The aircraft reached one-half mile and he continued, "one-half glide path good." Following normal practice when the aircraft was observed in good position to land the controller then discontinued the advisories and turned his attention to the 10-mile radar scope preparing to give advisories to the next flight. The controller said that his last transmission to Flight 560 ended with it correcting right toward on course. He stated, in summary, that the approach was very good and his advisories were not required. He said advisories are mandatory only when the flight exceeds certain defined tolerances relative to the glide path and course line which vary progressively commensurate with the distance from landing. He said Flight 560 was continuously well within these limits throughout the approach and at the time he discontinued the advisories.

The synoptic weather situation which existed during the trip and when the accident occurred consisted of a broad trough of low pressure which extended from Lake Erie through northern Indiana, central Illinois, and Missouri. Bounding the low pressure on the north and south were two high pressure areas. The spread between the temperature and dewpoint was narrow over the Chicago area and the terrain was moist from previous rain. These factors, together with light surface winds, made radiation fog easily predictable for the Chicago area and it was forecast before Flight 560 originated. The fog was especially expected during the early hours of July 17.

An experienced forecaster stated that fog of this type is commonly variable in density over relatively short distances either as a result of its movement or the variable factors producing the fog. He also stated that slow dispersion of industrial smoke around the airport was another factor affecting the density of fog. As a result weather observations were made continuously during the night and early morning hours. These reflected a gradual deterioration of the visibility until at the time of the accident it was one-half mile in fog and smoke. Thereafter, at 0655, the visibility was reported to be one-fourth mile in fog and smoke. The observations were taken approximately 1-1/4 mile from the accident scene and they did not incorporate the use of electronic "end-of-the-runway" visibility measuring equipment.

Under the reported weather conditions Flight 560 was permitted to land. Company minimums for the ILS approach are: Ceiling 300 feet, visibility 3/4 mile. Applying the sliding scale<sup>3/</sup> the landing was permissible with one-half mile visibility. Accordingly, the flight was permitted to descend along the ILS glide path to the minimum altitude and if visual contact was established with the runway threshold or approach lights it could continue to descend and land. After visual contact has been established the landing may be made without further adherence to the landing system. If, however, visual contact cannot be made at the minimum altitude the approach must be discontinued in accordance with the missed approach procedure.

During the investigation and public hearing many witnesses who were located in the immediate accident area testified or gave statements concerning their observations. Several heard the aircraft but because of dense fog could not see it until the instant it struck the sign or immediately thereafter. These persons said the approaching sound of the engines seemed normal, but judging by the volume, the aircraft seemed very low. They were not in agreement as to whether or not the sound increased or decreased with power changes, however, the most qualified said that power was reduced a few seconds before impact. One witness who saw the aircraft hit the sign stated that it appeared, to his best recollection, fairly level at that instant.

Many witnesses offered important information concerning the fog and its density. Many on the scene when the accident happened concurred that the fog there was very dense. They pointed out that the fog density rapidly increased a few minutes before the accident, then decreased after it. They pointed out that objects only a few hundred feet from them could not be seen at the time. Motorists stated that west of the scene the fog was quite dense and in several cases they used headlights while driving. Others approaching from the east said the fog did not hamper their driving but when they reached the immediate area visibility rapidly deteriorated until it became extremely poor. An air carrier flight crew testified that while taxiing on the north taxiway from the terminal to runway 13R visibility became somewhat poorer but remained at least one-half mile. One crew member noted several drifting fog patches while taxiing.

A flight captain, whose flight was behind Braniff 560 and next to land, said he did not pass the outer marker inbound but recalled that he was unable to see the airport at any time. He remained above the clouds and estimated their tops to be about 1,700 feet m. s. l. He also said the fog appeared like the top of an overcast, becoming a heavy haze over the airport. While he flew in the vicinity of the outer marker he noted a few small breaks with the ground visible through them. He also stated that the ILS was functioning normally.

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<sup>3/</sup> Operations Specifications, Part 20, par. 26 (2) (ii)

Straight-in Approaches

For each increase of 100 feet above the minimum ceiling specified, a decrease of 1/4 mile in visibility is authorized, until a visibility of 1/2 mile is reached.

The surviving passengers described the flight as very pleasant before the accident. Nearly all agreed that it was smooth and involved very little time in the clouds. Approaching Chicago several recalled that the flight descended smoothly until it was above a uniform cloud coverage. Several passengers recalled that the aircraft made several turns and then flew relatively straight for several minutes. The early morning sun was visible above the clouds and well above the horizon. The hostess checked their seat belts and then announced the landing at Chicago would be on time and in a few minutes. The aircraft began to descend again and as it entered the clouds several passengers recalled a series of left and right banks. None recalled any appreciable power changes but all agreed the engine sound was smooth and uninterrupted.

Several passengers who were seated over the wings on both sides of the passenger cabin said that during the final descent they tried to see the ground but could not at any time. Two others who looked down more vertically than those over the wings said they saw roof tops periodically through the mist immediately before impact. Many passengers said the descent was smooth, two however stated it seemed a little steep and one, a former pilot, said the rate of descent increased sharply a few seconds before the accident.

The flight crew of Flight 560 was well qualified. Captain Tobin and First Officer Hanks had 15,000 and about 9,000 hours, respectively. Captain Tobin had flown the Convair more than 1,300 hours and First Officer Hanks had flown it nearly 2,000 hours. Both pilots had extensive experience and had flown over the subject route many times. Captain Tobin and First Officer Hanks had landed at the Chicago Midway Airport 5 and 8 times, respectively, during the 30 days preceding the accident and both pilots were known to have been very familiar with the airport and its facilities.

First Officer Hanks was qualified to perform an ILS approach and from the recording the captain's voice was identified indicating that First Officer Hanks was probably flying the aircraft. He, the only surviving crew member, was so seriously injured that following the accident he could not recall any details concerning it. Several months thereafter he again stated he could not remember the flight.

### Analysis

The available evidence indicates that Flight 560 was well planned and conducted in a normal manner until it was near a position approximately one-half mile from landing. Although two incidents occurred during the operation, one at Wichita and the other at Kansas City, it is believed that neither was a factor in the accident. Both are not foreign to air carrier operation and the left engine involved failed to indicate any evidence of malfunction.

As previously shown the sign was about 20 feet high. With respect to the ILS glide path and localizer course centerlines it was approximately 84 feet below and 122 feet left, respectively. It was 12 feet lower than the allowable obstruction height at that position established by the obstruction criteria. Although the Board considers construction of the type exemplified by this sign below an approach area undesirable, it believes this accident resulted primarily because of the extremely low altitude of the flight rather than the height and position of the sign.

Analysis of the physical evidence, testimony of witnesses, and the probable flight path indicate the flight was well established on the ILS in the area of the outer marker. Evidence indicates thereafter the rate of descent was well stabilized and the greater portion of the approach appeared to be executed in a nearly perfect manner. Strict adherence to the ILS during this time indicates that the flight was being flown with reference to the ILS glide path and localizer course and that the associated ground and airborne equipment were operating normally.

After passing the one-half mile from touchdown position the aircraft departed from the glide slope and descended rapidly. Considering the various factors involved this descent averaged at least 2,000 feet per minute between the one-half mile position and the sign.

It is believed that as the flight approached the middle marker the pilots probably established visual contact with the outward end of the approach lights and proceeded visually. This is the normal position where visual contact must be established for landing or the approach must be discontinued. As near as can be determined it was approximately in this position where two passengers saw roof tops and one witness on the ground heard a reduction in power. Both observations are indicative that visual reference was being made then.

Without doubt the accident area was engulfed in dense fog which would limit flight visibility to near zero. It is believed that this was confined to a relatively small area and was unknown to the pilots or to ground personnel in a position to alert them.

The importance of more precise and accurate weather reporting for the normal breakout area of an ILS approach has resulted in an endeavor, for several years, to develop instruments to measure the conditions in this area. As a result "end-of-the-runway" electronic equipment is becoming available. The U. S. Weather Bureau has obtained 20 sets of end-of-the-runway instruments consisting of a rotating beam ceilometer for ceiling measurement and a transmissometer for visibility measurement. Installation of these instruments is being accomplished on a priority basis with high volume traffic airports receiving first consideration. As a result a ceilometer has already been installed and is in operation at the Chicago Midway Airport; the transmissometer has also been installed but was not yet in operation as of October 31, 1955. The program for the installation of the balance of these instruments at various airports will continue during this fiscal year, with 45 additional sets programmed for the fiscal year 1957 as received from the manufacturer. The Board wishes to endorse this program and recommends that it progress as expeditiously as possible.

Based upon available evidence the Board does not believe (1) that the pilot continued below the prescribed minimum altitude without having had visual references, or that (2) as he descended visually he saw the heavy fog before entering it. Although it cannot be positively stated on the available evidence and without the first officer's recollection, it is believed that after visual contact had been made and the aircraft adjusted for landing the flight unexpectedly encountered the area of fog which reduced the flight visibility to zero. During the necessary transition back to flying the aircraft by reference to instruments it is believed that the pilot experienced momentary disorientation during which the aircraft descended more rapidly before corrective action could be taken.



## Findings

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

1. The company, the aircraft, and the crew were currently certificated.
2. The flight was properly dispatched.
3. The incidents which occurred at Wichita and Kansas City are not considered factors in the accident.
4. En route and terminal forecasts were adequate and before the flight originated fog was forecast for the Chicago area on arrival.
5. The flight departed Kansas City loaded to a weight less than the maximum allowable and the load was properly distributed.
6. En route reports and flight procedures were routine.
7. The reported weather conditions at Chicago permitted the flight to land and were accurately reported from the observer's position.
8. The navigational aids, the ILS components, and ground lighting facilities were functioning normally.
9. An ILS approach was made to runway 13R and was executed precisely and accurately until one-half mile from touchdown.
10. Radar advisories were furnished in a normal manner supplementing the ILS approach.
11. After approximately one-half mile from touchdown the aircraft descended at a high rate.
12. The aircraft struck an advertising sign and its supporting steel post located 1,000 feet short of the runway threshold.
13. Fog, with near zero flight visibility, enveloped the crash site over an indeterminable area.
14. Examination of the aircraft wreckage and its components revealed no evidence indicating malfunction or failure and there was no evidence of an emergency aboard the flight.

## Probable Cause

The Board determines that the probable cause of this accident was momentary disorientation caused by the loss of visual reference during the final visual

phase of the approach resulting in an increased rate of descent at an altitude too low to effect recovery.

BY THE CIVIL AERONAUTICS BOARD:

/s/ ROSS RIZLEY

/s/ JOSEPH P. ADAMS

/s/ JOSH LEE

/s/ CHAN GURNEY

/s/ HARMAR D. DENNY

# S U P P L E M E N T A L     D A T A

## Investigation and Hearing

The Civil Aeronautics Board was notified of this accident at 0645, July 17, 1955. An investigation was initiated 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 was held in Chicago, Illinois, on August 10, 11, and 12, 1955.

## Air Carrier

Braniff Airways, Inc., is a scheduled air carrier incorporated in the State of Oklahoma. Its principal offices are located in Dallas, Texas. The carrier operates under a currently effective certificate of public convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Civil Aeronautics Administration. These authorize the company to transport by air persons, property, and mail between various points in the United States including route AM-9 over which the accident occurred.

## Flight Personnel

Captain Allen R. Tobin, age 40, held a currently effective airline transport certificate and rating for the Convair 340. He was employed by the company in 1940 and was continuously in its employ thereafter. Captain Tobin had accumulated 15,121 flying hours of which 1,281 were in the Convair and 1,362 were instrument. His last physical examination was completed February 8, 1955.

First Officer Orbin W. Hanks, age 36, was employed by the company in 1946. He held a currently effective airline transport certificate. First Officer Hanks had accumulated 9,040 flying hours of which 1,989 were in the Convair 340 and 453 were instrument hours. He completed his last physical examination January 29, 1955.

Hostess Mary E. Teel entered training with the company April 5, 1954, and completed it April 21. She completed a satisfactory physical examination April 5, 1954. On September 29, 1954, and May 16, 1955, Hostess Teel completed refresher emergency training. During employment she had accumulated 1,118 flying hours as hostess with 798 in the Convair.

## The Aircraft

N 3422, a Convair 340 aircraft, was manufactured April 10, 1953. The airframe had 4,956 flying hours. The engines were Pratt and Whitney model R-2800-CB-16 and the propellers were Hamilton Standard 43E60-303.