

## CIVIL AERONAUTICS BOARD

**ACCIDENT INVESTIGATION REPORT**

Adopted: September 1, 1955

Released: September 7, 1955

UNITED AIR LINES, INC., CONVAIR 340, N 73154,  
DEXTER, IOWA, JANUARY 19, 1955

The Accident

A Convair 340, N 73154, owned and operated by United Air Lines, Inc., made a wheels-up emergency landing six miles southeast of Dexter, Iowa (30 miles west of Des Moines), January 19, 1955, at 1625.1/ A few of the 36 passengers received minor injuries; there were no injuries to the crew of three. The aircraft was substantially damaged.

History of the Flight

United Air Lines Flight 329 of January 19, 1955, originated at Newark, New Jersey, with its destination Lincoln, Nebraska, and with intermediate stops scheduled at Allentown, Pennsylvania; Youngstown, Akron, and Cleveland, Ohio; Chicago and Moline, Illinois; Iowa City and Des Moines, Iowa; and Omaha, Nebraska. It departed Newark at approximately 0703 and was routine to Chicago.

At Chicago a customary crew change was made. The new crew consisted of Captain Earl W. Andreason, First Officer Thomas D. Boyle, and Stewardess Enid Patricia Johnson. The aircraft departed Chicago at 1330 and the segments of the flight to Moline, Illinois, and Iowa City and Des Moines, Iowa, were normal; no mechanical or operational delays occurred.

Flight 329 departed Des Moines on a VFR (Visual Flight Rules) flight plan at 1608 for Omaha, Nebraska. The gross weight of the aircraft was 45,215 pounds, 1,685 pounds less than the allowable 46,900 pounds. According to company records, the load was properly distributed with respect to the center of gravity of the aircraft.

The climb to 5,000 feet was uneventful but at that altitude the crew noticed vibration and a slight fore-and-aft movement of the control column. The climb was continued to 6,000 feet, where the aircraft was leveled off and power was reduced. As the vibration was still present at this time, the captain attempted to dampen it by engaging the autopilot; however, this was unsuccessful and it was immediately disengaged.

The first officer next lowered the flaps, first to 5 degrees and then to 15 degrees, without any noticeable effect. The "Fasten Seat Belt" sign was turned on and the captain told the first officer to advise the company of their difficulty via radio. About this time a sudden failure in the control system

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

was felt and it was with extreme difficulty that any semblance of elevator control was maintained. The first officer again tried lowering the flaps, this time to the 24-degree position, but as this did not help to maintain control he returned them to the 15-degree position, where it was found the most favorable results were attained. Accordingly, the first officer transmitted "Mayday" (distress call) on the radio and said that they were attempting to return to Des Moines but were experiencing control trouble. The buffeting became so severe it was then necessary for the copilot to help the captain hold the control column. However, the buffeting lessened and the captain advised the first officer to depressurize the aircraft and tell the stewardess to prepare the passengers for an emergency landing. This was done.

By that time the aircraft had descended below 3,000 feet. Both throttles were retarded in turn to see if the trouble could possibly be caused by one of the engines. This also proved to no avail. The vibration built up to high level and suddenly another failure in the control system was felt and the airplane went into a steep climb. As it seemed that a stall was imminent, the captain quickly moved the propellers to a high r. p. m. and pushed the throttles forward until about 50 inches of manifold pressure was seen on the gauges. The airplane then nosed over and began to dive at a very steep angle. During this rapid descent the captain reduced power and headed toward open country to his right. When the aircraft reached 500 feet above the ground the captain was successful in flaring the aircraft and it struck the ground in a flat attitude. All occupants were quickly deplaned as soon as the aircraft stopped.

### Investigation

The aircraft came to a stop heading 195 degrees magnetic and in an upright position with its wheels retracted. It was in a level, snow-covered cornfield approximately six miles southeast of Dexter, Iowa.

From marks on the ground it was determined that the tips of the propeller blades and the antenna attached to the bottom of the fuselage made first contact with the ground. At this time the aircraft was approximately level laterally, and slightly nose-high. The next ground contact was about 900 feet from the first marks found. At this point the aircraft struck the ground and bounced over a barbed wire fence. It again struck the ground with severe force about 390 feet farther on, hurdled another fence, and skidded in a slight right curve for an additional 1,485 feet. Minor wreckage was strewn along the path.

The underside of the fuselage was crushed upward and the top of the fuselage was badly damaged. All cabin and cockpit seats remained intact. Leading edges of the wings were dented somewhat; the flaps were extended about 15 degrees. All propeller blades were broken. Both engines were still attached to the airplane but their mounts were severely damaged. The snow, which was uniformly five or six inches deep on the ground, considerably lessened the damage the aircraft received during its slide.

Because of the nature of the accident, attention was immediately directed to the empennage and control system of the aircraft. The empennage section was intact and virtually undamaged by ground contact. During the examination of the

elevator torque tube assembly it was observed that there was a vertical fracture of the right side. This completely disconnected the right elevator from the main torque tube assembly, and the pilot could no longer operate this elevator by means of the elevator control system. The left elevator was still attached to the torque tube assembly, however, and partial elevator control could still be effected.

The left elevator servo tab was found hanging in the full down (nose-up) position, with the rear terminal of the aft push-pull tube attached to the tab horn. Internal inspection of the servo tab assembly revealed that this push-pull tube had broken transversely about 12 inches forward of its rear terminal. The rear portion of the broken tube showed evidence of abrasion over most of its exterior surface, caused by its rapid and violent movement within the elevator. The interior surface of the elevator skin in the area of the tab push-pull rod was seared and abraded, and the skin was punctured in several places. The inspection doors were opened, and it was found that the servo tab idler was completely detached from its support in the elevator. The 1/4 x 3 1/2-inch close tolerance support bolt was fractured about one inch from the head end and this end of the bolt was found in the lower rear flange of the stabilizer 20 inches outboard of the idler. The remaining portion of the idler rear spar support bolt was found in place in the idler with its fractured end flush with the inboard face of the idler; its broken end was battered. A 1/4-inch castelated nut and two washers of the size and type used with the support bolt were recovered from a fold in the seal balance curtain. No cotter pin was found. The hinge cutouts on the tab were torn rearward, indicating there had been a violent oscillation of the tab resulting in considerable overtravel.

The elevator closing spar was crushed and deformed upward by action of the servo tab horn and push-pull rod. The inner face of each idler link support bracket was severely battered and abraded near and downward from the support bolt bushing.

It was determined that the aircraft was properly dispatched and that weather was not a factor in this accident.

A study of the maintenance records disclosed that on January 18 and 19, 1955, this aircraft underwent a 1500-hour inspection at the company's line maintenance base at Newark. After completion of this inspection the aircraft flew approximately five hours before the accident occurred.

To understand better the chain of events that occurred with respect to work performed on this aircraft, it was advisable to examine the line of command with respect to personnel at the Newark base, and their working hours. The base is headed by a station manager, who has under him a chief mechanic, supervisors of mechanical services (crew chiefs), inspectors, lead mechanics, and mechanics. There are three 8-hour shifts daily beginning at 12 midnight, with personnel reporting for duty 30 minutes before each shift. Top supervisory personnel above the crew chief level are a part of each shift or are available by telephone if needed.

The card system used in the allocation of work comprises a work control record, a routine job card, and a nonroutine job card. The work control record is a master card that lists all the work to be performed. Routine job cards are distributed among the mechanics according to the number of areas

necessary to be covered for each individual inspection. Nonroutine job cards are made out and initialed by mechanics when they encounter work necessary to be done other than that specified on the routine job card.

N 73154 was in the shop ready for a 1500-hour check at the start of the 8:00 a. m. - 4:00 p. m. shift the morning of January 18. During the inspection of the empennage, which involved a detailed inspection of the horizontal stabilizer, elevator, and related control system components, it was found that there was excessive play in the elevator servo tab. A nonroutine job card was made out by the mechanic but no corrective action was taken because of the proximity of a shift change. The crew chief going off duty briefed the crew chief on the afternoon shift on the required work. The card indicating that repair of the servo tab was necessary was then given to another A & E mechanic.

The idler linkage was disassembled to determine the cause of the play and it was found that the idler support bolt was considerably worn. The mechanic left the bolt with his crew chief for examination and returned to his work. This particular type bolt was not in stock and an emergency order was issued requesting that it be sent immediately from the company's base at San Francisco. This emergency order was written up on the nonroutine job card. The mechanic later testified that the worn bolt was returned to him by the lead mechanic with the instruction to put it back in the idler assembly loosely (finger-tight). The worn bolt was then replaced but not safetied. No explanation was written on the nonroutine job card covering this temporary installation. This was contrary to the company's maintenance instructions.

When the midnight shift came on duty there was a heavy workload and the new crew chief (who was the only one assigned on that shift - normally there are two) was not briefed with respect to the worn bolt.

The work on the aircraft continued in a normal manner and when completed the supervisor noticed that the subject nonroutine job card had not been signed off as completed. At this time, however, the mechanic assigned to the job reported to the supervisor that he could not find any excessive play in the servo tab assembly. Accordingly, an inspector was requested to check and determine if this was so. He returned in a short time and said that he also could find none. The supervisor then went to the job with the inspector and from the ground watched while the tab was checked for free play. Observing no excessive play the supervisor initialed the nonroutine card, adding the notation "OK for service."

### Analysis

Correlation of known physical facts with crew testimony indicates the following sequence of failure. The unkeyed castellated nut which fastens the idler assembly support bolt in its brackets backed off because of vibration. This permitted the bolt to come out of the outboard bracket. With the idler supported only by the bolt through the inboard bracket, forces were exerted which broke the bolt one inch from its head. This allowed the idler to drop down and the servo tab began to oscillate, causing a forward and rearward movement of the cockpit control column. Loads were then induced in the rear push-pull tube causing it to fail. With the then unrestrained tab oscillating, the left elevator was also affected so that it, too, oscillated about its hinge line. The resultant loads caused by the left and right elevators being out of

phase broke the right side torque tube connector plate, eliminating the right support for the torque tube assembly and preventing cockpit control of the right elevator. Without the right support, forces deformed the torque tube assembly forward about the left support, resulting in almost negligible control of the left elevator from the cockpit.

A thorough study of the company's line maintenance procedures, encompassing its record control system, was made during the investigation of this accident. As a result of this study, and the testimony of the witnesses called at the public hearing, it was determined that the carrier's maintenance program and the detailed procedures set up to it were adequate. In this instance, however, the procedures broke down because of the frailties of the human element. The system provided safeguards, one of which required that an explanation of all work performed be written on the respective nonroutine job card; another, that the outgoing crew chief at the time of the work shift brief, in as much detail as necessary, the relieving crew chief concerning the work accomplished during the foregoing work period. These company procedures were not followed in this case.

When the final inspection for play in the servo tab was made, no excessive play was found. It was testified to, that if the worn support bolt was replaced and by chance turned from its position when removed, a manual test for play might result in none being found. However, since the nonroutine job card was written up for work to be done and was not signed by the mechanic to indicate that the work had been accomplished, it is believed that the inspector making the final inspection should have gone beyond the normal instructions and actually examined the servo tab system. If this had been done the mistake probably would have been discovered before the mechanic was told to close all inspection covers and doors. The critical omission was the failure to write an explanation on the job card that the bolt had been removed and replaced only finger-tight pending the arrival of a new bolt.

As a result of this accident the company has increased the number of both supervisory personnel and mechanics.

The Board believes the crew was confronted with an extremely hazardous situation and that it was only by employing the utmost judgment and skill that a disaster was avoided.

### Findings

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

1. The crew, the aircraft, and the carrier were currently certificated.
2. The aircraft was under its allowable gross weight and the load was distributed so that the center of gravity was within approved limits.
3. The aircraft was properly dispatched.
4. Weather was not a factor.
5. During a routine maintenance inspection of the aircraft an explanation was not written on the nonroutine job card that the bolt had been removed and replaced finger-tight pending the arrival of a new bolt.
6. Final inspection of the servo tab system failed to disclose its unairworthy condition and the aircraft was released for service.

7. Vibration backed off an unsafetied nut in the servo tab system resulting in a sequence of structural failures that ended in almost complete loss of control of the aircraft elevators.

Probable Cause

The Board determines that the probable cause of this accident was a series of omissions made by maintenance personnel during a scheduled inspection which resulted in the release of the aircraft in an unairworthy condition and an almost complete loss of elevator control during flight.

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 2000, January 19, 1955. An investigation was immediately 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 Newark, New Jersey, on March 30 and 31, and April 1, 1955.

### Air Carrier

United Air Lines, Inc., is a scheduled air carrier incorporated in the State of Delaware with its principal offices in Chicago, Illinois. It operates under currently effective certificates of public convenience and necessity issued by the Civil Aeronautics Board and scheduled operating certificates issued by the Civil Aeronautics Administration. These certificates authorize the company to transport by air persons, property, and mail between various points in the United States including the route Newark, New Jersey, to Lincoln, Nebraska.

### Flight Personnel

Captain Earl Wayne Andreason, age 35, held a currently effective airline transport certificate with the appropriate rating for the subject aircraft. Captain Andreason was employed by United Air Lines on September 22, 1944. He had a total of 7,578 pilot hours, of which 750 hours were in the type equipment involved. His last physical examination was on December 16, 1954. First Officer Thomas D. Boyle, age 29, held a currently effective commercial pilot certificate. He was employed by United Air Lines on April 23, 1952. He had a total of 2,123 pilot hours, of which 1,147 hours were in the type of equipment involved. His last physical examination was on April 16, 1954.

Stewardess Enid Patricia Johnson was employed by the company in November 1954. She graduated from the Stewardess School in Cheyenne on December 12, 1954. Miss Johnson received company training on emergency procedures at the UAL school. In addition, she received emergency training during previous employment as a stewardess with Trans World Airlines.

### The Aircraft

N 73154, a Consolidated Vultee CV-340-13, serial number 00180, was manufactured on May 5, 1954, and had a total of 1,502 hours and 45 minutes. It was currently certificated by the Civil Aeronautics Administration. The aircraft was equipped with Pratt and Whitney model CB-16 ADI system engines and Hamilton Standard model 43E60 propellers. Time since overhaul on both the left and right engines was 409 hours and 16 minutes; on the propellers 1,502 hours and 45 minutes.