SA-343

File No 1-0057

CIVIL AERONAUTICS BOARD

AIRCRAFT ACCIDENT REPORT

ADOPTED: April 20, 1961 **RELEASED:** April 25, 1961

AMERICAN AIRLINES, BOEING 707-123, N 7514A
NEAR PECONIC RIVER AIRPORT, CALVERTON,
LONG ISLAND, NEW YORK, AUGUST 15, 1959

SYNOPSIS

At approximately 1641 e.d.t., August 15, 1959, an American Airlines Boeing 707, N 7514A, crashed and burned in an open field approximately three miles northeast of Peconic River Airport, Calverton, Long Island, New York, during a training flight. All five crew members, which included one captain-instructor, two captain-trainees, one flight engineer-instructor, and one flight engineer-trainee, were fatally injured.

The Board believes the accident was caused by the failure of the crew to recognize and correct the development of excessive yaw which resulted in subsequent loss of control. The unintentional maneuver which followed occurred at too low an altitude to permit complete recovery.

Subsequent to the accident, the Federal Aviation Agency discontinued the requirement that Boeing 707 aircraft make actual landings with simulated failure of 50 percent of the power units concentrated on one side of the aircraft during training flights, type ratings, and proficiency checks. These maneuvers may now be simulated at an appropriate higher altitude.

On February 5, 1960, Boeing Airplane Company issued a service bulletin approved by the Federal Aviation Agency for an improved rudder modification which adds boost power to the wider ranges of directional movement, and gives increased control capability at low airspeeds and minimum gross weight. This modification also replaces the original rudder with an improved version.

Investigation

On August 15, 1959, Boeing 707-123, N 7514A, which had been regularly used for nonstop air carrier flights between Los Angeles and New York, was scheduled for two training flights.

Following completion of the first morning training flight, a turnaround check was accomplished and several minor discrepancies were corrected. In order to bring the total fuel to 84,000 lbs , 10,647 gallons were added. The engine oil and water tanks were serviced to the required capacities.

Jet transition training flight 514 was dispatched with Captain Harry C. Job as captain-instructor, Captains Fred W. Jeberjahn and William T. Swain as

captain-trainees, Flight Engineer Arthur Anderson, flight engineer-instructor, and Flight Engineer Edgar Allen Freeman, flight engineer-trainee. At departure Captain Jeberjahn occupied the captain's seat, Captain Job occupied the first officer's seat, Captain Swain was in the second officer's seat, Flight Engineer Freeman occupied the engineer's seat, and Flight Engineer Anderson was in the jump seat. The aircraft took off from Idlewild International Airport at 1340,1/ with a gross weight of 201,410 pounds. The VFR flight plan was direct to Fire Island, then V-16 to Peconic River Airport.

Training flight 514 accomplished high altitude airwork after takeoff to permit sufficient fuel burnoff for airport transition training which was planned at Peconic River Airport.

Subsequent to the departure of flight 514, two company radio contacts were made with the aircraft. One contact obtained an Idlewild e.t.a. of 1830 from the crew. At approximately 1517 company advised the flight that N 7514A was being considered for use on trip No. 7, a New York to Los Angeles nonstop flight. A communication from the flight stated that the aircraft would probably need a tire change prior to scheduled operations.

Peconic River Airport at Calverton, Long Island, is used by American Airlines and other air carriers as an outlying airport for conducting jet transition training. Tower personnel are employed by the Grumman Aircraft Engineering Corporation.

Excerpts from the Peconic River tower log indicate that training flight 514 was in the Peconic area from 1511 until the accident occurred. During this time the crew of flight 514 accomplished several maneuvers, including full-stop landings, crosswind landings and takeoffs, a high off-set approach, simulated engine-out landings, and a no-flap aborted approach to landing.

The Peconic River tower controller testified the aircraft did not retract its landing gear following the last aborted approach to landing on runway 23 but continued in the traffic pattern at an estimated altitude of from 1,000 to 1,100 feet. The crew reported on left base leg for runway 23, was given clearance to land, and was informed that the wind was from 230 degrees at 10 to 15 knots. The last communication from the crew was the acknowledgement of landing clearance and wind information, at which time nothing of an unusual nature was reported.

Several eyewitnesses near the impact area were accustomed to the presence of Boeing 707 aircraft in the air over their homes or property. Immediately prior to the accident, a considerable number of these witnesses observed N 7514A and they were of the opinion that the aircraft was lower than usual, slower than usual, and making less noise than usual. Some witnesses observed smoke coming from the engines on one side of the aircraft prior to impact.

Eyewitnesses positioned along the landing pattern flight path observed the aircraft flying in a northerly direction on its downwind leg. N 7514A was observed to turn on the base leg to a northwesterly direction. At this time the aircraft was estimated by witnesses to be at various altitudes of from 600 to 1,000 feet. As it approached the extended centerline of runway 23 it made a left bank, steepening to approximately 45 degrees. The aircraft was then observed

1/ All times are eastern daylight based on the 24-hour clock.

to recover immediately to level flight and to begin a bank to the right which became progressively steeper. The right bank continued until the aircraft was inverted, at which time the nose dropped and a yaw to the left was observed. N 7514A then continued to roll to the right in a nosedown configuration, variously described as from 30 degrees to vertical. The aircraft emerged from the right bank with the wings level, approximately 20 degrees to the left of the course from which the maneuver started. Investigation revealed the aircraft struck the ground in a wings-level attitude, in a nearly stalled condition, yawed to the left approximately 12 degrees, with considerable and nearly symmetrical power. The attitude was approximately 12 degrees nosedown but the angle of impact, which was the result of sink rate, was approximately 26 degrees. A severe kerosene-fed fire followed impact. Weather at the time was good and not a factor in this accident.

One eyewitness, a private pilot, was flying a J-3 Cub airplane and was practicing takeoffs and landings from a small field located approximately one-half mile from the impact site. This witness testified that he was flying his airplane on a southbound heading at an altitude of approximately 300 feet when he observed the Boeing 707 to his left at an estimated altitude of 600 feet. He observed the 707 start a shallow turn to the left (south) and estimated the separation between the two aircraft as approximately 800 to 1,000 feet. He testified that he did not feel concerned about the possibility that the two aircraft were on a collision course and believed no evasive maneuvers were required.

N 7514A crashed and burned in a nearly level potato field approximately three miles northeast of the Peconic River Airport. The wreckage area was confined to approximately the wing span of the aircraft in width and 1-1/2 times the length of the aircraft, with a few components strewn in the direction of travel nearly 500 feet from the point of initial impact.

The fuselage broke up into small sections at impact, the sections below the floorline were compressed front to rear and were shorn rearward. Nearly all of the fuselage sections forward of the rear passenger loading door were consumed by fire. No semblance of a recognizable cockpit or passenger cabin remained; the identifiable pieces from both were scattered throughout the wreckage area. The wing outer panels broke off just inboard of the outboard nacelles and were partially consumed by fire. The inboard panels were broken into several sections with the upper skin sections receiving less heat damage than the lower sections. The horizontal tail surfaces remained attached to the tail cone and received relatively little impact damage and no fire damage. The vertical fin and the rudder broke from the fuselage but were intact except for fire damage and secondary impact damage near the tip. Ground impact was along a direction of approximately 282 degrees magnetic.

Investigation also revealed the landing gear was fully extended and that all sections of the wing flaps were extended 30 degrees at impact. The leading edge flap sections were found in the fully extended position. All flight control surfaces were accounted for in the wreckage but their positions at impact could not be established. The stabilizer was set at approximately 1-2/3 units of noseup trim and the rudder and aileron trim spirals indicated approximately neutral trim at impact.

Attempts were made to determine whether there had been a flight control failure prior to impact. Many components of the aircraft's flight control

system between the flight control surfaces and the cockpit were so badly destroyed by impact and subsequent fire that their condition prior to impact could not be established. No indication of any pre-impact malfunction, failure, or unairworthy condition could be found in an examination of those flight control components that withstood impact and the subsequent fire.

The four Pratt and Whitney, model JT3C-6, turbojet engines were found completely detached from their respective pylons. Nos. 1, 2, and 4 engines were found just forward of their initial point of contact and they were inclined, forward end up, about 30 degrees with their compressor ends resting on the forward edges of the engine impact holes. These engines had rotated about their longitudinal axes in a clockwise direction by approximately the following amounts: No. 1, 15 degrees; No. 2, 80 degrees; No. 4, 45 degrees. No. 3 engine lay upside down about 50 feet ahead of the location of its initial ground contact. All fire damage to the engines occurred after impact. Except for No. 3 engine, which lay in a general ground-fire area, fire damage was localized and caused by spillage from broken fuel lines, fuel pumps, and fuel controls.

The engines and accessories were shipped to the American Airlines shop at Tulsa, Oklahoma, where they were disassembled. No evidence of operational failure or distress was revealed during the disassembly and examination. All engines were producing appreciable power at impact. Nos. 3 and 4 engines were more severely damaged by rotational interference than were Nos. 1 and 2. Engine instrument readings obtained were so variable that no pattern could be established; however, the oil temperature gage readings were No. 1, 105 degrees c., No. 2, 105 degrees c., No. 3, 70 degrees c.; and No. 4, 74 degrees c.

The hot sections of all engines were free of any evidence which would have indicated they had been subjected to over temperatures. Bearings of all engines were normal except for damage resulting from impact loads and the drying effects of heat from the ground fire.

Maintenance records were reviewed, nothing of an unusual nature was found.

N 7514A was equipped with a Lockheed Aircraft Service, Inc., flight recorder in accordance with Sec. 40.208 of the Civil Air Regulations.2/ The record made by this instrument provides information enabling reconstruction of the complete flight path. The flight parameters are recorded by styli, which are mechanically linked to sensors and move vertically across a foil tape. As the aluminum alloy foil is fed past the recording styli, lines are embossed on the surface. One spool will accommodate approximately 100 feet of foil, which allows approximately 150 hours of recorder operating time.

The flight recorder installed in N 7514A was a model "C" recorder, serial No. 107, and was certified as meeting Federal Aviation Agency Technical Standard Order C-51. It was severely damaged by crushing and fire, however, most of the recorder mechanism was functional. The recorder was opened at the scene of the accident and a preliminary reading of the data was made by a Board employee.

2/ Sec. 40.208 reads "A flight recorder which records time, airspeed, altitude, vertical acceleration, and heading shall be installed on all airplanes of more than 12,500 pounds maximum certificated takeoff weight which are certificated for operations above 25,000 feet altitude, and shall be operating continuously during flight."

Subsequently, the entire flight recorder, including the foil, was taken to the manufacturer where a more detailed reading of flight data was accomplished with the use of precision equipment. Following this examination by the manufacturer the data tape was released by the Board to Boeing Airplane Company for further study. The tape reduction data are analyzed under Analysis.

Flight tests were conducted subsequent to the accident wherein a light aircraft and a Boeing 707 participated in an exercise to determine whether or not the close proximity of the J-3 Cub aircraft would have required evasive action on the part of the 707 crew. The test was to duplicate conditions which occurred at the time of the accident. Four passes were made in which the small aircraft approached the 707 from the right on a collision course but slightly below the 707. The four passes were conducted as follows:

	Boeing 707 altitude	J-3 Cub altitude
1st pass	1,000 feet	400 feet
2nd pass	800 feet	400 feet
3rd pass	600 feet	300 feet
4th pass	600 feet	300 feet

An experimental pilot for Boeing Airplane Company testified that should all control pressure be relaxed during an approach maneuver while simulating failure of 50 percent of the power units concentrated on the right side with landing gear extended and flaps 30 degrees extended, the Boeing 707 would yaw and roll to the right. Approximately five to seven seconds would be required to stop the roll before the aircraft reached a 90-degree bank. Recovery could be accomplished by applying full opposite aileron and rudder and reducing power on all engines. During such a maneuver, the pilot stated, the aircraft could lose as much as 600 feet of altitude.

Analysis

At the time of the accident, training flight 514 was accomplishing airport transition maneuvers at the Peconic River Airport. Following a no-flap aborted approach landing, the aircraft continued around in the traffic pattern with the main landing gear extended. Somewhere in the pattern the Nos. 3 and 4 engine thrust levers were retarded to simulate a multiple engine failure and Nos. 1 and 2 engines were advanced to sufficient power to maintain an indicated airspeed of approximately 160 knots. Nearly full power would have been required on Nos. 1 and 2 engines to maintain altitude with gear down and flaps extended to 30 degrees. The exact point at which power was reduced on Nos. 3 and 4 is debatable; however, since the oil temperature readings for these engines were determined to be 70 and 74 degrees c., respectively, it must be concluded that power was reduced early in the pattern, as evidenced by the engine cooling that occurred.

According to the tape reduction data, the downwind leg was made on a heading of approximately 55 degrees; speed was reduced from an indicated airspeed of approximately 200 knots to 170 knots; and altitude was decreased from approximately 1,850 feet to 1,700 feet. During the turn to the base leg the aircraft descended from 1,700 feet to approximately 1,100 feet in the turn. The base leg was flown on a heading of approximately 305 degrees, an indicated airspeed of approximately 165 knots, and an altitude of approximately 1,050 feet. Acceleration during the downwind and base leg was maintained at approximately one g.

Tape reduction data show that the first indications of other than normal flight began about 15 seconds before impact. At this time the aircraft was pushed over and rolled into a left bank. It was time to commence a left turn to the final approach and the increasing compass heading, due to gyro gimbal error, shows the roll which was also verified by witnesses.

At this point the aircraft yawed rapidly to the right. The yaw angle has been estimated as high as 17 degrees, which is well beyond the 11- to 14-degree angle that can be successfully controlled with full opposite use of the lateral control devices. The crew, for some unknown reason, failed to recognize and correct the development of this yaw and the aircraft continued to roll to the right.

When the aircraft passed the 90-degree bank position, it was yawed right approximately 20 degrees, resulting in approximately a 30-degree nosedown attitude. The yaw was at its maximum angle and the roll rate had reached approximately 40 degrees per second.

As the aircraft passed the inverted position the yaw angle was reduced considerably, indicating that some corrective action had been taken in the form of advancing the thrust levers on Nos. 3 and 4 engines and applying full left rudder and aileron. Positive acceleration was held at 1-1/2 to 1-3/4 g.

As the aircraft passed the 270-degree roll position it was in a zero yaw condition. Acceleration was held at approximately 2 g. which is in the buffet range and is the tightest pullout that the aircraft could make. The power was then nearly symmetrical.

The aircraft struck the ground in a nearly wings-level attitude, yawed to the left approximately 12 degrees, with considerable and nearly symmetrical power. The attitude was approximately 12 degrees nosedown but the angle of impact was approximately 26 degrees, giving a floorline angle of attack of 14 degrees. The yaw and nearly stalled condition indicated on the flight recorder trace were verified by the ground impact marks at the crash site.

There was no control or actuator position by which power being produced at impact could be determined. The energy expended in halting rotation of the engines, as evidenced by the extent of damage from rotational interference, was the primary means of determining the approximate power at impact. Rotational damage indicated all engines were producing appreciable power at impact. Unstacking of the N_1 compressors of Nos. 3 and 4 engines suggests slightly more power was being produced by these engines than Nos. 1 and 2. However, the readings of the four oil temperature gages indicated more power was being produced by Nos. 1 and 2 engines than by Nos. 3 and 4. This apparent conflict of factual evidence would be logical if, at the start of loss of control, while operating with Nos. 3 and 4 engines reduced to idle thrust their power levers were advanced quickly to the full-thrust position. The higher power established by advancing the thrust levers would not be reflected on the oil temperature gages during the elapsed time to ground contact. In view of the relatively low altitude as which control was lost, it is concluded that this sequence of events occurred.

Another factor in this accident was the delay in acceleration time of jet engines after thrust lever advancement. The delay in engine acceleration from

idle to full power could be as high as six seconds. The Boeing Airplane Company recommends that all thrust levers be retarded immediately in case of any out-of-control situation and thrust levers then be advanced on all engines together. The rolling maneuver could have been stopped rapidly by reducing power to engines Nos. 1 and 2, since the yawing forces and the high unequal rudder forces would have been eliminated. However, even had this procedure been followed it is questionable whether sufficient altitude remained to effect complete recovery.

In the flight configuration that had been established, the asymmetrical power condition would tend to create yaw to the right and would require the application of opposite controls, particularly left rudder, to compensate for the unbalanced thrust.

The rudder characteristics of the Boeing 707 are such that when yaw angles in excess of approximately 10 degrees are attained, the rudder effectiveness deteriorates quite rapidly with a resultant loss of directional control. This can produce a dangerous flight condition. In order to minimize the probability of large yaw angles during flight with both engines on one side inoperative, directional control must be maintained with the rudder. Excessive aileron or bank angles should not be used to maintain directional control. Yaw angles of approximately 10 degrees require nearly full aileron control to maintain heading when inadequate rudder is applied. There is also a noticeable stiffening of rudder pedal forces during the last two or three degrees of rudder deflection. Therefore, the pilot must be certain to depress the rudder pedal fully whenever a maneuver requires full rudder deflection. It is extremely important that the employment of rudder be positive and properly timed.

It is apparent that roll due to yaw resulted either from a lack of application of sufficient rudder, or an inadvertent release of left rudder. Since there is a noticeable stiffening of rudder pedal forces during the last two or three degrees of rudder deflection, it is possible that in this maneuver, where full rudder was needed to make the turn to final approach with Nos. 3 and 4 engines at idle thrust, full left rudder was not utilized. If this were the case, a yaw of as much as or more than 10 degrees could be brought about as the aircraft was banked to the left. Such a yaw would produce a violent roll to the right due to the aerodynamic response of the aircraft to yaw.

The student might have released the controls after assuming the instructor was taking over to initiate evasive action following his observance of a light aircraft low and to the right of the Boeing 707's flight path. Subsequent flight tests have revealed that the light aircraft could have been an alarming factor and a possible cause for evasive action on the part of the Boeing 707 crew. The instructor, sitting on the right side, could have indicated that evasive action should be taken and in the process of his taking control of the aircraft, the student relaxed rudder pressure before the instructor assumed control of the rudders. These circumstances pertaining to the presence of a light airplane are conceivable, however, certain points are difficult to resolve. First, it is believed that a prudent instructor would keep ahead of the maneuver, especially in jet transition training and particularly in the type maneuver being conducted, and prevent the development of a critically unsafe condition. Secondly, the testimony given by a Boeing test pilot attested that evasive maneuvers could be accomplished successfully even though the aircraft was in an asymmetrical power condition.

Conclusions

After due consideration, the preponderance of evidence suggests the most logical fact for the loss of control was either the lack of application of sufficient rudder, or an inadvertent release of left rudder for some unknown reason. The delayed corrective action, together with the decision to advance power on the idled engines instead of reducing power on the good engines, permitted the yaw and induced roll to become severe and uncontrollable.

Subsequent to the accident, the FAA discontinued the requirement that Boeing 707 aircraft make actual landings with simulated failure of 50 percent of the power units concentrated on one side of the aircraft during training flights, type ratings, and proficiency checks. These maneuvers may be simulated at an appropriate higher altitude.

On February 5, 1960, Boeing Airplane Company issued a service bulletin approved by the FAA for an improved rudder modification, which adds boost power to the wider ranges of directional movement and gives increased control capability at low air speeds and minimum gross weights. This modification also replaces the original rudder with an improved version.

Although the Civil Air Regulations do not require a flight recorder to be operating during training, test, or ferry-flight operations of a scheduled air carrier aircraft, nevertheless, the flight recorder aboard N 7514A was operating during this training flight and considerable information concerning the maneuver and flight path information just prior to impact was obtained through reduction of pertinent data on the flight recorder tape. Even though the recorder was severely damaged, considerable information was tabulated and graphed to assist the Board in determining a probable cause for the accident.

On January 12, 1960, the Board recommended to the Administrator, Federal Aviation Agency, that flight recorders be installed in all new transport-type airplanes and presently operating turbine-powered transport-type airplanes. Subsequent to that date and as a result of the information gained from the flight recorder in this accident, the Board has expressed the opinion to the Administrator, Federal Aviation Agency, that recorders should also be installed and operating during the training, test, and ferry-flight operations of these air carrier airplanes. It is the Board's belief that in these latter operations, the airplanes are subjected to the same environmental factors and flight loads experienced in scheduled service.

Probable Cause

The Board determines the probable cause of this accident was the crew's failure to recognize and correct the development of excessive yaw which caused an unintentional rolling maneuver at an altitude too low to permit complete recovery.

BY THE CIVIL AERONAUTICS BOARD.

/s/ ALAN S. BOYD
Chairman

/s/ ROBERT T. MURPHY
Vice Chairman

/s/ CHAN GURNEY
Member

/s/ G. JOSEPH MINETTI
Member

/s/ WHITNEY GILLILLAND
Member

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of this accident at 1715, August 15, 1959. An investigation was immediately initiated in accordance with the provisions of Title VII of the Federal Aviation Act of 1958 A public hearing was ordered by the Board and held in two phases. The operational phase of the investigation was held at the Henry Perkins Hotel, Riverhead, Long Island, New York, on August 27, 1959. The technical phase of the investigation was held at the Forest Hills Inn, Forest Hills, Long Island, New York, October 7, 1959

Flight Personnel

Captain-Instructor Harry C. Job, age 45, was employed by American Airlines on November 6, 1939 He was promoted to captain on October 17, 1945, and to flight supervisor on November 1, 1955. He held a valid FAA airline transport pilot certificate with ratings in Convair 240, DC-6, DC-7, and Boeing 707 aircraft. Captain Job had a total of 18,000 flying hours as of January 13, 1959 His latest first-class physical examination was taken April 1, 1959. Captain Job had completed the special Boeing 707 ground training courses and had over 210 hours in Boeing 707 aircraft, 188 hours of which were as an instructor Captain Job had flown with approximately 30 students in the jet transition program

Captain William T. Swain, age 49, was employed by American Airlines on September 8, 1936 He was promoted to captain on May 8, 1940. He held a valid FAA airline transport pilot certificate with ratings in Convair 240, DC-4, DC-6, and DC-7 aircraft He had a total of 22,498 flying hours as of February 28, 1959 His latest first-class physical examination was taken February 28, 1959. Captain Swain had completed the special Boeing 707 ground training courses, had accumulated 9 55 hours pilot time, 14.52 hours (training) observation time, and approximately 23 hours (line) observation time in Boeing 707 aircraft, and had 16 hours of Boeing 707 simulator time

Captain Fred W. Jeberjahn, age 50, was employed by American Airlines on April 22, 1939. He was promoted to reserve captain on October 28, 1941, and to captain on March 28, 1946. He held a valid FAA airline transport pilot certificate with ratings in Convair, DC-4, DC-6, and DC-7 aircraft. He had a total of 20,175 flying hours His latest first-class physical examination, taken June 23, 1959, included a waiver of lenses for near vision. He accomplished a company physical on July 11, 1959. Captain Jeberjahn had completed the special Boeing 707 ground training courses, had accumulated 9:10 hours pilot time, 29:18 (training) observation time, and approximately 25 hours (line) observation time in Boeing 707 aircraft, and had 19·30 hours of Boeing 707 simulator time

Flight Engineer-Instructor Arthur Anderson, age 40, was employed by American Airlines on February 26, 1940, as an apprentice mechanic. He was promoted to flight engineer on February 13, 1951, and to flight engineer-instructor on March 10, 1951 He held a valid flight engineer certificate with ratings in DC-6, DC-7, and Boeing 707 aircraft. He had a total of 5,000 flying hours, 149 50 of which were in Boeing 707. He had over 164 hours as a

flight engineer-instructor. He completed his last FAA physical examination on January 13, 1959. He had completed a special Boeing 707 ground training course consisting of 152.00 hours.

Flight Engineer Edgar Allen Freeman, age 36, was employed by American Airlines on April 11, 1949, as a flight engineer. He held a valid FAA commercial pilot certificate with instrument rating, and a flight engineer certificate with ratings in DC-6 and DC-7 aircraft He had over 10,200 flying hours as of May 29, 1959. His second-class physical examination was completed on May 29, 1959. He had completed the special Boeing 707 ground training course, had performed two periods of Boeing 707 training, and had accumulated a total of 7.30 hours of Boeing 707 aircraft time. He also had 19:30 hours of Boeing 707 simulator time.

The Aircraft

N 7514A, a Boeing 707-123, serial number 17641, was manufactured June 5, 1959. It had approximately 736 hours of flight time. The aircraft was equipped with four Pratt and Whitney turbojet, model JT3C-6 engines.