

CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted: January 10, 1958

Released: January 14, 1958

EASTERN AIR LINES, INC., MARTIN 404, N 453A, STANDIFORD FIELD,
LOUISVILLE, KENTUCKY, MARCH 10, 1957

The Accident

Eastern Air Lines Flight 181, a Martin 404, N 453A, was substantially damaged while landing at Louisville, Kentucky, on March 10, 1957, about 1138.^{1/} A small ground fire developed but was quickly extinguished. One of the 31 passengers was seriously injured and five received minor injuries. None of the three crew members was injured.

History of the Flight

Flight 181 originated at Midway Airport, Chicago, Illinois, for Miami, Florida. Several stops were scheduled including Indianapolis, Indiana, and Louisville, Kentucky, the latter a point of crew change.

Departure, scheduled for 0955, was at 1001, with a crew of Captain Clarence G. Chambers, Pilot Harold D. Bingham, and Stewardess Shirley Michael. To Indianapolis the flight was routine, with Captain Chambers flying, and arrival was on schedule.

Departure from Indianapolis was on schedule, at 1105, with 31 passengers and 450 gallons of fuel. The aircraft's gross weight was 41,126 pounds, 3,774 less than the maximum takeoff allowable of 44,900, and its center of gravity was located within prescribed limits. Captain Chambers instructed Pilot Bingham to do the flying and, accordingly, Bingham, seated on the right, made the takeoff and flew this segment of the flight. The aircraft proceeded along V-53 airway at 5,000 feet altitude on a VFR flight plan in clear weather.

At 1133 the flight advised Standiford (Louisville) tower that it was over New Albany, Indiana, eight miles to the north-northwest, and requested clearance to the airport. At 1134 the flight asked landing information of its company radio station and was given the Louisville pressure altitude as 340 feet and the Louisville altimeter setting as 30.10 inches. A minute later the flight advised the tower that it was over the city and received clearance to land on runway 11. Wind conditions were given as southeast five to eight knots, variable both sides. Ceiling and visibility were unlimited. The "Fasten Seat Belt" sign had been put on.

Pilot Bingham descended from 5,000 feet to 2,000 feet and then reduced both rate of descent and power. An airspeed of 165 knots was established, the landing

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

gear was lowered, and the flaps were placed in takeoff position. Bingham then started a turn for final approach, and the flaps were placed in approach position. Captain Chambers saw that the aircraft was too high and reduced power still further; Bingham lowered the flaps to full down. The prelanding checklist had been accomplished.

At this point (the altitude was then 1,000 to 1,500 feet higher than the runway) the captain took over control. He nosed down sharply, holding as closely as possible to an airspeed of 100 knots. The landing gear remained down, flaps remained fully down, and throttles were pulled fully back. Neither pilot read the rate-of-climb (descent) indicator during the approach.

When approximately over the threshold of the runway and while about 100 feet above it, the captain pulled back on the yoke to flare out. No power was used. The aircraft's attitude was observed to change from nose-down to nose-up but its rate of descent did not seem to lessen markedly. The aircraft struck the runway on its main landing gear, the left wing separated inboard of the left engine nacelle, and the remainder of the aircraft half rolled to an inverted position. It slid along in that attitude, turning and coming to rest headed nearly opposite its direction at touchdown.

Two minutes later, by estimate, all occupants were out of their inverted seats, in which they were belted, and away from the wreckage which had developed a small fire. This was confined by a passenger using a hand extinguisher until emergency apparatus, which had been alerted by the tower, arrived quickly and took the necessary steps to prevent further fire.

Investigation

Weather was excellent and was not a factor in this accident. Captain Chambers stated that the air was relatively smooth during the final approach and there was very little wind. He was satisfied with the tower's advice to use runway 11, which was the active runway and is 5,000 feet long by 150 feet wide. This runway was dry, smooth, level, in good condition, and its elevation is 497 feet.

Investigation disclosed that there was no pertinent air traffic and that arrival at Louisville was on time, actually a little ahead of schedule.

As mentioned, the flight from Indianapolis was at 5,000 feet altitude in clear weather. During this segment, of which the total elapsed time was only 33 minutes, the stewardess served luncheon to, and removed trays from, the 31 passengers. Captain Chambers, realizing that this would be a rather hurried operation, allowed Pilot Bingham to maintain cruising altitude of 5,000 feet somewhat longer than he normally would. Chambers testified that there was a haze line with some choppiness at 4,500 feet and descending through it was delayed slightly to give the stewardess more time in smooth air. This might account, according to the captain, for arrival in the Louisville area while somewhat higher than usual. Captain Chambers also testified that the local noise-abatement program, which imposes a minimum altitude over Louisville, four miles north of the airport, was not a factor in the flight's altitude as it neared the airport.

Both pilots stated that they could not sense any blowing back of the wing flaps during the approach. These flaps incorporate a safety feature which allows a partial retraction from the full down position at airspeeds of 104 or more knots.

Both flaps and the landing gear were found fully extended with the landing gear in the locked position.

The first tire marks were made almost simultaneously by the left and right tires 242 feet from the approach end of the runway, with the left marks five feet inside the left edge of the runway. Markings of the left tires were much more pronounced and wider than those of the right, indicating harder contact. The left individual tire marks had a maximum width of 12-1/2 inches, those of the right tires were 11 inches, and both were within a few feet of their initial contacts. A track made by the nose wheel tire began 36-1/2 feet from the start of the left gear tracks and continued parallel to them for 59-1/2 feet. The Martin 404 nose wheel is 22 feet and 4 inches forward of the main gear.

Adjacent to the end of the nose wheel track was the first of 11 marks made by the left propeller blades. This series of marks began with slight nicks which deepened further along the path. Identifying marks made by the left wing were on the turf, off the runway 340 feet beyond initial touchdown. This area of flattish contact between left wing and turf was 5 feet by 14-1/2 feet. From this point forward, the tracks curved to the left running off runway 11 at a point 175 feet from the intersection of runways 11 and 6, then crossed the turf at the corner and onto runway 6. The distance from first contact to where the inverted fuselage came to rest is 1,080 feet. About 150 feet from the fuselage was the left wing with left engine and left landing gear attached. A short distance away the left propeller with its dome and the fractured left engine nose section stopped.

All landing gear shock struts were found to be properly serviced with air and oil. This also was true of the main gear dampener struts. Under test all shock struts operated freely after release of pressure. Air pressure in the tires was checked and found to be as prescribed in the Maintenance Manual for the Martin 404.

All cockpit controls and those continuing through the cockpit were found slack, due to aircraft damage. But all were found to be properly connected and safetied and were continuous through their respective pulleys and fairleads.

Examination of the entire wreckage revealed no evidence of failure or impairment of any component in flight. It also disclosed that all components of the aircraft were present in the wreckage.

Examination of both propellers disclosed no evidence of any malfunctioning. All blades were close to 30 degrees of pitch which is normal when delivering no power. Engines likewise were examined. Nothing was found in either to indicate any malfunctioning prior to contact.

Both airspeed indicators, both rate-of-climb indicators, and the altimeters were examined in detail and found to have been functioning within acceptable limits.

All maintenance records were examined at the carrier's main overhaul base. These disclosed that maintenance of the aircraft, engines, propellers, and related components had been conducted in accordance with the CAA approved Maintenance Manual for Eastern Air Lines' Martin 404 aircraft. The last six flight reports (squawk sheets) for the aircraft carried no entries pertinent to this accident.

Eastern Air Lines acquired this aircraft new in February 1952. Company records indicate that it had never been subjected to a landing hard enough, nor to turbulence severe enough, to demand an inspection for airworthiness since its acquisition, nor had it ever been involved in an accident.

The left wing failed between the left nacelle and the fuselage. Examination indicated that the failure was of the static overload type and there was no evidence of fatigue. Examination further indicated that the initial failure was the shearing of one or both spar webs. This permitted both lower and upper caps of both spars to fail in secondary bending, whereupon the covers tore free and the entire wing became detached.

Sections from the two failed lower spar caps, front and rear, were examined by the National Bureau of Standards. The Bureau's report was summarized as follows:

"No evidence of fatigue was found on any of the fractures of the two spar caps. All the fractures were due to bending overloads.

"Samples of material from both spar caps complied with the requirements of reference (b) for tensile strength, yield strength, elongation, and chemical composition." Reference (b) is to Federal Specification (QQ-A-267) for 24S aluminum alloy extension, the spar cap material.

The U. S. Weather Bureau altimeter setting at the airport, at 1125, was 30.10 inches. The aircraft's lower left altimeter was found set to a barometric pressure of 30.10 inches. The captain's upper altimeter, as well as the first officer's, was at 340 feet pressure altitude, which was the pressure given by the company radio a few minutes before the landing. Thus, altimeter settings were as given and were correct.

Captain Chambers estimated that when he took the controls to complete the approach his altitude was 1,000 to 1,500 feet above the runway. The horizontal distance from the approach end of the runway has not been determined with any degree of reliability, although the pilots thought it might be a mile or a mile and a half. The captain believed that his position was not enough out of the ordinary to warrant going around. He did not use power prior to starting the flareout because he thought it unnecessary to do so. He testified that when he pulled the control wheel back to flare out the response was not as expected.

A number of persons on the ground observed the approach and/or landing of this flight. One was in the airport parking lot office. His view was practically at right angles to the descent although he did not see the actual touchdown which was obscured by buildings. Another, the Airport's Director of Operations, was in front of and on the airport side of the Administration Building. Another was about 1-1/2 miles north of the airport. Five controllers in the tower saw the approach and the runway contact. Their attention had been called to the unusually steep approach by the controller at local control position. Two men at the northeastern part of the airport also watched the approach. These ten witnesses agree that the approach was steep, some describing it as extremely steep. Those who could see the runway contact concur that the attempted flare-out for landing did not significantly check the downward speed, but that the aircraft struck the runway forcibly.

Statements were requested of the 31 passengers; 21 complied. Their consensus is that the flight from Chicago to Louisville with Indianapolis landing was normal and routine, that the approach to landing at Louisville was steep, and that the contact was hard. Most thought the air was smooth although a few thought otherwise. As mentioned, the captain testified that the air was relatively smooth during approach. In regard to the steepness of approach, passengers described it variously as "articles slid from my lap," "nose pointed straight down," "seemed to be going straight down," and "the sink rate seemed to be excessive," the last by an Air Force officer.

The theoretical angle and rate of descent under the conditions as testified to by the captain has been computed. With no wind, full flaps, landing gear down, a sustained 100 knots indicated airspeed, throttles fully retarded, and a gross weight of 40,700 pounds, which makes due allowance for fuel burnoff, the angle should have been 11 degrees from the horizontal with the aircraft's longitudinal axis depressed six degrees below the 11-degree slope line. The rate of descent would have been about 1,800 feet per minute.

Shortly after the accident Captain Chambers flew another Eastern Martin 404, at high altitude, simulating the conditions of the actual approach. Pilot Bingham accompanied him as observer. According to the captain, this test, with the aircraft grossing nearly as much as the crashed one, and with other conditions the same, full flaps, landing gear down, throttles kept fully back, and maintaining 100 knots airspeed, resulted in a rate of descent of 1,950 feet per minute (32.5 feet per second).

Eastern Air Lines' training curriculum does not specifically prohibit this type of steep approach with power off during flareout and landing. But company officials were emphatic in testifying that such a technique is contrary to pilot training methods as explained orally and as demonstrated in flight. Captain Chambers' last previous company flight check was passed with a grade slightly better than average. His earlier checks and grades were also consistently satisfactory. During the three months preceding this accident he had flown Martin 404's exclusively, a total of 245 hours. He was thoroughly familiar, from long experience, with Standiford Field. Chambers and Bingham had flown together for 229 hours.

Analysis

All evidence indicates clearly that the wing failure was the result of and not the cause of this accident. The wing structure was intact throughout the flight and landing approach and did not separate until the aircraft had contacted the runway. Tests conducted on the pertinent parts disclosed no prior fatigue cracking and/or material defects, and it was established that the fractures were produced by excessive loads. Further, an engineering review of the manufacturer's technical data disclosed no discrepancies in this regard and that appreciable strength margins were provided in the design of the structure in the failed area. Failure of the wing structure prior to and/or without a failure of the main landing gear was a clear indication that high vertical loads, such as would accompany a hard landing, had been imposed on the structure.

In exploring why the aircraft had contacted the runway as hard as it did, the Board gave careful consideration to the captain's statement that the aircraft's response was not as expected when he pulled back on the yoke in an attempt to flare

out. The various components of the elevator and movable stabilizer control system were thoroughly examined for failures or malfunctioning evidence but none was found. Furthermore, no other complaints against the subject control systems had been received. Moreover, the elevators did function properly throughout this landing, as indicated by the fact that the captain's displacement of the elevators caused the aircraft's nose-down descent angle to change to a nose-up angle at touchdown. However, the change in attitude was too late to check the high rate of descent sufficiently, and the aircraft contacted the runway extremely hard. If the flareout had been started sooner, or if sufficient power had been applied just prior to and during the flareout, the excessive rate of descent might have been controlled and the hard landing with its resulting damage avoided.

Normally, Pilot Bingham, who flew the Indianapolis-Louisville segment, would have made the approach and landing. In this case Captain Chambers erroneously allowed Bingham to bring the aircraft to a position much too close in, considering the altitude, for the planned landing on runway 11. At that position relative to the runway, Chambers should have taken control and circled the airport to establish a normal approach, or instructed Bingham to do so.

But the captain did not do this. Instead, he elected to dive steeply with full flaps and no power. The precise angle of descent is not known but the preponderance of testimony is that it was exceedingly steep. This testimony is largely by well-qualified witnesses. Such an approach would require, in order safely to check an abnormally high rate of descent, a much earlier starting of the flareout with the use of such power as might be needed to maintain a safe margin of speed.

There was no urgency whatever, because of other traffic, weather, lateness in arrival, or any other compulsive factor, in pressing this approach and landing. Further, this flight crew was to have been relieved at Louisville. This type of approach is in conflict with general and long established airline training and practice. Because no other factors were involved in this accident and no alleviating circumstances stand forth, the Board can only conclude that the pilot erred in executing this type of approach and touchdown. Specifically, the approach was too steep, the flareout was ineffective because of the low airspeed, and consequently the landing was destructively hard.

Findings

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

1. The carrier, the aircraft, and the crew were properly certificated.
2. There was no irregularity in the functioning of the aircraft nor of any of its components.
3. Weather, radio facilities, or other traffic were not involved.
4. An approach was started from a point too close and too high in relation to the approach end of the runway.

5. The speed and configuration of the aircraft in conjunction with the retarded throttle during this approach resulted in an inordinately high rate of descent.

6. This high descent rate was not sufficiently checked during the attempted flareout.

7. Touchdown imposed loads beyond the design strength of the wing structure, which failed.

Probable Cause

The Board determines that the probable cause of this accident was the captain's faulty landing approach technique, resulting in an excessively high rate of sink at the instant of touchdown imposing load beyond the design strength of the wing structure.

BY THE CIVIL AERONAUTICS BOARD:

/s/ JAMES R. DURFEE

/s/ CHAN GURNEY

/s/ HAMMAR D. DENNY

/s/ G. JOSEPH MINETTI

/s/ LOUIS J. HECTOR

S U P P L E M E N T A L D A T A

Investigation and Taking of Depositions

The Civil Aeronautics Board was notified of this accident at 1315, March 10, 1957. Investigation was started immediately in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. Depositions were taken at Chicago, Illinois, on May 15, 1957; at Louisville, Kentucky, on May 16, 1957; and at Miami, Florida, on May 17, 1957.

Air Carrier

Eastern Air Lines, Inc., is a Delaware corporation maintaining its main office at New York, New York. The company has certificates of public convenience and necessity issued by the Civil Aeronautics Board and air carrier operating certificates issued by the Civil Aeronautics Administration authorizing the carriage by air of persons, property, and mail over the route involved in this accident.

Flight Personnel

Captain Clarence G. Chambers, age 33, had been employed by Eastern Air Lines since August 1949. He held all necessary certification and ratings for the subject flight. His total flying time was 7,795 hours, of which 2,151 hours had been in Martin 404's. His rest period prior to departing Chicago on the subject flight was 24 hours, 40 minutes. During the previous 30 days he had flown 404's 81 hours; during the previous 90 days, 245 hours. He had flown no other type of aircraft during that 90-day period. His physical examination and line check were current.

Pilot Harold D. Bingham, age 31, was first employed by Eastern in September 1949. He became a pilot for the company in March 1956, and was properly certificated and rated for the subject flight. His total piloting time was 1,201 hours, of which 652 had been in Martin 404's. Mr. Bingham's rest period prior to the subject flight was more than 48 hours and his physical examination and line check were current. Bingham and Chambers had flown together for 229 hours.

Stewardess Shirley Michael had been employed by Eastern since October 1955 and had satisfactorily completed the company's required training courses.

The Aircraft

N 453A, Martin 404, was acquired new by Eastern Air Lines in February 1952. At the time of this accident its total operational time was 15,365 hours. Records of its maintenance and overhauls indicated that both had met all CAA and company requirements.

Engines were Pratt and Whitney, model R-2800-CB-3. These engines had total times of 9,530 and 9,971 hours, and times since overhaul of 782 and 1,079 hours, for left and right, respectively.

Propellers were Hamilton Standard, model 43E60-7. Their total operational times were 13,714 and 14,075 hours, with 1,588 and 1,405 hours since overhaul, for left and right, respectively.

Maintenance of engines and propellers was in accordance with CAA and company requirements.