

AIRCRAFT ACCIDENT REPORT

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DELTA AIR LINES CV-880, N 8804E, ATLANTA,
GEORGIA, MAY 23, 1960SYNOPSIS

On May 23, 1960, at 1152 e. s. t., a Delta Air Lines Convair 880, N 8804E, crashed and burned during takeoff at Atlanta, Georgia, Four crew members, the only occupants, received fatal injuries.

The flight was scheduled for training for two pilots who were to "check out" in the CV-880. A pilot-trainee occupied the left seat and a qualified instructor-pilot occupied the right. Immediately after liftoff the aircraft assumed an extremely nose-high attitude and banked steeply to the left. It then rolled to a vertical right bank, the nose fell through, and the aircraft struck the ground.

The Board determines the probable cause of this accident was that the aircraft was stalled, for reasons undertermined, at an altitude too low to effect recovery.

Investigation

A Delta Air Lines Convair 880, N 8804E, was scheduled as Flight 1903. It was to be a training flight for the purpose of giving flight instruction to two captain-trainees prior to their checkout in the CV-880. Delta Captain James H. Longino was the instructor-pilot and occupied the right (copilot's seat). Captain-trainee Henry L. Laube occupied the left (pilot's seat). Captain-trainee William F. Williams was in the observer's seat and Bryan E. Bolt was serving as Flight Engineer.

No flight plan was filed, however, according to Delta officials, the flight was planned for approximately four hours. It was to be operated in the area between Atlanta, Georgia, and Columbia, South Carolina, with landing and take-off training to be conducted at North Field, North, South Carolina.

Delta Form 0-18 (fuel service record) was completed for the flight and indicated that the aircraft had been serviced to approximately 60,000 pounds of fuel, distributed properly. The aircraft gross weight on departure from the ramp was 144,599 pounds (maximum allowable for this flight, 155,750 pounds) and the center of gravity location was within limits at 29.5 percent MAC.

The weather at the time of takeoff was scattered clouds at 3,000 feet, visibility 15 miles; wind west 15 knots variable, temperature 80 degrees.

Flight 1903 departed the ramp at 1140^{1/2} and taxied into takeoff position on runway 27. After landing-traffic on an intersecting runway was clear, N 8804E started its takeoff roll at approximately 1151. Observers indicated that acceleration appeared to be normal and the aircraft rotated at a point just west of the intersection of runway 27 and a taxiway paralleling runway 21 about 3,450 feet from the threshold. Tower operators were also in agreement that the liftoff appeared to be normal and at a point on the runway opposite the new fire station which is approximately 4,425 feet from the threshold. Runway 27 is 7,860 feet long.

Within a very few seconds after liftoff the attitude of the aircraft changed from normal to an angle of pitch described by many qualified witnesses to be as much as 45 degrees. This abrupt nose-up was followed by a lowering of the left wing to an angle of bank estimated as 20 degrees, and a change of heading to the left of about 45 degrees. Witnesses described the flight of the aircraft at this point as a "left skid" or "slip" with the nose still extremely high. Next the aircraft rolled from the left bank to a vertical bank to the right. In this vertical right bank the nose fell through and the right wing contacted the ground followed immediately by the nose of the aircraft. As the breakup progressed an intense fire developed which largely consumed the wreckage. All occupants received fatal injuries at impact.

Most of the witnesses said that the aircraft's speed appeared to be extremely slow after becoming airborne. Some described a "stall" and "shuddering" of the entire aircraft. Others described a "fishtailing movement" after takeoff. There were also several witnesses who indicated that the No. 4 engine was not producing the trail of black smoke which is normally seen on takeoff. All were in agreement that the maximum height attained was about 200-300 feet. The wreckage distribution indicated that the initial ground contact was on the right wing while the aircraft was in a 70 to 80 degree right wing low angle of bank. The aircraft skidded along on the right wing and nose, and cartwheeled to the right. It came to rest heading in the opposite direction from which it had been traveling. The Nos. 3 and 4 engines were torn off as the wing was down and the Nos. 1 and 2 engines separated from the wing as the aircraft became headed in the opposite direction.

Examination of the wreckage did not reveal any evidence of structural failure prior to impact. In addition, no malfunction or failure in the control surfaces, control cables, or systems was found which could have caused or contributed to the unusual flight attitudes described by witnesses.

All aircraft systems and instruments were examined and no failure or irregularity was found. It was determined that the landing gear was fully extended and locked. The wing flaps were extended symmetrically to 20 degrees. The spoilers were operable and the stabilizer was set 4-1/2 to 5 degrees noseup. Information obtained from the remaining systems or instruments, i.e., engine performance gauges, etc., was determined to be unreliable because of the probability that impact forces would change the indications.

Examination of the engines showed that Nos. 1 and 2 at impact were producing thrust at an engine speed of at least 96 percent r.p.m. There were indications of considerable damage and metal spatter from internal interference within the

engine which occurred as breakup progressed and rotating parts was forced into stationary sections of the engines. The variable stator vanes on the compressors of both engines were in the full open position.

It was determined that engines Nos. 3 and 4 at impact were operating at reduced speeds. The variable stator vanes on No. 3 were found at an angle of minus 8 degrees 45 seconds. Those of No. 4 were fully closed. Because the angle of these variable vanes is a function of engine r.p.m., and compressor inlet temperature, it was possible to determine that the engine r.p.m., represented by these angles were 79 percent for No. 3 and 66 percent (or flight idle) for No. 4. In addition, the damage and metal spatter from internal interference and foreign object damage within these two engines were less than that noted on Nos. 1 and 2. There were no indications of pre-impact mechanical failure or malfunction in any of the four engines. Bearings showed no indications of operating distress or unusual wear. There were no overtemperature indications on any of the combustion or turbine assemblies and nothing was found which would have prevented the engines from developing full r.p.m., or full thrust prior to impact.

The metal spatter on the first stage turbine blades and nozzle guide vanes of engines 1 and 2 consisted of aluminum alloy which had been scraped from the variable stator shrouds by the stators at impact. This metal had passed down the engine and was fused to the turbine. The turbine blades of engine No. 3 evidenced no such fusion and only a slight amount of deposit on the vanes. Engine No. 4 had slightly more fused material than No. 3 on the vanes and a small amount on the first stage turbine blades.

The Delta Air Lines captain training program for the CV-880 consists of 120 hours of ground school instruction which covers jet weather, high-altitude indoctrination, CV-880 familiarization, systems familiarization, electrical systems, and CJ-805 engine familiarization. After completing this indoctrination each student must pass a written examination.

Following the ground school training, each captain-trainee receives a minimum of 13 hours of instruction in the CV-880 simulator, including three hours of panel time. The simulator airwork accomplished in this training includes emphasis on takeoff and landing practice with asymmetric power.

The captain-trainee is then given a minimum of 12 hours of flight training. In addition, he is given four hours of panel time and eight hours as observer. As in the simulator training, each captain is given practice in takeoff procedures with one engine out at V_1 , V_R , and V_2 . In addition, practice is given in operation with two engines "out" with the second engine being "failed" after takeoff at traffic-pattern altitude.

Several prior incidents during which heavy yaw rolling tendencies were encountered in the Delta Air Lines CV-880 training program were investigated. All of these were found to have involved simulated failure of an outboard engine at V_1 . Testimony indicated that a directional oscillation developed with coincident rolling tendency after an initial yaw toward the "cut" engine. No extremely nose-high attitude was associated with any of these incidents. Recovery even in the most severe case was easily effected by nosing the aircraft down sufficiently to allow speed to develop. Captain Longino had been the instructor-pilot during several of these incidents.

Captain Longino, age 42, had a total of 13,197 flying hours. Of this total, 273 hours had been obtained in the DC-8 and 227 hours in the CV-880. Captain Longino's total jet experience of 500 hours included 208 hours of instructor-pilot time in the DC-8 and 179 hours of instructor-pilot time in the CV-880.

Captain Laube was 45 years of age. He held a current ATR with ratings in DC-3, DC-4, DC-6, DC-7, CV-340, Lockheed Constellation, and DC-8 aircraft. He had a total of 17,221 flying hours, of which 14 had been obtained in the DC-8 and 10 in the CV-880.

The flight of May 23, 1960, would have completed Captain Laube's flight training in the CV-880 and would have prepared him for a type rating check-ride in the aircraft. The training curriculum required that failure of an outboard engine at V1 during takeoff be simulated on this flight. It was not unusual to simulate this three-engine takeoff at the Atlanta Airport.

Captain Laube had passed his most recent first-class medical examination December 23, 1959. At that time an electrocardiogram examination was given to him and noted as satisfactory. Immediately following the accident of May 23, an autopsy was performed on Captain Laube, as well as all other members of the crew. This examination disclosed that Captain Laube's heart exhibited atherosclerosis to a marked degree. This condition was found to have decreased the inside diameter of the left main coronary artery of the heart 70 - 90 percent; the circumflex coronary artery 25 - 100 percent with evidence of an old occlusion; and the right main coronary artery 50 - 80 percent. No evidence was found to indicate acute infarction or coronary thrombosis. In addition, nothing was found to indicate incapacitation due to coronary insufficiency.

Analysis and Conclusions

From the evidence adduced during this investigation it appears that the flight preparations, taxi to takeoff position and runup, were normal. The takeoff roll and aircraft rotation-to-climb attitude were also normal. Liftoff occurred at a point on the runway which was later calculated to be normal for the conditions existing.

The Board cannot determine the reason for the abrupt "nosing up" of the aircraft shortly after liftoff. In its investigation the Board has reviewed the manufacturer's performance records, flying qualities, and capabilities of the CV-880. No unusual or unsafe characteristics were noted and nothing was found which could account for this unusual flight attitude.

It appears certain that the aircraft was in a stalled condition while in this extreme nose-high attitude. It also appears certain that a large amount of yaw to the right was present along with considerable skid or slip. In swept-wing aircraft these conditions can create an uncontrollable rolling moment to the right. Briefly, this is a result of greatly increased lift generated by the advance wing, coupled with a large decrease in lift on the retreating wing. The Board believes the description of the "flightpath," as derived from witness statements, is entirely consistent with this assumption.

It is believed that the takeoff incidents which involved heavy rolling immediately following liftoff were the result of overcontrolling by pilots unfamiliar with the extremely sensitive lateral control of the Convair. Again, nothing was

found in any of these incidents which could help explain the accident, except that all occurred at low speeds on takeoff with one engine out.

Several witness observations indicated that the No. 4 engine was throttled prior to liftoff. Under normal procedures for a training flight such as this, it is possible that an engine would be throttled after V₁ speed had been reached to simulate engine failure. Moreover, it is most likely that an outboard engine would be the one "cut," because its loss is more critical during this regime of flight. For these reasons, and the fact that on impact No. 4 engine was at flight idle (66 percent), the Board believes it reasonable to assume that the No. 4 engine was throttled prior to liftoff. This condition is also consistent with the initial left wing-down attitude as a result of overcontrolling, and was probably the reason a large degree of yaw developed.

The amount and distribution of fused metal found in the engines can be related directly to the temperatures at which the engines were operating. The minimum turbine inlet temperature necessary to fuse metal to the inlet guide vanes and turbine blades ranges from 750° to 850°F. Temperatures at least this high were therefore present in Nos. 1 and 2 engines. The amount of fused metal found in engine No. 4 was considerably less and that in No. 3 was the least of all four engines. The stabilized turbine inlet temperature at flight idle (66 percent) is 850° to 900°F. These temperatures are sufficient for fusion; however, the engine speed and airflow within the engine during breakup would be less and would account for the lesser amount of metal found in engine No. 4.

At 79 percent engine r.p.m. stabilized turbine inlet temperature is from 850° to 915°F. During engine deceleration the transient temperature will fall below the given values at flight idle and rise to normal when engine speed has stabilized. The average time required for engine temperature to stabilize during deceleration from 103 percent to 79 percent is four seconds. Based on the lesser amount of fused metal, as compared to the other engines, it appears that temperatures in No. 3 were below those at stabilized flight idle. This indicates the engine was in a decelerating condition at the time of impact. It appears probable that this deceleration occurred within about two seconds during impact. This appears likely because if the engine had been cut as much as four seconds before impact, the temperature would have been stabilized in the 850° to 915°F range.

All attempts to correlate this information to the flightpath of the aircraft are again irreconcilable. It is estimated that for at least five seconds prior to impact, the aircraft had to be in a rolling condition from a left to right bank. The final three seconds of flight must have been in a right wing-down attitude. therefore, it appears that the engine cut on No. 3 would have to have occurred while the aircraft was rolling to the side, on which power had already been reduced (No. 4 was at flight idle at liftoff). The Board believes it doubtful that No. 3 was retarded intentionally at this time because this would greatly increase the asymmetry of power and aggravate the yaw and tendency to roll to the right. It is also unlikely that the throttle was closed inadvertently.

Finally, no evidence was found during the course of the investigation to indicate structural failure or mechanical malfunction prior to the aircraft's impact with the ground. As far as could be determined the aircraft systems were normal and should have been capable of normal operation at impact.

In further study of this accident the Board attempted to determine if Captain Laube had any history of heart trouble. None of the doctors known to have treated Captain Laube, including an insurance doctor, had knowledge of this condition. In addition, several of his electrocardiographs were examined and no abnormalities were present. Further, no evidence could be found from autopsy to indicate incapacitation as a result of a thrombosis or infarction. Although Captain Laube's atherosclerosis was considerably advanced for his age, the Board cannot find evidence to support any sudden incapacitating condition on which to base a finding of probable cause of this accident.

Probable Cause

The Board determines the probable cause of this accident to be the stalling of the aircraft, for reasons undetermined, at an altitude too low to effect 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

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 shortly after it had occurred. An investigation was immediately initiated in accordance with Title VII of the Federal Aviation Act of 1958. A public hearing was held in Atlanta, Georgia, August 30-31 and September 1, 1960.

Air Carrier

Delta Air Lines holds a current certificate of public convenience and necessity issued by the Civil Aeronautics Board to engage in the transportation of persons, property and mail. It also possesses a valid air carrier operating certificate issued by the Federal Aviation Agency.

Flight Personnel

Captain James H. Longino, age 42, was employed by Delta Air Lines May 30, 1945, and promoted to captain August 12, 1946. He held a valid FAA airline transport pilot certificate with ratings for the DC-3, DC-4, DC-6, DC-7, Convair 340, Lockheed Constellation, C-46, DC-8, and Convair 880. He had a total of 13,197 flying hours of which 273 were in the DC-8 and 227 were in the Convair 880. He was also an instructor-pilot for Delta Air Lines. His last FAA first-class physical was dated November 17, 1959.

Captain Henry L. Laube, age 45, was employed by Delta Air Lines March 25, 1942, and promoted to captain March 16, 1955. He held a valid FAA airline transport pilot certificate with ratings for DC-3, DC-4, DC-6, DC-7, Convair 340, Lockheed Constellation, and DC-8. He had a total of 17,221 flying hours of which 14 were in the DC-8 and 10 were in the Convair 880. His last FAA first-class physical examination was December 23, 1959, at which time an EKG was performed which was satisfactory.

Captain William F. Williams, age 50, was employed by Delta Air Lines June 23, 1941, and promoted to captain on April 26, 1943. He held a valid FAA airline transport pilot certificate with ratings in the DC-3, DC-4, Convair 340, DC-6, DC-7, and DC-8. He had a total of 17,196 flying hours of which 13 were in the DC-8 and 12 were in the Convair 880. His last FAA first-class physical examination was dated January 12, 1960.

Flight Engineer Bryan E. Bolt, age 31, was employed by Delta Air Lines January 2, 1956. He held a valid FAA commercial pilot certificate with aircraft single-engine and multiengine land and instrument rating. He also held a valid FAA flight engineer's certificate. He had a total of 5,810 flying hours of which 210 were in the Convair 880.