

CIVIL AERONAUTICS BOARD
ACCIDENT INVESTIGATION REPORT

Adopted: September 27, 1946

Released: October 2, 1946

EASTERN AIR LINES - CHESHIRE, CONNECTICUT, JANUARY 18, 1946

The Accident

Eastern Air Lines Flight 16B, enroute from New York, N. Y., to Boston, Massachusetts, crashed near Cheshire, Connecticut, at 1103*, January 18, 1946, as a result of failure in flight of the left wing following a fire in the left engine nacelle. All fourteen passengers and three crew members were fatally injured and the Douglas DC-3 was demolished by impact and fire.

History of the Flight

Flight 16B, the second section of Flight 16 originating at Miami, Florida, January 17, 1946, departed Miami, at 0143, January 18, 1946. Routine stops were made at Charleston, S. C., Washington, D. C., and New York, N. Y. Upon arriving at New York, the captain of the flight from Miami reported a slight oil leak from the left engine nacelle. Inspection of the engine by Eastern maintenance personnel disclosed a faulty installation of a hose connection to the left vacuum pump. The hose was replaced and the aircraft was certified as satisfactory for completion of its schedule.

Since crew change is regularly made at New York, a new crew was scheduled to complete the flight to Boston, Mass. The captain elected to

*All times referred to in this report are Eastern Standard and based on the 24-hour clock.

conduct the flight under contact flight rules although he had been granted an instrument release by the company dispatcher and the flight departed La Guardia Field at 1028. At 1058, the Eastern Air Lines' New York radio station received a request from the flight for a change in clearance to cruise at 3,000 feet. This request was coordinated with the New York center of Air Traffic Control and approved by that agency. In attempting to relay approval of the change of clearance to Flight 16B, the Eastern Air Lines' station was unable to reestablish contact. No further communication was received from the flight.

At approximately 1100, witnesses within and in the close vicinity of Cheshire, Conn., observed the flight approach Cheshire from the southwest at an altitude of about 1500 feet. A wisp of light gray smoke was seen to begin trailing behind the left engine, shortly after which an intense flame was observed coming from the left engine nacelle and trailing almost to the empennage of the aircraft. The flame died down momentarily and then flared up again in increased intensity, continuing to pour from the nacelle. The aircraft banked very slightly to the right and left and then, as a cloud of light gray smoke burst from the nacelle, the left wing failed upward and back and the aircraft dived into the ground with a slow rolling motion to the left.

Investigation

The wreckage of the aircraft was located on the side of a wooded ravine pointing in a southwesterly direction. Impact marks on trees and the wreckage indicated that the aircraft had struck the ground in an attitude slightly past vertical after having turned approximately 180°

to the left while falling. The direction of motion at the time of impact was toward the northwest and, after striking the ground, the fuselage whipped in that direction demolishing most of the tail section. The fuselage forward of the buffet compartment was almost completely consumed by fire subsequent to impact rendering inspection of the cockpit control systems very difficult. The right wing had struck the ground on its leading edge and most of the inboard section remained in approximately a vertical position. The left wing had broken off within the center section and, while the inboard portion had been almost completely disintegrated as a result of impact and fire, the outboard section received little damage.

Inspection of the left engine and engine accessories was conducted under difficult circumstances because of the extent of damage incurred as a result of the impact and fire. The investigation was conducted in three phases, the first of which was completed at the scene of the accident and consisted primarily of an inspection of the location of the powerplant components with respect to the aircraft structure, the correlation of the more apparent surface burns on both and an analysis of external damage to the engine. The entire engine was subsequently removed to Newark Airport and subjected to a detailed teardown to determine the nature of internal damage, burn patterns throughout the engine and its accessories, and the source of the fire which broke out in flight. Following the above investigation, several powerplant components were sent to the Bureau of Standards for further study by the Division of Metallurgy.

The left engine nacelle indicated a severe fire just aft of the firewall at the inboard side of the wheel well. The fire in this region had been sufficiently intense to burn a large hole in the nacelle but was significantly confined in its more intense proportion to this section. While the remainder of the nacelle showed signs of fire, these indications were in the nature of smudges and did not reveal the existence of the extremely high temperatures which had been necessary to burn the nacelle and aircraft accessories behind the firewall. It can therefore be concluded that the more intense, localized fire had occurred while in flight and that the remainder of the evidence of fire had resulted subsequent to impact. The inboard shock strut and the brake disc from the left landing gear were found separated from the major portion of the wreckage in an area which indicated that they had not been subjected to fire while on the ground. Inasmuch as these items bore evidence of intense heat, it can be further concluded that they were subject to fire prior to impact.

Analysis of the heat pattern of the left engine and its accessories indicated that fire had occurred in flight and had projected rearward and downward from the fuel pump outlet, past the hydraulic pump where it forked into two branches of flame, the upper branch passing under the right magneto and the lower flame passing over the generator and starter motor. Dural fuel lines, hydraulic fluid lines, and oil lines were successively consumed and their contents ignited. Thereafter, the path of the fire within the nacelle became difficult to trace with accuracy because of the greater number of sources of fire. The firewall immediately rearward of the fuel pump showed signs of most intense heat and the rivets

on the firewall in this area had apparently been burned out prior to impact. No part of the hose or the two hose clamps which were attached to the fuel pump out-line were located in the wreckage. The heat pattern inside the accessory gear housing also indicated the area of most intense fire as that on the side adjacent to the fuel pump.

The pattern of burns on the tail surfaces of the aircraft and particularly those about the rivet heads indicate conclusively that the empennage had been subjected to fire in flight and that the source of the fire was in the vicinity of the left engine nacelle. A search along the flight path of the aircraft to a point approximately 1/2 mile from the wreckage revealed numerous pieces of burned material identified as having fallen from the aircraft.

Testimony revealed the fact that the vacuum pump shaft in the left engine had failed due to excessive heat during a previous flight. This vacuum pump was replaced at Miami prior to departure of Flight 16B. The hose connection to the exhaust side of the new pump was replaced upon arrival at New York when the captain of that portion of the flight reported a slight oil leak. The cause for the oil leakage or the shaft failure was not determined in either instance.

With the exception of the fuel pump out-line hose-connection or hose-clamps, no evidence was disclosed of failure in flight of any aircraft equipment or component other than that caused by fire. Until observed approaching Cheshire, the flight appeared to be routine in every respect.

An aftercast of the weather at the time and in the vicinity of the accident indicated that conditions were satisfactory for contact operation.

Since leaving New York, the flight had encountered no adverse weather and was contact at the time of the accident.

Discussion

Inasmuch as the aircraft was observed before and during the time the fire originated and was seen in flight until it crashed, an approximation of the total time during which the engine was afire is possible. While there is a possibility that a fire may have been in progress not apparent either to the crew or to ground observers it is likely that the first indication observed by witnesses places the approximate moment of ignition. It is also likely that the "gray smoke" or "vapor trail" described by witnesses before the fire was observed was in reality not smoke but a fine spray of gasoline from the leaking fuel line. Approximately two minutes elapsed from the time flame was first observed until the left wing failed and the aircraft fell to the ground. During this period the fire had burned through the left engine nacelle inboard of the wheel well and the flames extended rearward as far as the empennage. The heat weakened the wing structure, and the lower surface and rear spar flange failed in tension causing the wing to collapse upward and back over the fuselage. In this condition the aircraft became completely uncontrollable and fell to the ground nose first, retaining some of its northwesterly momentum as it rolled slowly to the left.

Testimony of the witnesses to the accident indicated conclusively that the fire which occurred in the left engine of the aircraft was fed principally by gasoline. The fire path disclosed during the investigation further substantiates the above conclusion and places the origin of the

fire at the out-flow side of the fuel pump. The fact that the magnesium starter housing located behind the fuel pump was almost totally consumed by fire prior to impact further indicates that the source of the fire must have been directly forward of that area. It is apparent that the fuel out-line hose, hose connection, or hose clamps failed in flight sufficiently to permit gasoline to spray rearward throughout the accessory section. The possible causes of primary ignition are numerous but, in the absence of definite evidence, the actual cause was not determinable. However, the most likely cause for ignition is the generator or the exhaust manifold, either of which could have ignited the gasoline. Once the gasoline was ignited, the dural out-line at the fuel pump "T" fitting was burned away and the fire rapidly increased in intensity and spread rearward through the wheel well. The fact that none of the witnesses noted any irregularity in the operation of the left engine indicates that the fuel pump out-line was not completely consumed until approximately the time of failure of the wing.

Considerable attention was given by the Board to the difficulty encountered with the vacuum pump in the left engine prior to the arrival of Flight 16B in New York. However, it became readily apparent that it bore no direct relation to the fire in question. Discussion was entertained concerning the possibility of the fuel line having been damaged during the installation of a new hose connection at La Guardia Field; however, no evidence of such an occurrence was discovered.

Although the aircraft and the power plant involved were subjected to exhaustive investigation by the Board, no reason for failure of the fuel

line in question has been disclosed. It is significant, however, that the line eventually became totally consumed by fire in flight and it is apparent that the danger of such a condition contributing to the severity of a fire hazard may be obviated by the use of materials of greater fire resistance.

It is not known at what time the pilots became aware of the fire or if they were aware of its presence at all before the left wing failed. No action apparent to observers had been taken by the flight crew in extinguishing or in any manner controlling the effects of the fire. The aircraft continued in straight and level flight almost until the moment the left wing failed and no discernible descent was established prior to that moment. No evidence was disclosed that the engine fire extinguishers had been used in flight. The fact that both engines appeared to be operating normally until the wing failed indicates that no attempt was made to cut off the fuel flow, feather the propeller or in any other manner stop the left engine. All evidence indicates that fire was of such intensity and of such short duration that even if the pilots had been aware of its existence their efforts to control it undoubtedly would have been ineffective. It is obvious that, under the circumstances of the fire in question, the flight crew could not afford the loss of a single second in initiating emergency procedures. Since the aircraft was not equipped with fire detection apparatus and since the engines are so located with respect to the cockpit that they would not normally be within the line of the pilots' vision, it would, under otherwise normal circumstances, have necessitated communication from someone in the cabin before action could have been taken. It is readily apparent that an automatic fire detection

Would have assured an immediate warning of the presence of fire and avoided the loss of valuable time in such an instance.

Findings

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

1. The air carrier, its aircraft and crew were properly certificated for the flight.
2. Until observed in the vicinity of Cheshire, Connecticut, the flight had been of a routine nature.
3. Failure of a fuel line or fuel line connection in the vicinity of the left engine fuel pump caused leakage of gasoline in the left engine nacelle.
4. Gasoline ignited in flight burning through the engine nacelle and weakening the left wing structure.
5. The left wing failed in tension of the lower skin and main spar flange causing the wing to collapse upward and backward rendering the aircraft uncontrollable.
6. The aircraft fell to the ground in a diving spiral and burned upon impact.

Probable Cause

The Board determines that the probable cause of this accident was failure of the left wing in flight due to an engine fire caused by failure of a fuel line or fuel line connection.

BY THE CIVIL AERONAUTICS BOARD:

/s/ James M. Landis

/s/ Oswald Ryan

/s/ Harilee Branch

/s/ Josh Lee

/s/ Clarence M. Young

APPENDIX

As the result of the investigation of this and other accidents, both prior to and subsequent to this one, the Board has, after months of study and coordination with the parties concerned on the part of the Safety Bureau, promulgated additional fire prevention regulations effective September 20, 1946, which amend Civil Air Regulations Part 04 with respect to airworthiness and which also amend those Parts of the Civil Air Regulations governing operations, namely; Parts 41, 42, and 61 to require retro-active incorporation of the changes in transport aircraft now engaged in passenger service. Briefly, these new regulations require that the following features be provided in the aforesaid aircraft which are powered with one or more engines rated at 600 h.p. or over:

- (a) Powerplant Installation: Fire-resistant flexible lines with factory-fixed ends are required for all lines which carry combustible fluids or gasses under pressure through or forward of the firewall and which are subject to relative motion between components of the powerplant installation. Firewalls are required to be fireproofed and shall not permit the passage of any hazardous quantity of heat or flame. Shut-off means are required for all lines which carry combustible fluids into the engine compartments, so that no hazardous quantity of such combustible fluids will drain into the engine compartments forward of the firewall after emergency shut-off has been accomplished. Approved fire-detection systems and approved built-in fire extinguishers are required for all engine installations. Similar requirements hold for any installations where combustible fluids are ignited, such as combustion heaters, auxiliary powerplants, etc.

- (b) Passenger and Crew Compartments: All coverings, linings, upholstery, carpets, etc., in the passenger and crew compartments are to be for the most part of flame-resistant materials but in all other cases of flash-resistant materials. All receptacles for waste material are to be of fire-resistant materials and provided with covers to smother any fire which may originate within. Ample hand fire extinguishers are to be placed at accessible points. Improved ashtrays from the fire prevention point of view are required.

- (c) Cargo and Baggage Compartments: Unless cargo and baggage compartments are visible to a member of the airplane crew while he is at his duty station, fire-detector systems are to be installed; unless all parts of any cargo or baggage compartments are completely accessible to a member of the crew in flight, built-in fire-extinguishing systems are to be installed in each such compartment along with the fire-detector system.
- (d) Hydraulic Fluid: Although non-inflammable hydraulic fluids are not yet available in sufficient quantities to require their use in transport aircraft, their availability in the not too distant future is considered reasonably sure. At such time the requirement will be promulgated calling for its use in all transport aircraft, replacing present inflammable fluids.

SUPPLEMENTAL DATA

Investigation and Hearing

The Civil Aeronautics Board received notification of the accident at 1204, January 18, 1946, and immediately initiated an investigation in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. Air Safety Investigators of the Board's New York office arrived at the scene of the accident 1430, the same day, and were later assisted in the investigation by other members of the Safety Bureau staff.

Air Carrier

Eastern Air Lines, Inc., a Delaware corporation with headquarters in New York City, was operating as an air carrier under a certificate of public convenience and necessity and an air carrier operating certificate, both issued pursuant to the Civil Aeronautics Act of 1938, as amended. These certificates authorized the corporation to fly persons, property and mail between various points in the United States, including New York, N. Y., and Boston, Mass.

Flight Personnel

Captain Raymond E. Kuser, age 38, of Trenton, New Jersey, was pilot of the aircraft, and had accumulated a total flying time of 7826 hours of which 3226 hours were obtained in DC-3 equipment. Robert S. Knight, age 24, of New York, N. Y., was copilot of the aircraft and had accumulated 2252 hours flying time of which 492 hours were as second pilot in DC-3 equipment. W. F. Bassett, of New York, N. Y., was Flight Attendant. Both pilots were properly certificated for the flight and the captain was qualified over the route.

Aircraft

NC 19970 was a Douglas DC-3 manufactured in October of 1940 and sold directly to Eastern Air Lines. At the time of the accident it had accumulated a total of 22,028 hours, of which 6,557 hours were obtained since the last major overhaul. It was equipped with two Wright 6-202A with Hamilton Standard propellers. The total times logged for the left and right engines respectively, were 14,404 hours and 3,955 hours, both having operated 43 hours since the last major overhaul. At the time of departure from New York, the total weight of the aircraft was less than the allowable maximum gross and the center of gravity was within approved limits.