

CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted: May 28, 1956

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PAN AMERICAN WORLD AIRWAYS, INC., DOUGLAS DC-7B, N 776PA,
NEAR VENICE, ITALY, DECEMBER 28, 1955

The Accident

A Pan American World Airways DC-7B, N 776PA, lost No. 3 powerplant because of engine fire while in flight near Venice, Italy, on December 28, 1955, about 1930.^{1/} The aircraft returned to Rome, its last point of departure, and landed without further difficulty. The 42 passengers and six crew members were not injured.

History of the Flight

Pan American World Airways Flight 65 of December 28, 1955, originated at Teheran, Iran, for New York, New York, with several stops scheduled including Rome, Italy, and Brussels, Belgium. (Brussels was a temporary replacement stop for Paris, France.) The flight segments from Teheran to Rome were routine. Flight 65 departed Rome at 1818 on an IFR (Instrument Flight Rules) flight plan to Brussels which specified a cruising altitude of 19,000 feet. The crew of six consisted of Captain A. D. Reedy, First Officer W. J. Box, Third Officer J. B. Sorenson, Flight Engineer L. C. Thayer, Purser Miss Artha Gruhl, and Stewardess Miss Eva Fredin. A navigator (second officer) was not required or carried on the flight. Cruising altitude was reached without incident at 1842 and the flight proceeded in clear weather.

At 1912 No. 3 engine and propeller oversped and the tachometer needle swung rapidly past the highest calibration, 3,200 r. p. m., to full deflection, where it remained. The captain immediately reduced power on all engines, then disengaged the auto-pilot, and the flight engineer attempted to feather the No. 3 propeller, without success. At the same time the copilot noticed a momentary flicker of the fire warning light for the power section of No. 3 engine. Airspeed was reduced from 200 knots to 140 knots and descent was started. The first officer, who had been in the cabin, came forward and reported a fire in No. 3 engine. As No. 3 propeller was windmilling at a high speed, an attempt was made to "freeze" the engine by shutting off its oil supply. Accordingly, the firewall shutoff valves were closed. One bank of CO₂ was discharged which reduced the intensity of the fire but did not extinguish it. The second bank of CO₂ was temporarily held in reserve. During these actions the flight engineer was intermittently depressing the feathering button. The discharge indication on the ammeter showed the feathering motor to be operating but the propeller did not feather and continued to windmill as

^{1/} All times referred to herein are Greenwich mean; altitudes are mean sea level.

before. Fire warnings were still lacking in the cockpit with the exception of the momentary flicker immediately following the overspeeding.

Zone 2 and zone 3 fire warnings from No. 3 engine then appeared. This was followed by increased fire at the No. 3 engine area, whereupon the second bank of CO₂ was discharged to that engine. The red warning lights and aural alarm still operated after this second use of CO₂. About this time the flight engineer noticed an intense white fire through a rupture in the cowl near the air scoop of No. 3 nacelle.

The beach and flat shores of the Adriatic Sea near Venice, Italy, were visible in the moonlight from the flight's altitude of 5,000 feet. It was decided to make an emergency landing on or near the beach and Rome radio was so advised. The aircraft descended to 500 feet and, at this altitude, after a series of bright flashes and severe vibration, the burning No. 3 engine fell free of the aircraft. The aircraft then went below 500 feet and severe buffeting occurred with the airspeed dropping abruptly to about 90 knots. Power was applied to the remaining three engines and an airspeed of 140 knots and a climb of 150 feet per minute were soon established.

A visual inspection revealed the fire to be extinguished with no apparent damage to the wing; the use of 10 to 15 degrees of wing flap reduced the existing buffeting. A further check indicated that the aircraft was capable of continuing flight and Rome was advised of their intention to return. The aircraft was then climbed to a cruising altitude of 7,000 feet and the flight proceeded to Rome, where it landed at 2040.

Weather conditions were clear throughout the area that was flown by Flight 65.

Investigation

A shepherd observed the still burning engine on the ground near Venice and notified State Police, who guarded the engine and propeller until arrival of PAWA personnel. After photographs were taken these components were trucked to Rome for examination and subsequent shipment to PAWA's maintenance base at New York.

The propeller governor had not been damaged by fire and after an initial examination this component was flown to the United States. At the Hamilton Standard factory it was disassembled under the supervision of Board investigators.

Disassembly of this governor, model 5U18-66P3, serial No. 76400, revealed a fatigue type failure of the governor drive shaft, part No. 67035U. Initial failure extended through the web between two of the high pitch oil ports with resulting failure occurring to the drive shaft through the remaining webs. The fracture line passed through one or more quench cracks at the port webs. Total time on the shaft was 407 hours when the failure occurred. Examination of the remainder of the governor revealed that broken parts of the shaft had blocked oil ports which effectively prevented leathering of the propeller.

A review of past governor drive shaft failures of this type revealed four others that occurred during October and December 1955. All of these were

in the same type engines and DC-7B's. Further, all were similar in that a fatigue failure occurred at the corners of the rectangular high pitch ports in the shaft. Total times on all of the failed shafts were between 375 and 592 hours.

As a result of these failures Hamilton Standard had revised its heat-treating procedures to reduce quench cracking. All governor drive shafts in service were returned for replacement with those having the improved heat-treatment. The letter "U" after the part number (67035) on the drive shaft involved in this accident indicates that this replacement had been accomplished.

In November 1955 all DC-7B operators were advised by the propeller manufacturer that as a result of the failures a program was being initiated to replace all governor drive shafts bearing the part number 67035 with a new shaft, part number 321822. This new drive shaft incorporates elliptical high and low pitch ports in place of the rectangular ports, thereby eliminating stress concentrations in the corners. All PAWA DC-7B8s are currently being equipped with the 321822 drive shaft and an r. p. m. sensitive hydraulic pitch lock^{2/} in the dome assembly. This replacement program was established by the manufacturer with priority given to governors having less than 1,000 hours. Those with over 1,000 hours of use were considered to be airworthy.

On January 16, 1956, the Civil Aeronautics Administration issued Airworthiness Directive 56-2-2 making mandatory the replacement of propeller governor drive shaft 67035 with governor drive shaft 321822 on all DC-7 aircraft.

The manufacturer is producing a newly designed drive shaft which increases the web strength between the ports by 50 percent. The new shaft, part number 321841, has four oval ports at the high and low pitch positions, thereby increasing the web size between the ports.

An examination of the No. 3 engine at New York indicated that its operation, prior to the shaft failure, had no bearing upon the difficulties encountered by Flight 65. The examination also indicated that as a result of over-speeding the engine impeller assembly failed and damaged the rear engine case to an extent that the fuel injection lines in the case were broken. This undoubtedly allowed fuel to escape, resulting in severe fire. There was no apparent maloperation of No. 3 engine prior to the drive shaft failure.

Analysis

The engine impeller assembly must have disintegrated centrifugally, throwing metal particles outwardly through the cowling through which was seen the intense white fire; this failure also accounted for the severed fuel lines that provided a source of fuel for the fire.

The reason for the failure of the fire warning system to function properly could not be determined because of damage to the system during the fire and the tearing away of the engine and propeller. However, in this case

^{2/} A device to prevent blade movement toward low pitch if the r. p. m. reaches a preset valve.

there was no delay in applying emergency measures because of alertness of the crew member in the cabin at the time of the overspeeding.

It is very apparent that a serious accident was barely averted. Had the flight reached higher terrain on course a descent, as made, would not have been possible. Alertness and good judgment, under extreme emergency, are strongly reflected in the crew's conduct.

Findings

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

1. The company, the aircraft, and the crew were currently certificated.
2. The gross weight of the aircraft at takeoff was under the maximum allowable.
3. The governor drive shaft of No. 3 propeller failed in flight causing the engine and propeller to overspeed.
4. No. 3 propeller could not be feathered because broken fragments of the drive shaft blocked oil ports of the feathering system.
5. High-speed windmilling continued and the engine impeller failed centrifugally, severing fuel injection lines and oil passages; a severe engine fire ensued.
6. The fire could not be extinguished and the engine and propeller fell free.

Probable Cause

The Board determines that the probable cause of this accident was failure of No. 3 propeller governor drive shaft which resulted in over-speeding, inability to feather the propeller, an engine failure, fire, and inflight loss of the No. 3 powerplant.

BY THE CIVIL AERONAUTICS BOARD:

/s/ JAMES R. MURFEE

/s/ JOSEPH P. ADAMS

/s/ CHAN GURNEY

/s/ HARMAR D. DENNY

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

Investigation

The Civil Aeronautics Board was notified of the accident on December 28, 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.

Air Carrier

Pan American World Airways, Inc., is a New York corporation with its main offices in New York, New York, as are headquarters for its Atlantic Division. The corporation operates as an air carrier under a certificate of public convenience and necessity issued by the Civil Aeronautics Board, and an air carrier operating certificate issued by the Civil Aeronautics Administration. These certificates authorize the carrier to engage in air transportation between various points in the United States and foreign countries, including the route involved in this instance.

Flight Personnel

Captain A. D. Reedy, age 43, held a valid airman certificate with an airline transport rating and DC-7, B-377, L-49, and 749 equipment ratings. He had a total of 13,972 flying hours, of which 366 hours were in DC-7 aircraft.

First Officer W. J. Box, age 34, held a valid airman certificate with airline transport rating and DC-4, DC-6, and DC-7, and L-49 and B-377 equipment ratings. He had a total of 11,704 flying hours, of which 307 hours were in DC-7 aircraft.

Third Officer J. B. Sorenson, age 24, held a valid airman certificate with commercial pilot, single- and multi-engine land and instrument ratings. He had, in addition to other time, 29 hours in DC-7 aircraft.

Flight Engineer L. C. Thayer, age 43, held a valid airman certificate with flight engineer, aircraft and engine mechanic ratings. He had 6,952 hours of flying time, of which 311 hours were in DC-7 aircraft.

Miss Artha Gruhl was employed by the carrier on July 20, 1953. She was acting in the capacity of purser on the flight.

Miss Eva Fredin was employed by the carrier on October 3, 1955, and was acting in the capacity of stewardess on Flight 65.

The Aircraft

Douglas DC-7B, N 776PA, manufacturer's serial No. 44870, was delivered to Pan American World Airways on August 19, 1955. Total flying time since manufacture was 1,224 hours. The aircraft was powered by four Wright model TC97218DA4 engines. Time since overhaul on Nos. 1, 3, and 4 engines was approximately 200 hours each; No. 2 engine had 306 hours since new. The aircraft had Hamilton Standard model 34E60 propellers with total time on Nos. 1, 3, and 4, of 1,224 hours each with 806 hours on No. 2.