

## CIVIL AERONAUTICS BOARD

## ACCIDENT INVESTIGATION REPORT

Adopted: June 18, 1948

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## PAN AMERICAN AIRWAYS, INC.—MAYADINE, SYRIA—JUNE 18, 1947

## The Accident

Pan American Airways Flight 121, a Lockheed Constellation, Model 049, NC-88845, en route from Karachi, India, to Istanbul, Turkey, crashed during a forced landing at night in the desert near Mayadine, Syria, at 2340,<sup>1</sup> June 18, 1947. Seven of the 26 passengers, and 7 of the crew of 10 were fatally injured. The aircraft was destroyed by impact and fire.

## History of the Flight

Flight 121 departed from Karachi at 1537 June 18, 1947, for a return trip to the United States. The climb to the cruising altitude of 18,500 feet was routine, and the flight was proceeding "direct" to Istanbul, the first intended point of landing, estimating its arrival there to be 0208 the next day. Five hours after take-off trouble developed in the No. 1 engine, and the No. 1 propeller was feathered. The captain, J. H. Hart, decided to continue to Istanbul with the use of three engines, however, it soon became evident that at an altitude of 18,500 feet the airspeed obtainable was not sufficient to provide adequate cooling for the engines, even though climb power was applied. Power was accordingly reduced and altitude was gradually lost. At 17,500 feet the engines still overheated and the descent was continued to 10,000 feet.

At 2140, approximately one hour after the failure of engine No. 1, the flight advised its company radio in Karachi of the engine trouble, following which it reported its 2200 position. This report placed the aircraft at 14,000 feet, 50 miles east of Bagdad, Iraq, and 90 miles east of the Royal Air Force Field at

Habbaniya, Iraq. Shortly after this report Habbaniya Tower was advised by the flight that its approximate position was over Bagdad at an altitude of 10,000 feet, and the flight requested Habbaniya Tower to inform the civilian airfields in their area that the aircraft was proceeding with the use of only three engines to Istanbul. Habbaniya Tower replied, stating that no airfields would be open until dawn, and suggested that an emergency landing be made at Habbaniya. Flight 121, however, affirmed its intention to continue, and added that if it were impossible to reach Istanbul, a landing would be made at Damascus, Syria. Habbaniya Tower answered, at 2225, that all airfields in the Damascus area were closed until 0400 and again suggested that the flight land at Habbaniya. The flight again stated that it would continue to Istanbul, but that it would turn back to Habbaniya if it experienced any more trouble.

Contemporaneous with this communication to Habbaniya Tower the flight sent a message, received in Karachi, and relayed to Damascus, requesting that Damascus Radio be alerted to stand by, and that the airport be opened. At 2308, June 18, Damascus Radio was on the air, and the field was opened as had been requested.

At approximately 2300 the flight reported its position to be 75 miles northwest of Habbaniya at 10,000 feet. Fifteen to thirty minutes later the purser seated in the passenger cabin noticed that the "fasten seat belt—no smoking" sign had come on, and he immediately started to awaken the passengers so that they might fasten themselves in their seats. Suddenly, the entire cabin became illuminated from a fire which had started in Zone 1 of the No. 2 engine nacelle. A report of this fire was received at 2330, by the Habbaniya direction finding station, at which time the

<sup>1</sup>All times referred to in this report are Greenwich Meridian Time and based on the 24-hour clock. (Time of the accident, Mayadine, Syria, local time 1 40 a m June 19)

flight was reporting a position of 34 38 degrees north and 41 05 degrees east, a point 170 statute miles northwest of Habbaniya, and 290 miles northeast of Damascus. Immediately after the fire started in engine No. 2 a rapid descent was made for the purpose of crash landing the aircraft, and six to seven minutes later on the landing approach the No. 2 engine fell from the aircraft. The wing in the area of the No. 2 engine, however, continued to burn intensely. Less than a minute after the No. 2 engine fell from the aircraft a wheels-up landing was made on relatively smooth, hard-packed desert sand.

The left wing tip made the first contact with the ground, then the No. 1 propeller, and then the left wing at the No. 2 engine position. The impact tore the left wing from the fuselage near its root, and caused the aircraft to ground loop violently to the left. During the course of the ground loop the aircraft turned around its longitudinal axis 180 degrees, skidded backwards for a distance of 210 feet, then came to rest in flames 400 feet from the first point of impact, and headed opposite to its course of landing.

## Investigation

With the exception of the empennage and parts of the wing, the aircraft structure was largely destroyed by fire. At the trailing edge of the wing the fuselage was broken in two, and approximately 200 feet from the main body of the wreckage, the left wing was located on the landing path of the aircraft. The left main landing gear had been torn from its mounting, however, the right main landing gear and the nose wheel, though burned, were found in the retracted position. The position of the trim tabs could not be determined. Flaps were in the 50 percent down position and the landing lights were found to have been extended.

No difficulty was reported with engines 3 and 4, accordingly no detailed examination was made of these engines. Engine No. 1 was examined at the scene of the accident, and it was found that the exhaust rocker arm for the No. 18 cylinder had broken as a result of fatigue. It was this break that caused the unsatisfactory operation of the engine.

The No. 2 engine was located one mile back of the wreckage on the flight path

Part of the nacelle had broken free from the engine and was located a short distance away. An examination of the engine and nacelle showed that severe fire had extended from Zone 1 through Zones 2 and 3, and that the most intense area of burning had been along the upper inboard side of the nacelle. It was impossible to determine the cause of either the fire or the failure of this engine at the scene of the accident. Consequently, the No. 2 engine was returned to the United States where the necessary facilities were available for detailed examination.

A considerable amount of both the aircraft structure and the engines was carried away by native souvenir hunters before the aircraft could be satisfactorily placed under guard, and many parts of engine No. 2 were not recovered. However, the nose and power sections of the engine with all cylinders attached were returned to the United States. A complete teardown of these engine sections was then accomplished.

It was found that the thrust bearing assembly was almost entirely destroyed, and was marked with signs of excessive frictional heat. The ball bearings and roller bearings with their retainers and races were badly mutilated. The oil seal rings for the governor oil passage were found normal except that they also showed signs of heat. The oil transfer ring sleeve for the propeller control oil passage was found normal except that the oil seal rings had worn marks over the openings of the oil transfer passages.

The No. 18 exhaust cam follower roller was found to be worn flat on its circumference to the extent of being 1/8" below original contour. With the exceptions of the Nos. 8, 10, 12, and 14 cylinders, all cylinders showed considerable fire damage with major damage being concentrated in the area of cylinders Nos. 1, 3, 5, and 18. All piston heads showed signs of striking the exhaust and intake valves.

A considerable amount of internal damage was found in the propeller reduction gear assembly, and the power section. As indicated above, the accessory section for this engine was not recovered from the scene of the accident for detailed examination.

The No. 2 engine, a Wright 745C18BD3 engine, Serial No. 60336, had a total of 1,588 hours since new, and 609 hours since its last overhaul. During the

course of the eastbound flight from LaGuardia Field, New York, to Gander, Newfoundland, the flight engineer observed a drop of 10 BMEP<sup>2</sup> in this engine, and so the No 2 propeller was feathered. After landing at Gander, the spark plugs for the No. 18 cylinder were changed, and the oil sump plug was examined and found to be free of any foreign matter. The flight then departed for Santa Maria, Azores, and London, England. Again a drop in BMEP on the No 2 engine was noted, so the flight returned to Gander. A piston ring failure was discovered which was corrected by replacing the No. 18 cylinder and piston assembly. When the flight arrived at Istanbul, the flight engineer reported that the No 2 engine was again giving trouble, this time reading 15 BMEP low at rated power. An examination of the engine disclosed that the left magneto breaker points were closed. They were regapped, and the engine then operated normally. No further malfunction of this engine was experienced so far as is known until the fire was observed in the No 2 engine on the return flight to the United States.

No evidence was found in the examination of the propellers which would indicate other than normal operation.

### Discussion

So far as is known, the difficulty experienced with the No 2 engine at Gander and Istanbul was not associated with the fire. When the piston ring failure in the No 18 cylinder was discovered at Gander, the cylinder and piston assembly was replaced. An examination of the oil sump plug gave no indication of any internal damage, and no further trouble was at that time experienced in the operation of that engine. It would appear, therefore, that all required maintenance had been performed, and that no reason existed to anticipate any further difficulty. At Istanbul closed breaker points were found in the left magneto for the No 2 engine, which accounted for the loss of power developed by the No 2 engine prior to the flight's arrival there. When the breaker points were regapped the engine operated normally, and again no reason existed to anticipate further engine trouble. Therefore, none of the

known events occurring during the course of the flight provided any reason from which the crew could have expected other than normal operation of engine No. 2.

The extensive damage found in the thrust bearing for the No. 2 engine clearly indicated that this failure preceded the fire. So extensive was the damage to the propeller shaft that proper alignment was impossible. However, it has not been possible to determine over how long a period of time this failure progressed, but it is highly probable that the crew became aware of vibration and erratic engine speed sometime prior to the time that the fire occurred.

The fire in Zone 1 of the No 2 engine was intense and sustained. The only possible source of fuel to support such a fire was engine oil. This oil could have been fed to the fire either through the main engine case or its attached cylinders, or through a rupture in the propeller feathering line or fitting. No break was found in the engine case or its attached cylinders.

The markings of the oil seal rings found on the oil transfer sleeve showed that the oil seal rings had moved forward as a result of the thrust bearing failure, and that they effectively restricted the oil transfer holes to the extent of covering approximately 7/8s of the openings. Such a restriction would have resulted in excessively high oil pressure in the feathering line had any attempt been made to feather the propeller.

An attempt to feather the No 2 propeller was in all probability made. The flattened exhaust valve cam follower roller in itself might have accounted for an erratic BMEP reading. An erratic power output in conjunction with the known progressive failure of the thrust bearing would have resulted in a fluctuating engine speed, and considerable vibration. Such a condition, possibly becoming progressively more intense, would certainly have been ample reason for attempting to feather the No. 2 propeller.

As stated above, the oil seal rings during the course of failure of the thrust bearing moved forward and effectively sealed the openings in the oil transfer sleeve, thereby blocking the passage of oil from the feathering pump into the propeller dome. It is highly possible that a surge of excessively high

<sup>2</sup> Brake Mean Effective Pressure =  $\frac{782,000 \times \text{brake horsepower}}{\text{Displacement} \times \text{Revolutions per Minute}}$  lb/sq in

oil pressure in an oil line which was being subjected to severe engine vibration may have been sufficient to cause a rupture either in the line itself or at a fitting. Had such an event occurred, a large volume of atomized engine oil, highly inflammable, would have been sprayed on the front exhaust collector ring which would have most certainly resulted in the fire which was experienced in this case. This theory of engine fire is supported by the fact that the cylinders and engine cowling in the immediate vicinity of the propeller feathering line showed the most intensive fire damage, and furthermore, no break was found in the wells of any cylinders or in the main case from which the oil could have escaped from the engine.

High engine operation temperatures may have contributed to the failure of the No. 2 engine thrust bearing. However, under the known conditions of flight, high engine operation temperatures would be normally expected and would not in themselves be any special reason for alarm or anticipation of further engine trouble. The decisions made by the pilot in this case were consistent with known test and operational data for the engines in the aircraft, and he could have reasonably expected after descending to a lower altitude that there would be sufficient cooling for normal temperatures of the three operating engines.

Had the crew experienced difficulty with engine No. 2 other than high temperatures, certainly a landing should have been effected at the nearest available field. However, it is not known over how long a period of time the progression of failure of the No. 2 engine thrust bearing was extended. If this period of time was short, the crew may have had little warning, and no opportunity to anticipate the loss of that engine. Accordingly, no criticism can be made of the decisions that were made in this instance.

### Findings

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

1. The aircraft, the carrier, and the crew were properly certificated.
2. At the time of departure from Karachi, India, the total weight of the aircraft was less than the maximum allowable, and the load was properly distributed with respect to the center of gravity.
3. Approximately 5 hours after take-off from Karachi, and while cruising at an altitude of 18,500 feet to Istanbul, Turkey, the No. 18 exhaust rocker arm on the No. 1 engine broke as a result of fatigue, and the No. 1 propeller was feathered.
4. The aircraft continued toward Istanbul, descending to 10,000 feet in order to provide adequate cooling for the three operating engines.
5. Approximately 3 hours after the loss of the No. 1 engine the thrust bearing for the No. 2 engine failed, which resulted in blocking the passage of oil from the propeller feathering motor to the propeller dome.
6. Subsequent to the failure of the No. 2 engine thrust bearing, engine oil caught fire in the upper inboard region of Zone 1 of that engine and extended through Zones 2 and 3.
7. Before an emergency landing could be effected the No. 2 engine dropped from the aircraft and the fire continued in the wing panel.
8. The aircraft landed on hard-packed desert sand, ground looped violently, and came to rest in flames.

### Probable Cause

The Board determines that the probable cause of this accident was a fire which resulted from an attempt to feather the No. 2 propeller after the failure of the No. 2 engine thrust bearing.

BY THE CIVIL AERONAUTICS BOARD

/s/ JOSEPH J O'CONNELL, JR

/s/ OSWALD RYAN

/s/ JOSH LEE

/s/ HAROLD A JONES

Adams, Member, did not participate.

# Supplemental Data

## Investigation and Hearing

The Civil Aeronautics Board was notified of the accident during the morning of June 19, 1947, and an investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. An accident investigator was ordered to proceed immediately and he arrived at the scene of the accident June 23. He was assisted in the foreign phase of the investigation by Civil Aeronautics Administration, Pan American Airways, Lockheed Aircraft Corporation, and Wright Aeronautical Corporation personnel. The subsequent domestic phase of the investigation was conducted in New York, New York, with the assistance of other personnel of the Safety Bureau staff. A public hearing was ordered by the Board and was held in New York City, August 5, 6, and 7, 1947.

## Air Carrier

Pan American Airways is incorporated under the laws of the State of New York and has established its headquarters in New York City. Pan American Airways was operating under a currently effective certificate of public convenience and necessity and an air carrier operating certificate issued pursuant to the provisions of the Civil Aeronautics Act of 1938, as amended. These certificates authorized Pan American Airways to engage in the transport of persons, property, and mail between various points in the United States and abroad, including the route between Karachi, India, and Istanbul, Turkey.

## Flight Personnel

Captain Joseph Hall Hart, age 40, of Greenwich, Connecticut, was pilot of the aircraft at the time of the accident, and possessed a currently effective airline transport pilot rating. Until the date of the accident, he had accumulated a total of 12,768 hours flying time, of which 1,009 were obtained in Model 049 aircraft. First Officer Robert Stanley McCoy, age 25, of Flushing, Long Island, New York, was co-pilot of the aircraft at the time of the accident and possessed a currently effective airline transport pilot rating. He had accumulated a total of 3,178 hours, of which 674 had been in Model 049 aircraft. Both pilots were properly certificated and the captain was qualified over the route. Robert B. Donnelly, age 33, Bayside, Long Island, New York, was flight engineer and held an A & E and Flight Engineer's Certificate. He had accumulated a total of 799 hours as Flight Engineer on Constellation equipment.

## The Aircraft

NC-88845, a Lockheed Constellation, Model 049, had been operated a total of 2,645 hours since original manufacture. It was equipped with four Wright 745C18BD3 engines, with Hamilton Standard propellers installed. The Nos. 1, 2, 3, and 4 engines had been operated a total of 1,601 hours, 1,547 hours, 1,078 hours, and 1,734 hours, respectively, and all engines had accumulated 251 hours, 568 hours, 601 hours, and 241 hours, respectively, since the last major overhaul. At the time of departure from Karachi, the total weight of the aircraft was 187 pounds less than the maximum allowable, and the load was distributed with respect to the center of gravity within approved limits.