

## CIVIL AERONAUTICS BOARD

**ACCIDENT INVESTIGATION REPORT**

Adopted: April 30, 1956

Released: May 3, 1956

PENINSULAR AIR TRANSPORT, DOUGLAS C-54-DC, N 88852,  
SEATTLE, WASHINGTON, NOVEMBER 17, 1955

The Accident

At approximately midnight,<sup>1/</sup> November 17, 1955, a Douglas C-54-DC, N 88852, operated by Peninsular Air Transport, crashed in a residential area of Seattle, Washington. The accident occurred immediately following takeoff from Boeing Field. Of 74 persons aboard, 28, including a third pilot, were fatally injured. The remaining 46, including other crew members, received injuries of varying degree. Although there were no injuries to persons on the ground, the accident caused substantial property damage. The major portion of the aircraft was destroyed by impact and fire.

History of the Flight

Peninsular Air Transport Common Carriage Flight 17K was scheduled to originate at Boeing Field and terminate at Newark, New Jersey, with intermediate refueling stops. The assigned crew consisted of Captain W. J. McDougall, First Officer F. C. Hall, and Steward J. O. Adams. The third pilot, Edward McGrath, deadheading to Miami, Florida, occupied the jump seat with no crew duties. The flight, scheduled to depart at 2030, was delayed because of a heavy snowfall during the afternoon and early evening of November 17 which delayed passenger arrivals and necessitated removal of snow from the aircraft before departure.

At 2332 the flight taxied to runway 13, holding off the runway waiting its turn behind other flights to take off. During this time the crew completed pretakeoff checks and received an IFR (Instrument Flight Rules) clearance. This, in part, instructed them to turn right after takeoff and climb on the northwest course of the Seattle Range to 5,000 feet m. s. l. (mean sea level).

The takeoff was started at 2358 and appeared normal as the landing gear retracted and right turn was begun. When approximately 300-400 feet above the ground the first reduction of power, from takeoff to normal rated power, was made and about five of the 15 degrees of flaps extended, were retracted. At this time the No. 4 propeller surged and engine r. p. m. increased to about 2,800. Unable to reduce the r. p. m. of No. 4 by reducing its power an attempt was made to feather the propeller; this also was unsuccessful. As the aircraft then began to descend takeoff power was reapplied to Nos. 1, 2, and 3 engines and the power from No. 4 was further reduced. This action did not reduce the r. p. m. of No. 4 which surged again and increased to more than 3,000. The aircraft veered to the right and continued to descend. Realizing that a

<sup>1/</sup> All times herein are Pacific standard and are based on the 24-hour clock.

crash-landing was imminent Captain McDougall reduced the airspeed until the aircraft was nearly stalled and applied full power to all four engines. The aircraft continued to settle. It then struck a telephone pole and several trees before crash-landing in a nose-high attitude.

Fire and rescue equipment was dispatched to the scene from both the Seattle Fire Department and the Seattle-Tacoma Airport. The units arrived promptly and gave first aid to the survivors. Fire which followed the crash was quickly extinguished but not before extensive property was burned and the aircraft was nearly consumed.

### Investigation

The accident scene was located approximately 2-1/2 miles from and 300 feet higher than the takeoff position of the flight. Evidence showed the aircraft was banked to the right when it initially struck the telephone pole with its right wing and horizontal stabilizer. Continuing along the impact heading of 210 degrees it came to rest approximately 650 feet beyond the pole. Along this path the aircraft struck several buildings, trees, and another pole, causing separation of both wings and tail and severe damage to the fuselage. The fire which broke out after final impact consumed major portions of the structure. Examination of the remaining portions of the wings, fuselage, and tail disclosed no evidence that indicated structural failure or malfunction prior to impact. Both pilots stated they had experienced no difficulty except that associated with the No. 4 engine and propeller.

The four powerplants, including their accessories, were located within a relatively small area. Each had been separated from its mount and its nose case torn off. All had been exposed to the resultant fire which consumed their rear magnesium cases. The propellers were found attached to their respective propeller shafts and Nos. 1 and 4 were not damaged by fire. Teardown inspection of Nos. 1, 2, and 3 engines and propellers disclosed no evidence to indicate they were factors in the accident.

The No. 4 propeller, attached to the engine nose section, was located about 25 feet from the main wreckage. There was oil covering its barrel, the face side of all propeller blades, and the engine nose section. Examination disclosed that the propeller dome retaining nut protruded approximately one-eighth of an inch above the barrel dome bore and the safety cap screw was pressed against the corner of its safetying recess. The lock screw was safetied. The screw was removed and its examination showed no evidence of bending or mutilation. After the nut and barrel were marked to show their original positions a check was made for tightness. The result showed the nut could be moved with comparative ease with a small drift and hammer for at least 4-1/2 inches in the tightening direction. The nut was then unscrewed and the dome removed to check the propeller blade pitch settings as indicated by the cam gear position. This revealed the cam gear lug was against the low pitch stop, or the normal low pitch blade angle setting. The blade segment gears were marked to show their positions in relationship to each other and to the cam gear. The propeller assembly was then further disassembled and examined after which it was removed from the accident scene for continued examination and testing.

Examination was directed to ascertain the individual blade angle settings. This disclosed that all of the eight spring packs which retain the segment gears, with their respective blades, were mutilated and displaced such that this retention was destroyed. Each of the segment gears was fractured at one of the spring pack recesses. This permitted free rotation of the blades about their longitudinal axis; however, the cam gear prevented any movement of the segment gears, enabling the investigators to determine the individual blade position at impact. Examination showed that the fifth valley from the low pitch end of the segment gears was lined up with the center etched line on the barrel bore for the Nos. 1 and 2 blades. The No. 3 blade segment gear, however, had the sixth valley lined up with the etched mark. This showed that the Nos. 1 and 2 blades were positioned one segment gear tooth less, or eight degrees less, than the No. 3 blade. Compared to the low pitch stop the No. 3 blade was positioned at 24 degrees, the normal position, while Nos. 1 and 2 blades were at 16 degrees, eight degrees less than the normal position.

To determine the possibility of oil leakage and, if existent, the amount of leakage from the loose dome assembly, the propeller was reassembled using replacement parts only where necessary; the dome and barrel assembly from the original propeller were used. The exact dome looseness was duplicated on a propeller test stand and oil was pumped into the propeller assembly at various pressures. The tests revealed that there was oil leakage at all pressures and that the maximum oil pressure obtainable was 200 p. s. i. (pounds per square inch), because of an 18-quarts per minute oil leakage past the loose dome. At this time the pump was operating under test conditions which would normally produce about 600 p. s. i. The test further showed the oil supply of the engine would rapidly be exhausted. (Oil capacity per engine is 20 gallons.)

The No. 4 engine was examined in detail. This revealed that the rear master rod bearing was in the process of failure. It also showed the front master rod bearing was beginning to fail. Examination of the bearing failures showed they were characteristic of those associated with oil starvation. Neither, however, had progressed to the extent that it would be expected to appreciably affect the operation of the engine or its power capability. The engine examination disclosed no other evidence of malfunction or failure.

According to company witnesses and records, the No. 4 propeller had been overhauled September 7, 1955, and thereafter installed on another company DC-4. On November 11, 1955, it was removed as a result of a pilot roughness complaint applying to it or the No. 4 engine. The propeller was examined, repaired, and tested, after which it was installed by Peninsular maintenance personnel on N 88852 in the No. 4 position. Maintenance personnel stated a new propeller dome seal was used during this installation. At the time of the accident the propeller had accumulated 475 hours since the major overhaul and 20 hours since its installation on N 88852.

During a portion of the 20 hours, the aircraft was flown to Kansas City where Captain McDougall took command of the aircraft and continued a military contract flight to McChord Air Force Base, Tacoma, Washington. This flight was uneventful except for a failure of the No. 4 starter solenoid at Billings, Montana. Because there were no adequate repair facilities there to correct this problem the passengers were offloaded and the engine was started by taking off on three engines and airstarting the No. 4 engine. According to the crew, snow on the runway made it inadvisable to start the engine by fast taxi since

it was doubtful if the aircraft could have been stopped safely thereafter on the remaining runway.

After arrival at McChord Air Force Base on November 13, 1955, the aircraft was immediately ferried to Boeing Field where Captain McDougall contacted the Seattle Aircraft Repair, Inc., a repair agency under contract to do certain maintenance for Peninsular, to replace the No. 4 starter solenoid, and to correct several other discrepancies noted and/or written up during the previous flight. Captain McDougall instructed the repair agency to examine the No. 4 engine to be sure it was not damaged in any way by the airstart. The crew noted an accumulation of oil on the right wing in the area of the engines and brought it to the attention of maintenance personnel for corrective action. Without cleaning the oil from the aircraft and running the engines to determine the source of leaking oil, the employees concluded from visual inspection that the leak came from the Nos. 3 and 4 propeller dome seals.

During the public hearing the mechanics and helpers who worked on the aircraft, and particularly on the No. 4 propeller, were called to testify. These witnesses were employed by Seattle Aircraft Repair, some working as part-time employees and others as full-time. In connection with the personnel working on the No. 4 propeller, the helper had recently been employed and the CAA certificated mechanic in charge had not replaced dome seals for three years. Neither employee was familiar with the experience and capability of the other or the prescribed procedure to be followed in correctly replacing the dome seals. These witnesses, through their testimony, showed there was no clear line of responsibility within the company nor were there reference manuals to define their specific work procedures.

Witnesses testified that the work on the No. 4 propeller was done under adverse weather conditions. It was accomplished outside in very cold weather and with considerable snow falling. The two employees who worked on the No. 4 propeller, an A&E mechanic and a helper, said that an accumulation of oil was evident under the right wing and around the propeller dome. The Nos. 3 and 4 domes were removed and, according to testimony, the No. 4 seal was found gouged. New seals were then obtained from the company supply, warmed, and installed in the domes. The mechanic helper said he assisted in placing the No. 4 dome in position, turned the dome retaining nut on a few threads, and left the job to go home. The employee in charge of this work said that with the assistance of his helper he tightened the dome retaining nut with a dome wrench. He further stated that he was satisfied it was tight and that he had replaced and safetied the lock screw. Testimony of the witnesses clearly showed that during the work the propeller was not feathered, as required by good practice, and the positions of the blades were not checked either before the seal was installed or after the work was completed. An inspection of this work was made by an authorized employee but consisted only of a check to see if the lock screw was safetied. It was also learned that neither this engine nor any of the others was run up at any time to determine the adequacy of the maintenance.

While the maintenance work described was in process, a No. 1 inspection was ordered by Peninsular Air Transport officials from Miami. This was completed, according to numerous witnesses; however, the records were apparently destroyed, being aboard the aircraft when it crashed. Company instructions required that one copy of the inspection be mailed to the home office; how-

ever, Captain McDougall did not do this but instead put all the records in the flight log.

Testimony of the flight crew indicated that they arrived at the Boeing Airport about 1900, November 17. They stated that they went to the Seattle Aircraft Repair office and were unable to contact anyone who could inform them concerning the work performed on N 88852, or the readiness of the aircraft for flight. They returned to the terminal thereafter and began preparation for the flight, contacting the weather office and completing other necessary details. Another trip to the repair agency office was made with the same results as the first, after which they again returned to the terminal and found Mr. Aho, Vice President of Seattle Aircraft Repair. According to Captain McDougall and First Officer Hall he informed them that the aircraft was ready for flight and that all the maintenance work had been completed. The captain further stated he received the No. 1 inspection form, the daily flight check form, and the repair forms on the work he had ordered. Although not sure who had told him, Captain McDougall said he was told that the engines had been run up. He further stated that the forms given him indicated the engines had been run up and that the aircraft was signed off as airworthy by Mr. Aho. The crew testified that following this they went to Seattle Aircraft Repair to get their aircraft. They performed a walk-around inspection, noting that the evidence of oil had been cleaned from the No. 4 engine. They started all engines, running them at low r. p. m. for approximately 10-20 minutes until they were warm. The aircraft was then taxied to the terminal for loading.

Mr. Aho testified that the crew did not contact him until after the aircraft had been brought to the terminal. He stated the crew brought the aircraft there without knowledge of whether it was ready and without having the various work forms. The witness indicated that the engines were not run up during the nonroutine maintenance work on the propellers. He added that following the type work accomplished on the No. 4 propeller a runup would normally be required. Following the other work, the daily inspection and No. 1, the runup was not done because of the extremely heavy workload upon his organization. He added that the forms given the crew did not indicate the engines had been run and the subject was not mentioned during any conversation with the Peninsular crew. Mr. Aho said he signed the forms given the crew, indicating the aircraft was airworthy.

Captain McDougall stated that the aircraft was covered with considerable snow and it was necessary to have a crew remove it. The flight crew, several passengers, and personnel who cleaned the aircraft all agreed that it had been thoroughly cleaned before departure.

Records pertaining to planning and load distribution of the flight indicated the flight was correctly and completely planned. They showed the aircraft was loaded to a gross weight of 61,188 pounds; the maximum allowable takeoff weight was 62,000 pounds. According to the records the weight was properly distributed with relation to the center of gravity of the aircraft. There were 1,200 gallons of fuel aboard which was sufficient for the flight in accordance with instrument rules.

The crew and many other competent witnesses stated that weather conditions were substantially as reported by the Weather Bureau - ceiling 1,600 feet broken, 2,300 overcast, visibility 7 miles. The crew said that after the aircraft was cleaned of snow there was no precipitation and thus no chance of ice forming on the aircraft. The weather observer stated that in his observations during the period between 2300-2400 he carefully watched for signs of freezing rain but there were none. Other aircraft crews who departed just ahead of the accident flight found no icing before or during takeoff. Captain McDougall said that visibility was good, that weather conditions did not affect the course of his action, and that at no time was the aircraft high enough to encounter the clouds.

The crew stated the pretakeoff checks were comprehensive and were completed while waiting their turn to take off and just after taking position on the runway. During the checks the engines were run up to approximately barometric pressure (30 inches of manifold pressure). Nos. 2 and 3 engines were run up together and then Nos. 1 and 4 together. The crew said no roughness was observed or felt. Copilot Hall stated he used the ice light to observe Nos. 3 and 4; however, Captain McDougall did not recall it being used. The propellers were exercised at least four times before the response was normal for Nos. 3 and 4 propellers. The customary feathering checks were made.

Captain McDougall testified that he made the takeoff from the left seat. As was his habit under the existing conditions, control of the aircraft was accomplished principally by reference to instruments. Both pilots agreed the takeoff and climb were normal until the first power reduction, 300-400 feet above the ground, at an airspeed of approximately 120 knots, and with a rate of climb of between 500 and 1,000 feet per minute. The captain felt the aircraft yaw to the right when the No. 4 r. p. m. surged at the first reduction of power and again when the power on No. 4 was reduced. The rate of climb immediately decreased and as the engine and propeller began to overspeed an unsuccessful attempt to feather was made. Both pilots noted a reaction from the propeller and momentarily it appeared that the propeller was feathering. The copilot said he noted a reduction in r. p. m. to about 1,500-1,800 which Captain McDougall said he felt when the yaw was momentarily relieved. Takeoff power was added to all but No. 4 engine. Immediately thereafter the r. p. m. of No. 4 increased to more than 3,000 which, after consideration, the copilot felt was nearer 3,500. This was accompanied by a loud propeller whine, heard by the crew and numerous persons on the ground. The copilot said he felt the feathering button which was still in, the position to actuate feathering. He pulled the button out, pushed it back in, in a second attempt to feather; there was no response. Captain McDougall stated that the aircraft was descending during this time, and he raised the nose of the aircraft in an attempt to hold altitude at a slower airspeed. The captain related that he did not use trim to alleviate the heavy yaw, stating he could hold directional control without trim and he was better able to feel his aircraft without it. He also stated that the No. 4 propeller drag felt insurmountable and it was impossible to gain or even hold altitude. Captain McDougall then concentrated on crashlanding the aircraft with as slow an airspeed as possible and in the least populated area. He therefore allowed the aircraft to turn away from a hill toward a flatter area. Both crew members said full power was applied to all engines and the aircraft hit tail first in a full power stall.

Eyewitnesses who described the flight were principally in agreement with numerous important factors and these support the observations and action of the crew. Several witnesses saw and heard the aircraft take off and stated that it appeared and sounded normal. Some of the witnesses described the overspeeding sound which reached a high-pitched whine. An experienced mechanic said, having heard the overspeed sound before, he recognized it immediately when N 88852 passed his position. He also said that he saw No. 4 engine torching badly and it appeared that the exhaust flame was being fed by oil. Several witnesses described the aircraft as flying in a considerable yaw to its right, and another saw it turn right to avoid the hill as described by Captain McDougall. There was a roar of increased power just before impact and one witness stated that the aircraft crashlanded in a nose-high attitude. Most witnesses were in agreement that weather conditions were similar to those reported, stating that it was snowing very little, if at all, and there was no freezing rain.

During the public hearing a qualified representative of the propeller manufacturer, Hamilton Standard, testified concerning the drag which would be expected from the improperly indexed propeller blades of N 88852. The witness stated that according to engineering data under the following conditions, blades properly indexed at 24 degrees, sea level condition, airspeed 115-150 m. p. h., engine r. p. m. 1,586, propeller drag was 570 pounds. Under the same conditions except with the propeller blades indexed as found on the accident aircraft, two at 16 degrees and one at 24 degrees, the propeller drag was 1,360 pounds, or about 2.3 times greater.

Tests were made to determine what, if any, roughness existed as a result of the improperly indexed propeller blades of the No. 4 propeller. The blade configuration of N 88852 was intentionally duplicated on an outboard propeller of another DC-4. Running that engine only, it was noted that vibration could be felt in the cockpit with noticeable swaying of the magnetic compass unit mounted by shock cords. The vibration was apparent around 1,000-1,200 r. p. m. and was visually noticeable by watching the engine shake on its mount. The vibration was evaluated as severe at the aforementioned r. p. m., becoming less apparent with increased r. p. m. In the experience of the testing group several instances of blade misindexing were known, nearly all of which were discovered during ground runup of the engines. At least one similar condition on a like aircraft went unnoticed during flight operation.

### Analysis

The Peninsular crew stated that after reaching the airport on November 17 and talking with Mr. Aho they were assured the aircraft was ready for flight. They stated that the maintenance forms given them were reviewed and showed the work ordered had been done. Because of conflicting recollections it is not known when this occurred, before or after the aircraft was taxied to the terminal.

Testimony of the maintenance personnel showed clearly that at no time after the aircraft was received for maintenance on November 14 were the engines run up. The Board is of the firm opinion that such a runup was essential to a vital part of the work performed on the Nos. 3 and 4 propellers and a responsibility of the maintenance agency. This was important in order to determine if the dome seals had been properly installed and if there were any leaks. It was

even more necessary because the maintenance personnel had concluded that the original leaking oil came from the propeller dome seals, without first cleaning the engines and thereafter running them to be sure. Had the engines been run up following the work and the propellers exercised, the loose dome condition of No. 4 would have been immediately evident by leaking oil around it.

As shown by numerous expert witnesses, including a representative of the propeller manufacturer, it was published procedure to change the dome seals with the propeller blades feathered. This was not done and such omission is not considered to be acceptable maintenance.

It is evident that had the correct procedures been followed during the dome seal change, improper positioning of the blades would not have occurred. It is further believed that a thorough engine runup would have revealed this error.

The Board therefore is of the opinion that good maintenance practices and procedures dictated an engine runup. It was the responsibility of Seattle Aircraft Repair, and only poor supervision, an over-extended workload, and poor maintenance procedures were responsible for the omission.

As the result of tests the Board is also of the opinion that considerable roughness would be caused by the improperly indexed No. 4 propeller blades, especially when the aircraft engines were warmed up before the aircraft was taxied to the terminal and while it was holding before takeoff. Considering that all four engines were used during taxi and two engines were run up together prior to takeoff, it is possible that the roughness would not be noticeable unless the crew carefully looked at the No. 4 engine with their Aldis lamp and/or ice light. Had this been carefully done it is believed the roughness could have been detected.

As indicated, when the crew made the first power reduction the No. 4 propeller did not respond. This was undoubtedly the result of insufficient oil supply to the propeller governor to actuate the propeller mechanism toward a higher blade angle. It is believed that sufficient feathering oil existed to start the process, but soon after the blades started to move the supply was exhausted. Exhaustion of feathering oil resulted in the blades returning to the low pitch setting with an attendant engine overspeeding. This sequence of events is substantiated by the observations of the flight crew when they noted a momentary reduction of r. p. m. and a decrease in rudder pressure during the feathering attempt and by the engine and propeller sound described by ground witnesses. Considering the drag as shown by the engineering data, and that described by the captain, continued flight under these conditions was extremely difficult, if not impossible.

During the sequence of events the oil supply of the No. 4 engine became exhausted during the attempted feathering operation following takeoff. As shown by the oil leakage tests, the total supply (20 gallons) was not entirely exhausted during flight but several gallons must have been lost before takeoff. It is very probable that this occurred during the power check, the feathering check of the No. 4 propeller, and when that propeller was exercised. It is not



known whether the leak could have been seen from the cockpit under the existing conditions and circumstances.

### Findings

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

1. The carrier, the aircraft, and the crew were currently certificated.
2. The aircraft was loaded within allowable weight limits and the load was properly distributed with respect to the center of gravity of the aircraft.
3. Weather conditions at takeoff were above minimums with respect to ceiling and visibility.
4. There was no snow or ice on the aircraft when it took off.
5. During the first power reduction the No. 4 engine r. p. m. fluctuated, became uncontrollable, and shortly thereafter increased to more than 3,000.
6. Efforts to reduce the r. p. m. and feather the malfunctioning propeller were unsuccessful.
7. The propeller dome retaining nut was not tightened sufficiently permitting oil to leak around the dome seal.
8. The leaking oil resulted in a lack of oil for reducing the r. p. m. or feathering the No. 4 propeller.
9. Poor maintenance procedures, omissions during maintenance, and lack of proper inspection were evident in the maintenance work performed by Seattle Aircraft Repair, Inc.
10. Improper indexing of the No. 4 propeller blades occurred during the work at Seattle.
11. Propeller drag from the overspeeding No. 4 propeller greatly increased by the incorrect indexing of the blades made continued flight difficult if not impossible.
12. The aircraft was unairworthy following the Seattle maintenance work.

### Probable Cause

The Board determines that the probable cause of this accident was the excessively high drag resulting from the improperly indexed propeller blades and inability to feather. These conditions were the result of a series of maintenance errors and omissions.

BY THE CIVIL AERONAUTICS BOARD:

/s/ JAMES R. DURFEE

/s/ CHAN GURNEY

/s/ JOSEPH P. ADAMS

/s/ HARMAR D. DENNY

# S U P P L E M E N T A L   D A T A

## Investigation and Hearing

The Civil Aeronautics Board was immediately notified of this accident. An investigation was initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. A public hearing was held in two parts, on January 19-20, 1956, at Coral Gables, Florida, and on January 26-27, 1956, at Seattle, Washington.

## Air Carrier

Peninsular Air Transport is a partnership with offices in Miami Springs, Florida, and it is engaged in irregular operation. The partnership operates an airline business under a Letter of Registration issued by the Civil Aeronautics Board and an Air Carrier Operating Certificate issued by the Civil Aeronautics Administration.

## Flight Personnel

Captain W. J. McDougall, age 40, was employed by Peninsular Air Transport May 14, 1955. He held a valid airline transport pilot certificate with a rating for the subject aircraft. Captain McDougall had approximately 5,920 flying hours, of which 1,000 hours were in Douglas C-54 aircraft and 750 hours of instrument flying time. Captain McDougall passed a CAA physical examination, first-class, May 2, 1955.

First Officer F. C. Hall, age 30, was employed by Peninsular Air Transport July 18, 1955. He held a valid airline transport pilot certificate with a rating for the subject aircraft. Mr. Hall had approximately 5,778 flying hours, of which 531 hours were in Douglas C-54 aircraft and approximately 190 hours of instrument flying time. Mr. Hall passed a CAA physical examination, first-class, September 19, 1955.

## The Aircraft

N 88852, a Douglas C-54-DC, serial number 3123, was owned by Aero Maintenance, Inc., Miami, Florida, and operated by Peninsular Air Transport. It was currently certificated by the Civil Aeronautics Administration. The aircraft, according to company records available, indicated a total time of 19,630:14 hours on December 22, 1953, and on November 13, 1955, a total time since overhaul of 7,094 hours. It was equipped with four Pratt and Whitney R-2000-11 engines and four Hamilton Standard model 23E50505 propellers with model 6507A-0 blades.