CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted: July 15, 1954 Released: July 19, 1954

NORTHWEST AIRLINES, INC. - McCHORD AIR FORCE BASE, TACOMA, WASHINGTON, SEPTEMBER 6, 1953

The Accident

A Lockheed L-1049 Constellation, N 6214C, operated by Northwest Airlines as Flight 8, burned following an emergency landing at McChord Air Force Base, Tacoma, Washington, on September 6, 1953, at 0231.1/ There were 23 adult passengers, three infants and six crew members. There were no fatalities although several passengers were burned in varying degrees. The aircraft was practically destroyed by fire.

History of the Flight

Northwest Airlines' Flight 8 departed Seattle-Tacoma Airport at 0148, September 6, 1953, for a nonstop flight to Chicago, Illinois. Gross weight on takeoff was 105,839 pounds; maximum allowable for takeoff was 116,740; maximum allowable for landing was 98,500 pounds. The location of the center of gravity was within prescribed limits. Weather at Seattle-Tacoma Airport during takeoff was: ceiling 200 feet and one-fourth mile visibility.

Just after the aircraft became airborne No. 3 propeller oversped. Attempts by the flight engineer to correct this condition were unsuccessful and feathering was started one and one-half minutes later. However, the propeller continued to rotate at about 400 r.p.m. The flight's takeoff alternate was Yakima, Washington (a distance of 122 miles), but due to high terrain en route the captain elected to request clearance to proceed to Portland, Oregon (a distance of 132 miles), at 5,000 feet. This clearance was granted immediately.

Using METO2/ power the aircraft reached 5,000 feet, well above the overcast, about 14 minutes after takeoff. Near the end of this climb the oil temperature of No. 4 engine was exceeding limits and the oil supply was being rapidly reduced. The flight engineer attempted to lower the temperature by fully opening the oil cooler flap. Temperature, however, remained high and the oil quantity continued to dwindle fast. Accordingly, the No. 4 propeller was feathered at about 0205 at the order of the captain who then declared an emergency and elected to land at McChord Air Force Base. Radio communication was established with McChord and arrangements made for a GCA approach after a short delay in establishing a frequency. No. 3 propeller had not feathered fully and was still windmilling at approximately 400 r.p.m.

1/ All times referred to herein are based on the 24-hour clock and are Pacific Standard Time.

2/ METO - Maximum except for takeoff.

Meanwhile the captain had requested "takeoff" flaps, but the flaps would not extend hydraulically, and the copilot went to the cabin to crank them down. He stated that he turned the crank about 15-20 turns, at which point he found that it would no longer turn freely, whereupon he backed it to its original position. He was then called back to the cockpit to assist the captain in controlling the aircraft. Control difficulty had been continuously experienced with the aircraft yawing sharply and dropping a wing. The captain had placed the trim controls approximately in neutral, believing that he had a better feel and control of the aircraft without them at the recommended minimum speed of 130 knots. The aircraft, which had re-entered the overcast at about 2,000 feet, was then several miles from McChord Field under GCA direction on its first approach when its position and heading became such that the GCA operator directed a box pattern be flown to establish a proper approach. The second approach was executed in accordance with the directed pattern and the final approach was in line with Runway 34.

The landing gear control was not actuated for gear extension until the aircraft broke out of the overcast at an altitude estimated at between 500 and 800 feet on a GCA controlled straight-in approach to Runway 34. At this time the captain ordered that No. 3 be unfeathered but it would not unfeather and continued to windmill. Only the right main gear extended fully and locked, as indicated by its green light, but the landing was then committed. Shortly after touchdown retraction of the unlocked nose and left main gears allowed the aircraft to veer off the runway to the left. It then skidded sideways to its right, folding the right main gear inward, and the No. 2 engine was torn free. The aircraft came to rest on a heading of 212 degrees true some 3,000 feet from the point of touchdown and about 7,000 feet short of the far end of the 10,000-foot runway. At about that time a gasoline fire started and spread rapidly over the ground below the airplane.

Previously alerted fire apparatus, already standing by, kept the fire from spreading while all passengers and four of the crew left quickly by the main cabin door, the door sill being five or six feet above the ground. The flight engineer and the captain left by the cockpit crew door after ascertaining the cabin to be empty. All 32 occupants were clear within an estimated two minutes. There were no fatalities although several persons were treated for burns at the McChord Air Force Base Hospital.

Investigation

Examination of the burned aircraft and subsequent tests revealed the following:

Two of the legs supporting the oil seal front adapter of the No. 3 propeller shaft had fractured and the fragments of metal from this failure had penetrated the governor pad oil screen with the failure occurring at the oil inlet passage. This allowed the passage of metal particles into the governor oil passages and valves. Foreign material holding open the low pressure relief valve would cause loss of propeller control.

Of the 40-gallon oil supply for No. 4 engine at the time of takeoff only about two gallons remained. The reason for this depletion could not be determined. Tests with the same power plant, both on a test stand and in the air mounted in a similar aircraft

in the same (No. 4) position, with the oil adulterated with increasingly large amounts of water, failed to produce foaming or abnormal oil depletion.

Examination of the wing flap hand cranking mechanism revealed no failure or malfunction which could have produced the reported binding and prevented hand cranking movement beyond 15 to 20 turns at the time of attempting emergency extension. Whatever obstruction may have been present, if any, must subsequently have been removed, for the wing flaps were found hydraulically extended approximately 8 inches (approximately 100 turns of the crank).

To understand better the operation of the wing flaps and landing gear, it is desirable at this time to briefly describe the hydraulic system of the aircraft in question. Each of the four engines drives a hydraulic pump. Those on Nos. 1 and 2 engines furnish jointly (or individually in the event of failure of either No. 1 or No. 2 engine) hydraulic pressure to supply boost for the aircraft's flight controls, and for certain other purposes. This is known as the primary hydraulic system.

Pumps on Nos. 3 and 4 engines furnish jointly (or individually in the event of failure of either No. 3 or No. 4 engine) hydraulic pressure to effect wheel braking, nose-wheel steering, wing flap motion, landing gear extension or retraction, and for certain other purposes. This is known as the secondary hydraulic system. It can supplement the primary hydraulic system, but the reverse is not possible. If Nos. 3 and 4 engines are inoperative, there is no means of obtaining nose-wheel steering; wing flaps must be cranked down manually, and the landing gear must be lowered with the hydraulic hand pump. It is therefore apparent that the only source of pressure available in the secondary system of the aircraft during its emergency was the hydraulic pump driven by the windmilling No. 3 engine. The result was an abnormally low volumetric output.

A small internal leak was found in the landing gear selector valve when in the "neutral" position. The leak was caused by an improperly seated poppet valve which permitted flow from "pressure" port to "down" port. Since the "down" port is connected internally to "return" port when selector valve is in "neutral" a leakage path was provided between pressure and return lines. This leakage at the landing gear selector valve prevented normal flap extension, due to insufficient hydraulic pressure.

With the flap control remaining in the "takeoff" position and with the flaps retracted, the existing hydraulic pressure of 1,000 to 1,100 p.s.i., and the reduced output of the No. 3 pump, an abnormally slow extension of the landing gear resulted.

It would have required an estimated two or more minutes to extend and lock all three landing gears and extend flaps to "takeoff" position, with the small quantity of hydraulic fluid being pumped by the windmilling No. 3 engine. It was only approximately 30 seconds from actuation of the landing gear control for gear extension to the touchdown.

An extension of the landing gear prior to breaking out of the overcast was not attempted due to the captain's decision to keep the aircraft's drag to a minimum during the instrument approach with two engines inoperative on one side. The windmilling No. 3 propeller was producing added drag. Once below the overcast, when he attempted to extend the landing gear, only the right main gear extended and locked. The left main gear and nose gear extended, but not far enough to lock in the down position and were forced upwards by contact with the runway.

There was no evidence of structural failure in the airframe, or control malfunctioning, prior to impact, nor any indication of other than normal operation in Nos. 1 and 2 power plants.

In regard to weather conditions during the approach and landing at McChord Air Force Base; the ceiling and visibility were 700 feet overcast and five miles, respectively. These values were in excess of all pertinent minima.

Investigation of the crew's training in the operation of the subject model aircraft disclosed that the flight crew (captain, first officer, and flight engineer) had been given L-1049 transition training by Eastern Air Lines at Miami, Florida. All three had completed both flight and ground courses for L-1049 aircraft for their respective duties. These courses were identical to those given by Eastern to its own crews and were completed to the satisfaction of Eastern, lessor of the subject aircraft, and the Civil Aeronautics Administration. The flight service attendant and senior stewardess had attended the Eastern school for L-1049 cabin personnel. The other stewardess received her training at Northwest's school.

Analysis

In the analysis of the facts surrounding this accident, it is important to remember that the overall time interval from takeoff (at 0148) to crash was 43 minutes. (See Attachment A.) During the final 20 minutes of flight, emergency factors multiplied rapidly. These were, delay in establishing a usable GCA channel with McChord Air Force Base, inability to extend flaps to takeoff position, difficulty of aircraft control, knowledge that the diminished secondary hydraulic pressure meant slow landing gear extension, low ceiling at McChord causing the captain's decision against early gear actuation, and the choice to be made between restarting either No. 3 or No. 4 engine. All these factors placed a heavy burden of mental pressure on the captain. The takeoff was under weather conditions such that, although within minimums, the flight must have been on instruments at once, shortly before No. 3 propeller gave trouble. After unsuccessful attempts to control its overspeeding, only partial feathering was accomplished due to structural failure in the propeller control. Fifteen minutes later, after the airplane had reached 5,000 feet, No. 4 propeller was feathered because of drastic oil loss from No. 4 engine.

The crew was then faced with the process of establishing a usable frequency for GCA communication and performing the requirements for an instrument approach while hampered by an unusual combination of mechanical difficulties. Some time was consumed working through the McChord tower in

settling upon the emergency frequency of 121.5 with which the aircraft was equipped.

Prompt and commendably efficient action by airport crash personnel enabled the flight crew to take immediate correct measures for getting the passengers out of the aircraft. Conditions were critically hazardous, with fire surrounding the aircraft and the constant possibility that it would spread or that an explosion would occur. Weather was an important factor in the accident. Conditions at the takeoff point (ceiling 200 feet - visibility one-fourth mile) prevented an immediate return after shutting down No. 3 engine.

The captain testified that he decided not to dump fuel for the emergency landing at McChord, due to the fire hazard during necessarily continuous radio operation with GCA, as well as the time element involved. The CAA-accepted manual requires that all radio equipment and all unnecessary electrical equipment be turned off while dumping fuel. With reference to the unsuccessful attempt to increase hydraulic pressure by unfeathering No. 3 propeller during final approach, rather than No. 4 propeller, the captain stated that he decided against the latter because of the danger of engine fire or other hazard that could result from the nearly exhausted oil supply for that engine.

The captain testified that he elected not to lower the landing gear because of the increased drag and the resultant adverse effect on aircraft performance. He said he chose not to put it down prior to breaking out of the overcast because there was no possible way of retracting it even if a go-around had been possible. Shortness of time precluded manual extension of the landing gear, since this is a rather lengthy process requiring several hundred pump strokes.

Following this accident the manufacturer of the aircraft issued a Service Bulletin recommending that certain changes be made in the hydraulic system of Constellations now in service and prepared the necessary changeover kits, and the company will incorporate these changes in all future Constellations. The change, in brief, allows the flight engineer to draw hydraulic pressure from the primary system for the secondary system.

Findings

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

1. The aircraft, the carrier, and the crew were properly certificated.

2. The aircraft's gross weight at takeoff was under the maximum allowable gross takeoff weight, and it was loaded properly with respect to the center of gravity limits.

3. Shortly after takeoff the aircraft lost the use of No. 3 engine due to an overspeeding propeller, and continued windmilling.

4. Weather conditions at Seattle-Tacoma were satisfactory for takeoff but were below landing minimums and the captain elected to proceed to Portland.

5. After reaching cruising altitude No. 4 propeller was feathered because of high engine oil temperature and depletion of oil supply.

6. After losing the use of No. 4 engine, the captain declared an emergency and set up a GCA approach to McChord Air Force Base.

7. A malfunction of the landing gear selector valve prevented normal use of the diminished hydraulic pressure to extend the flaps.

8. A GCA instrument approach to McChord was necessary because of weather conditions. The captain decided that he would extend the gear only after breaking out under the low overcast.

9. The short time interval between breaking out and touchdown was insufficient for extension and locking of all three landing gears with the existing hydraulic pressure.

10. After touchdown the unlocked and partially extended left main and nose gears were forced up into their wheel wells with complete loss of control of the aircraft's ground movement, and fire occurred after rupture of the fuel tanks.

11. The functional failure of No. 3 propeller governor was due to foreign metallic particles.

12. The reason for the loss of oil supply for No. 4 engine was undetermined.

13. The landing gear selector valve was improperly seated, resulting in insufficient hydraulic pressure.

Probable Cause

The Board determines that the probable cause of this accident was a sequence of mechanical failures resulting in an emergency landing under adverse weather conditions with insufficient hydraulic pressure in the secondary system to extend fully the landing gear in the time available. A contributing factor was the design of the hydraulic system which did not permit use of the available pressure in the primary system for that purpose.

By the Civil Aeronautics Board:

/s/ CHAN GURNEY

/s/ HARMAR D. DENNY

/s/ OSWALD RYAN

/s/ JOSH LEE

/s/ JOSEPH P. ADAMS

SUPPLEMENTAL DATA

Investigation and Hearing

The Civil Aeronautics Board was notified of this accident at 0240, September 6, 1953, by CAA Communications, Seattle, Washington. An investigation was immediately initiated in accordance with the provisions of Section 702 (a)(2) of the Civil Aeronautics Act of 1938, as amended. A public hearing ordered by the Board was held in the Washington Athletic Club, Seattle, Washington, October 15 and 16, 1953.

Air Carrier

Northwest Airlines, Inc., a scheduled air carrier, is a Minnesota corporation with its principal place of business at 1885 University Avenue, St. Paul, Minnesota. The company is engaged in the transportation by air of persons, property and mail under certificates of public convenience and necessity issued by the Civil Aeronautics Board and an operating certificate issued by the Civil Aeronautics Administration for operations over the route involved.

The company entered into an agreement on January 29, 1953, with Eastern Air Lines, Inc., for the charter of certain Lockheed Constellation aircraft to conduct a daily scheduled operation nonstop between Chicago and Seattle.

Flight Personnel

Captain Russell M. Bird held a currently effective airline transport pilot certificate with an appropriate rating for the subject aircraft. He had a total of 10,863 flying hours, of which 263 were in the type equipment involved. He successfully accomplished his last CAA medical examination on April 24, 1953, and had been employed by Northwest Airlines since May 19, 1941. He passed his last six months' check on April 16, 1953, and on the same date was checked out on L-1049 equipment at the Eastern Air Lines Training School.

First Officer Dale Moore held a currently effective commercial pilot certificate with single and multi-engine land and instrument ratings. He had a total of 4,230 hours of which 206 were in the type equipment involved. He passed his last CAA medical examination on July 17, 1953, and had been employed by Northwest Airlines since July 18, 1950. He qualified as copilot on L-1049 equipment April 21, 1953, at the Eastern Air Lines Training School.

Flight Engineer Robert M. Fuller held a currently effective flight engineer certificate, airplane and engine mechanic certificate, and a commercial pilot certificate. He had a total time of 2,763 hours as flight engineer, of which 349 hours were on L-1049 equipment. His employment with Northwest Airlines began February 26, 1948. He was qualified as flight engineer on L-1049 equipment.

Flight Service Attendant John Johnson started his employment as a Northwest Airlines Flight Service Attendant on July 27, 1952. His training periods were as follows:

Emergency Procedure Refresher Class - SEA - 11/5/52
Air-Sea Rescue & Emergency Procedures - SEA - 1/27/52
" " " " " " - " - 7/15/52
Classroom Instruction - Super Constellation - SEA - 4/21/53

Check Out - Super Constellation - SEA - 5/4/53
In-Flight Check Ride (SEA-EDF-B-377) - 10/23/52
" " " " (MSP-DCA-B-377) - 3/3/52

Stewardess Muriel Harms was employed as a stewardess by Northwest Airlines on June 21, 1948. Training periods covered the same subjects and check rides as those of Flight Service Attendant Johnson.

Stewardess Patricia Grivna was employed as a stewardess by Northwest Airlines on April 1, 1953. Her training periods were:

Air Sea Rescue & Emergency Procedures - SEA - 7/7/53
Classroom Instruction - Super Constellation - SEA - 4/20/53
Check Out on Aircraft - Super Constellation - SEA - 4/27/53
In-Flight Check Ride (SEA-GEG-SEA DC-3) - 4/8/53
" " " " (SEA-BIL-SEA DC-4) - 6/10/53
" " " " (GEG-SEA DC-3) - 7/13/53

The Aircraft

N 6214C, a Super Constellation, model L-1049, was owned by Eastern Air Lines, Inc., and operated under a charter agreement by Northwest Airlines, Inc. It had a total of 4,509 flying hours since manufacture and was currently certificated by the Civil Aeronautics Administration. The aircraft was equipped with Wright model 975C18CB1 engines and the propellers were Hamilton Standard model 43E60. All engines, propellers and governors had 877 hours since overhaul.

ATTACHMENT A

PST	ELAPSED TIME IN MINUTES AFTER START OF TAKEOFF	N W A N 6214C - McChord AFB - September 6, 1953
0148	0	Takeoff started (200' ceiling - 1/4 mi. vis.)
0149	1	#3 prop. overrevs between V_1 and V_2
0150	2	Flt. engr. cannot control #3 prop.
0151	3	#3 prop. feathering started
0152	4	Clearance to Portland @ 5,000' requested
0153	5	METO power for 3-engine climb
0154	6	Clearance to Portland rcvd.
0155	7	#3 prop. windmilling @ 400-500 RPM
0156	8	#3 eng. cleaned up
0158	10	#4 eng. oil temp. noted rising
0201	13	#4 oil temp. exceeding limits - oil supply going down
0202	14	5,000' alt. reached
0203	15	Power reduced
0207	19	#4 oil gauge reading - 10 gal. - hi temp.
0208	20	#4 eng. feathered
0209	21	Emergency declared - land at McChord AFB
0210	22	#4 eng. cleaned up
0211	23	Takeoff flap hydraulically unsuccessful
0212	24	Copilot to cabin for manual flap extension
0213	25	Capt. trying for radio contact GCA - McChord
0214	26	Capt. having difficulty controlling aircraft alone
0215	27	" " " " " "
0216	28	" " " " " "
0217	29	Copilot unable to extend flaps - remain full retract
0218	30	Copilot called back to cockpit
0219	31	Radio contact made with GCA - 27 mi. south McChord
0220	32	Letting down
0221	33	Off GCA scope
0222	34	Box pattern @ 1,500' alt., south of McChord
0226	38	Lined up (GCA) on final for RY 34
0230	42	Gear actuated breaking out @ 500-800' #3 prop. would not unfeather
0231	43	Landing on Runway 34 - fire starts (after gear folds)
0233	45	All occupants clear of aircraft
0234	46	Aircraft burning