File No. 2-0002

CIVIL AERONAUTICS BOARD

AIRCRAFT ACCIDENT REPORT

ADOPTED February 18, 1965 **RELEASED.** February 24, 1965

HANSEN AIR ACTIVITIES
DOUGLAS DC-3A, N410D
NEAR CHICAGO-O'HARE INTERNATIONAL AIRPORT
CHICAGO, ILLINOIS
MARCH 8, 1964

SYNOPSIS

A Douglas DC-3A, N410D, operated by and registered to Hansen Air Activities, crashed into an occupied house 7-1/2 miles west-northwest of the Chicago O'Hare International Airport at 2356 c.s.t., March 8, 1964. The copilot sustained fatal injuries and three of the 28 passengers received minor injuries. None of the six persons in the house were injured. The aircraft was damaged substantially.

The crew was attempting an ILS approach to runway 14R in instrument flight conditions when turbulence was encountered, accompanied by a rapid accretion of airframe icing. The crew was unable to maintain directional stability or altitude, and abandoned the approach. After leaving the approach course, the aircraft continued to descend in an uncontrolled condition until it crashed.

The Board determines the probable cause of this accdient was the failure of the crew to utilize available de-icing equipment and engine power to maintain positive control of the aircraft under conditions of rapid airframe ice accretion and vortex induced turbulence.

Accident

A Hansen Air Activities, Douglas DC-3A, N410D, crashed into an occupied house 7-1/2 miles west-northwest of the Chicago-O'Hare International Airport, Chicago, Illinois, at 2356[1] March 8, 1964. The copilot sustained fatal injuries and three of the 28 passengers received minor injuries. The aircraft was damaged substantially.

The crew was attempting an Instrument Landing System (ILS) approach to runway 14R in instrument flight conditions when turbulence was encountered, accompanied by the rapid accretion of airframe icing. The crew was unable to maintain directional stability or altitude and abandoned the approach. After leaving the approach course, the aircraft continued to descend in an uncontrolled condition until it crashed.

Investigation

The aircraft was leased from Midco Leasing, Inc., by a ski club for the purpose of transporting 28 of its members from Chicago, Illinois, to Pellston, Michigan, and

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1/ All times herein are central standard based on the 24-hour clock.

return on the weekend of the 7th and 8th of March 1964.[2/]

During this weekend, N410D made one round trip from Chicago, Illinois, to Pellston, Michigan, and one round trip from Chicago, Illinois, to Cincinnati, Ohio. During these flights, the aircraft accumulated approximately 5 hours of flight and no significant maintenance writeups were noted on the airplane flight log.

N410D arrived at Pellston, Michigan, at approximately 2057 on March 8, for the purpose of returning the 28 passengers to Chicago, Illinois. After arrival, the pilot visited the Federal Aviation Agency (FAA) Flight Service Station (FSS) at the Emmet County Airport, Pellston, Michigan, for the purpose of filing a flight plan and obtaining a weather briefing.

He was provided with the 2100 sequence weather observations for Traverse City, Muskegon, and Grand Rapids, Michigan; South Bend, Indiana; Midway Airport, Chicago-O'Hare International Airport, and Joliet, Illinois. The briefer indicated that these observations showed ceilings in these areas ranged from 1,500 feet obscured in the Traverse City area to 700 feet in the Grand Rapids and Muskegon areas. In the South Bend and Chicago areas, the ceilings were 300 to 700 feet. Visibilities were one and one-half miles in snow showers in the Traverse City area, and five to six miles in rain, snow, and fog, in the Muskegon and Grand Rapids areas. Visibilities were 1-1/2 miles at Joliet, and 4 to 6 miles in rain, fog, and smoke at Chicago Midway and Chicago-O'Hare International Airports. The temperature and dewpoint at Chicago-O'Hare were 35°F. and 33°F., respectively. The briefer indicated that the area forecast included a forecast for moderate to heavy icing in clouds and that this information was provided to the pilot. An Aviation Severe Weather Forecast indicated severe thunderstorms along a 60-mile front either side of a line from Vandalia, Illinois, to Jackson, Michigan.

SIGMET No. 1[3/] effective for the period of 1830 to 2230, forecast intermittent moderate to heavy mixed icing for central and southern Wisconsin and southwestern Lake Michigan. A chance of occasional moderate to heavy icing was forecast for northern Illinois, the northern third of Indiana, and southeastern Lake Michigan. According to the FSS pilot weather briefer, all the above weather information was made available to the captain of N410D, although the pilot testified he did not recall a forecast of moderate to heaving icing in the weather forecast.

The pilot filed an instrument flight rules (IFR) flight plan with the FSS requesting a cruising altitude of 5,000 feet, via V-193 to White Cloud VOR, V-215 to Muskegon VOR, V-55 to Pullman VOR, V-84 to Northbrook VOR, direct to the Chicago-O'Hare International Airport. The flight plan indicated the estimated true airspeed as 140 knots, estimated time en route as 2-1/2 hours, and fuel for 4 hours. The alternate airport was listed as Madison, Wisconsin. Prior to departure, the flight received an IFP clearance issued by the Minneapolis Air Route Traffic Control Center (ARTCC) by radio from the Pellston FSS to the Chicago-O'Hare Airport, essentially in accordance with the details of the flight plan. Pellston weather at departure was overcast, visibility was 4 miles in light snow showers.

2/ At the time of the accident, Frank D. Hansen, doing business as Hansen Air Activities, was registered with the FAA as the owner of the aircraft. Subsequently, on March 12, 1964, Midco Leasing, Inc., filed an application dated March 6, 1964, for a certificate of registration as the owner of the aircraft. Neither organization possessed an FAA certificate authorizing the operation of large aircraft for compensation or hire.

3/ A meteorological message designed primarily for aircraft in flight warning of weather conditions potentially hazardous to transport category and other types of aircraft.

N410D departed Pellston at 2132 with 28 passengers and the two-pilot crew. The flight from Pellston to the vicinity of the Chicago-O'Hare terminal area was described by the pilot as being smooth and uneventful. At 2335:15, a handoff[4] of N410D was accomplished from Chicago ARTCC to Chicago Approach Control while the aircraft was at 5,000 feet. At this time, radar indicated the aircraft was seven miles east of the Sturgeon Intersection and the crew was instructed by Chicago Approach Control to descend to 3,500 feet 15 miles east of the Northbrook VOR.

The pilot stated that he then established a 500-foot-per-minute descent utilizing engine power settings of 2000 r.p.m. and manifold pressure of 21 to 23 HG.[5] N410D was then informed that it would be provided radar vectors for an ILS approach to runway 14R. After N410D departed the Northbrook VOR, the landing gear was extended and power was increased by changing manifold pressure to 23-24 HG. Approximately 115 knots indicated airspeed (KIAS) was maintained.

Several other aircraft which preceded N410D were also being vectored to land on runway 14R. Among these was TWA Flight 83, a Boeing 707 jet aircraft. (See Attachment 1.) This aircraft weighed approximately 180,000 pounds and its left turn to intercept the ILS localizer course was accomplished at approximately 165 KIAS.

While TWA 83 was being vectored to the final approach course of runway 14R, and in a turn from a 270 degree to 220-degree heading, it was instructed to continue the turn to 170 degrees. Eight seconds after this flight had been instructed to turn from 270 to 220 degrees, N410D was instructed to turn from 200 to 190 degrees.

The transcript of communications by Chicago-O'Hare Approach Control indicates that at 2350·56, TWA 83 was 2-1/2 miles north of the Romeo Outer Marker descending to 2,500 feet and continuing a left turn from 200 degrees to 170 degrees.

At approximately the same time, N410D was at 2,500 feet, four miles from the Romeo Outer Marker, on a heading of 190 degrees until intercepting the ILS localizer course after which it was to turn inbound.

At 2353:05, the crew reported· "Ten Delta is in a blast of air, sir." This was followed at 2353:15 by· "We can't hold it, sir." The crew of N410D said they would attempt another approach and were instructed to turn right to 270 degrees and to maintain 2,500 feet. At this time, the crew reported they were at 1,500 feet. The approach controller then informed the crew of the existence of high radio towers west of the airport and instructed the flight to climb to 2,500 feet. The landing gear was then retracted.

At 2354:40, after the radar target of N410D was observed to depart the localizer course, the following transmission was received from the crew. ". . . Very bad air, sir, very bad. We're almost going down."

At 2354:45· "Right now at eighteen hundred; at eight hundred feet, sir."

4/ A transfer of identity and control of an aircraft from one radar traffic control facility to another.

5/ Pressure in the intake manifold of an engine measured from zero and expressed in inches of mercury.

At 2354:50, the approach controller transmitted: "Okay, you still in the rough air at this time?" The crew then replied: "No sir, we're coming out of it now but its very, very bad air." No further communications were heard and, at 2356:15, the radar target associated with N410D disappeared fron the radar scope.

About this time, a Cessna 310, N6720X, was being vectored from the south for an ILS approach to runway 14R. In a statement received subsequent to the accident, the pilot stated that at a point west of the Romeo Outer Marker he was cleared to descend to 2,500 feet on a 360-degree heading. N6720X was vectored to a heading of 090 degrees and intercepted the runway 14R localizer course approximately 8 miles from the Romeo Outer Marker. From this position on the localizer course at 2,500 feet until descending to 1,100 feet, a period of approximately 5 minutes, the pilot of the Cessna 310 stated his aircraft accumulated one to one-and-a-half inches of rime ice. The temperature at 2,500 feet, when intercepting the localizer course, was 29°F., and at 1,100 feet, where he lost the ice, was 32°F.

The captain of N410D said that shortly after becoming established on the localizer course, the aircraft suddenly went into a violent bank to the right. As the wings were being leveled, the nose pitched up. As the nose came back down, the aircraft rolled to the left and control was difficult. After the "blast of air," several attempts were made to increase power but each time power was increased, the aircraft buffeted and control was difficult. Attempts to climb were made without success. He described the feeling of being in a steady downdraft. The elevator control was "light-feeling," but aileron control was normal. Airspeed was fluctulating with the pitch changes, although he was attempting to maintain 110 KIAS. He did not recall descent below the clouds or striking the ground.

The only known ground witness observed the aircraft flying "very slow" at an estimated altitude of 100 feet. (See Attachment I.) Surface weather conditions were described as weather "breaking" with some snow.

Aeronautically qualified passengers indicated the flight was smooth, uneventful, and occasionally above clouds until some ten to 15 minutes after the letdown was initiated. At this time, the "seat belt" and "no smoking" signs were on and the aircraft had descended into clouds. They described the sound of the engines as characteristic of cruise power. They compared the rolling movement of the airplane to a series of lazy eights followed by a shudder as if in a stall. Passengers observed large deflections of the aileron control surfaces and felt abrupt elevator control movements. Some passengers stated that just prior to impact the aircraft was in a mushing attitude and power reduction was evident. Impact and deceleration after impact were described as moderate to severe.

The aircraft struck the ground in a flat, open area 756 feet m.s.l., on a flightpath of 238 degrees. The right wing struck a 40-foot telephone pole 3 feet above ground causing damage inboard of the right engine. Contact with the pole caused the aircraft to turn right to a heading of 285 degrees while continuing to travel in a 238-degree direction. The aircraft slid into an occupied dwelling, coming to rest with the nose in the rear wall of the attached garage and the left wing embedded in the rear wall of the house. None of the six occupants of the house was injured.

All 28 cabin seats were occupied at time of impact and remained secured to the floor mountings. None of the seat belts failed. There was no fire and passengers exited through the main cabin door and the emergency exits.

The Chicago-O'Hare International Airport 2358 special weather observation was in part as follows. ceiling measured 400 feet overcast, visibility 7 miles in very light drizzle, temperature 34°F, dewpoint 30°F, wind from 350 degrees at 10 knots.

The gross takeoff weight of the aircraft as computed during the investigation was approximately 26,440 pounds. The aircraft was over the maximum allowable certificated takeoff weight of 25,346 by 1,094 pounds, and it was within center of gravity (c.g.) limits for takeoff from Pellston, Michigan.

Examination of all rudder, elevator, and aileron control systems and their associated trim systems revealed no evidence of pre-impact failures or malfunction. Examination of the leading edges of the right wing, right and left horizontal stabilizers approximately 90 minutes after the accident revealed an accumulation of mixed rime and clear ice which was extremely rough textured. The base of the ice was approximately 3/8 of an inch thick and there were many projections extending approximately one inch from the airfoil leading edges. An examination of the inner surface of the ice revealed that it was smoothly contoured to fit the leading edge with no cracks or irregularities that would be indicative of de-ice boot actuation.

All major aircraft components were located within the immediate confines of the wreckage site and those components which had separated from the main structure did so as a result of impact. Both landing gear and flaps were in the fully retracted position at impact.

Examination of both powerplants disclosed discrepancies in valve clearance adjustments. Propeller chafing strips were severely deteriorated. One propeller dome stop ring was found to incorporate retaining screws of a superseded type. These screws were found to be loose during examination of the propeller dome. Angular measurements of impact indentations on propeller shim plates showed propeller blade angles of ∠26 and ∠18 degrees on the left and right propellers, respectively, at initial ground impact.

The electric pump which provides the pressure to pump alcohol to the propeller, carburetor and cockpit windshield de-icing systems was found to be inoperative. The maintenance records for the last 100-hour inspection of N410D on September 6, 1963, reflected a requirement to "Free up Alcohol Ind. motor." A mechanic who accomplished the work stated "I oiled alcohol pump then checked it out. The motor and pump operated normal." Examination of the pump motor after the accident indicated massive corrosion and complete seizure. Neither the pilot's testimony nor physical examination of the aircraft's pheumatic wing and empennage de-icing system disclosed any evidence to the effect that this system was utilized during the flight from Pellston, Michigan, to Chicago.

Examination of the flight instruments disclosed that the captain's artificial horizon did not meet manufacturer's specifications for settling time limits from pitch attitude of twenty degrees above the horizon to zero degrees. The unit was also found to have an extreme amount of radial play in the roll axis, and was missing one rubber bumper on the left side of the roll axis limit stop; had a deteriorated and loose rubber bumper on the right side; had misaligned flippers which affect pitch response, and there was excessive radial looseness (1/16 inch) in the horizon bar.

During examination of the flight control system, it was found that the two castellated nuts securing clevis bolts which connect the left aileron main control

cables at the left wing to center section attach point contained no cotter pins. The nuts, however, had remained in place.

The aircraft's fuel, oil, hydraulic, heating, electrical and pneumatic systems were found to be capable of performing their designed functions prior to impact.

During the examination of the aircraft wreckage at the scene of the accident, a total of approximately 110 U. S. gallons of fuel were removed from the aircraft's fuel tanks. None of the aircraft's fuel tanks were ruptured during impact, although some deformation was evident.

An examination of the aircraft's records indicated that flight time computations and records were incomplete and inaccurate after October 26, 1962, when the aircraft was sold by a scheduled air carrier and registration subsequently passed through five successive owners. The logbooks did not reflect the actual engine operating times for the aircraft. Available records indicated the left and right engines had accumulated totals of 1,624 and 1,640 hours, respectively.

The flight crew held the required FAA certificates and ratings. The captain had a total of 5,232 flying hours. 923 hours of this time were in the DC-3, of which 100 flying hours were pilot-in-command. He had 34:00 hours in the DC-3 within the last 90 days. The copilot had 15:10 flying hours in the DC-3.

Analysis

With the exception of the condition of the captain's artificial horizon, which could have provided the pilot with an inaccurate portrayal of his flight attitude and thus contributed to his inability to maintain flight, no causal relationship between the other potentially hazardous maintenance discrepancies and the occurrence of the accident appears to exist, the inoperative alcohol pump notwithstanding, for the captain testified that he did not attempt to utilize any de-icing or anti-icing system during the approach. It should, however, be noted that the discrepancies reflect the absence of an adequate inspection and maintenance system.

Although the aircraft was over the maximum allowable weight at takeoff, it was below the maximum certificated gross weight at the time of the accident. The weight and c.g. of the aircraft are not considered a factor in the accident.

The weather briefing received by the captain prior to departure from Pellston should have alerted the crew to the possibility of encountering freezing precipitation.

On the basis of ATC communications and controller testimony, the probable flightpaths of several aircraft which preceded and followed N410D were prepared. (See Attachment I.) Both N410D and TWA 83 were being vectored from the left to the runway 14R localizer course of 138 degrees. As TWA 83 turned to the left, its flightpath continued to approach that of N410D until TWA 83 passed the 190-degree heading. The flightpaths were separated by 3 miles prior to TWA 83's turn from 270 degrees to localizer heading. This distance decreased to a minimum of 2-1/4 nautical miles at the point where TWA 83 passed through the 190-degree heading. During this time TWA 83 was 1,000 feet above N410D. After TWA 83 passed through the 190-degree heading in his turn, horizontal distance from N410D increased to 3 nautical miles or more. Throughout the entire approach, standard ATC separation was afforded.

TWA 83 intercepted the glide slope at 2351:38 while at 2,700 to 2,800 feet m.s.l., 5 nautical miles from touchdown and 1 nautical mile from the Romeo Outer Marker.

At the same time, N410D intercepted the localizer course for runway 14R approximately 3-1/2 nautical miles northwest of the Romeo Outer Marker while at 2,500 feet.

At 2352:38, N410D would have been at the same geographic position and at an altitude approximately 250 feet lower than the jet had been one minute earlier since N410D had been cleared to maintain 2,500 feet and had reported at that altitude at 2349:54.

Considering the atmospheric condition just prior to the accident, the velocity within the jet's vortex trails[6/] one minute after the vortex was shed would be approximately 10 feet per second or 600 feet per minute. The rate at which the vortices would move downward perpendicular to the wing would be 4.4 feet per second or 264 feet per minute.

The vortices created by the jet aircraft would have settled approximately 260 feet by 2352:38. At the same time, because of the light wind from the northwest, they would have drifted southeast along the localizer course approximately 1,500 feet or 1/4 of a nautical mile. As a result, the turbulence would be at N410D's altitude and along a course where it would be penetrated approximately 1-1/4 to 1-1/2 nautical miles northwest of the Romeo Outer Marker. At this point, vortex turbulence caused N410D to make an abrupt roll to the right with the subsequent loss of altitude.

It is apparent that during this approach N410D was accumulating airframe ice. Below freezing temperatures existed from approximately 1,000 to 2,500 feet m.s.l., and at altitudes above 5,000 feet m.s.l. Moderate icing would have been encountered in clouds in the sub-freezing zones. The pilot of N6720X, an aircraft approximately

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6/ Vortex turbulence is a part of the air disturbance created by a lifting airfoil. It exists in the wake of all fixed wing aircraft and is generated at the wing tips by spanwise flow of air from the high pressure side of the wing around the tip toward the low pressure side. Vortex intensity is dependent on airspeed, wing angle of attack, wing span and area, weight, and distance down-stream of the wing tip. Persistence of vortex turbulence at a given point after passage of an airplane is dependent also on the natural air turbulence at the place and time, persistence decreasing with increased natural turbulence.

This subject is not new. In 1953, the Civil Aeronautics Board issued a Safety Bulletin, No. 187-53, "Keep Your Distance" dealing with and warning against the hazard. In 1962, the Board issued a rewrite of that Bulletin under the same title. A Board aircraft accident report released October 10, 1959 (File No. 2-0124) carried an attachment titled "A Safety Message for Pilots" which dealt with the danger of vortex turbulence. Other publications on the subject include: NACA Technical Note 3377, Kraft, Christopher C., Flight Measurements of the Velocity Distribution and Persistence of the Trailing Vortices of an Airplane, March 1955. NASA Technical Note D-1777, Wetmore, Joseph W., and Reeder, John T., Aircraft Vortex Wakes in Relation to Terminal Operations, April 1963. NASA Technical Note D-829, McGowan, William A. Calculated Normal Load Factors on Light Airplanes Traversing the Trailing Vortices of Heavy Transport Airplanes, May 1961. NASA Technical Note D-1227, Connor, Andrew B., and O'Bryan, Thomas C., A Brief Evaluation of Helicopter Wake as a Potential Operational Hazard to Aircraft, March 1962.

4 minutes behind N4lOD, picked up ice when on the localizer course 8 nautical miles northwest of the Romeo Outer Marker at 2,500 feet. He experienced the fast accumulation of from 1 to 1-1/2 inches of rime ice from that point until reaching 1,100 feet prior to passing the middle marker.

No anti-icing or de-icing equipment was activated by the crew of N4lOD since they were unaware of the ice accumulation. Since the crew failed to recognize the icing situation, they did not correct for the increase in stall speed which resulte It is difficult to determine when ice began to accumulate on the airframe of N4lOD, but its effect began when vortex turbulence was encountered. While the icing was a factor in aircraft control, the amount accumulated would not have prevented operati of the aircraft if power had been added and airspeed maintained. The ice could hav been removed with the use of wing de-icing boots.

The transition from the rolling condition caused by the vortex turbulence and low airspeed, to the rolling resulting from the partial stall, was not recognized b the captain. Statements by the captain indicate that attempts to utilize more engine power resulted in control difficulties. However, the Board is unable to reconcile these statements with known aircraft response.

Both engines were operating at impact and if utilized in conjunction with the proper aircraft attitude/airspeed combination, sufficient power should have been available to sustain normal flight. The short distance traveled after ground impact confirms an extremely low ground speed at impact and the lack of appreciable surface wind resulted in the airspeed and ground speed being nearly the same.

Although the captain possessed the required FAA certificate, his actions show a lack of familiarity with flight in icing conditions. He apparently became confus because of the vortices, the effect of the unknown accumulation of airframe ice, an the difficulty in maintaining airspeed. As a result, he failed to take proper acti to stop the aircraft's descent prior to ground impact.

Probable Cause

The Board determines the probable cause of this accident was the failure of the crew to utilize available de-icing equipment and engine power to maintain positive control of the aircraft under conditions of rapid airframe ice accretion and vortex induced turbulence.

BY THE CIVIL AERONAUTICS BOARD:

/s/ ALAN S. BOYD
Chairman

/s/ ROBERT T. MURPHY
Vice Chairman

/s/ CHAN GURNEY
Member

/s/ G. JOSEPH MINETTI
Member

/s/ WHITNEY GILLILLAND
Member

SUPPLEMENTAL DATA

Investigation

The Civil Aeronautics Board was notified of this accident shortly after its occurrence on March 8, 1964. An investigation was immediately initiated in accordance with the provisions of Title VII of the Federal Aviation Act of 1958, as amended. Depositions were taken in Chicago, Illinois, April 14, 1964.

Operator

N410D was registered to Frank D. Hansen Air Activities on the day of the accident. Midco Leasing, Inc., was an organization formed in the State of Illinois for the purpose of holding aircraft for lease without a crew. Neither Hansen Air Activities nor Midco Leasing, Inc., possessed an FAA certificate which authorized the operation of large aircraft for compensation or hire.

Flight Personnel

Captain Virgil Norman Pronovost, age 39, had accumulated a total of 5,232 10 hours flight time of which 923:40 hours were in DC-3 aircraft. 100.30 hours of the DC-3 flying hours were pilot-in-command. He held currently effective airline transport pilot certificate No. 1183388 with multiengine land and Douglas DC-3 type ratings. He also held currently effective airplane and powerplant mechanic certificate No. 1027204. He held a first-class medical certificate dated January 27, 1964, with no limitations.

Copilot Daniel Winn Jordan, Jr., age 21, had accumulated a total of 550.15 hours flight time of which 15:10 copilot were in DC-3 aircraft. He held currently effective commercial pilot certificate No. 1489840 with single and multiengine land and instruments ratings. In addition, he held a free balloon pilot certificate No. 1516667 with a rating in hot air balloons, and airplane and powerplant mechanic certificate No. 1499960. He had a first-class medical certificate dated August 8, 1963, with no limitations indicated.

Aircraft

N410D, a Douglas DC-3, manufacturer's serial number 4970, was manufactured on November 4, 1942. It was utilized by the U.S. Navy until purchased by Pan American Airways on December 2, 1944. The aircraft was purchased by Robinson Airlines Corporation on August 13, 1948, which later became Mohawk Airlines. The aircraft was then purchased by Houston Aviation Products on October 26, 1962. The aircraft was registered to Jack Adams Aircraft on August 31, 1963. It was then purchased by Ted Cooper and Associates September 28, 1963. It was sold to Graubart Aviation, Inc., on January 30, 1964, who sold it to Hansen Air Activities on February 20, 1964. The last application for registration, dated March 6, 1964, but not submitted to the FAA until March 12, 1964, was to have transferred ownership of N410D from Hansen Air Activities to Midco Leasing, Inc.

The aircraft had a total time of 37,744 hours. It was powered by two Wright R1820-71 series engines with the following statistics:

Position	Serial Number	Time Since Overhaul	Total Time
1	135374	1,624	23,423
2	78789	1,640	3,512

The propellers were Hamilton Standard, full-feathering hydromatic with the following statistics:

Position	Hub Mfg. No.	Type	Blade Dwg. No.	Blade Serial No.
1	28563	23E50-505	1-6353-18	1-P241122
			2-6353-18	2-P241123
			3-6353-18	3-P241124
2	94903	23E50-473	1-6353-18	1-NKF1880
			2-6353-18	2-261485
			3-6353-18	3-289744

Attachment 1

PROBABLE FLIGHT PATHS BASED ON ATC COMMUNICATIONS, AND PILOT AND WITNESS STATEMENTS

TWA FLIGHT 83 DELTA FLIGHT 96 DELTA FLIGHT 975 N410D N6720X

CHICAGO, ILLINOIS MARCH 8, 1964