CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted: March 6, 1958 **Released:** March 10, 1958

NORTHEAST AIRLINES, INC., DC-6A, N 34954,
RIKERS ISLAND, NEW YORK, FEBRUARY 1, 1957

The Accident

Northeast Airlines Flight 823, a Douglas DC-6A, N 34954, crash landed on Rikers Island, New York, at 1802[1/] on February 1, 1957. The accident occurred at night under IFR conditions less than one minute after takeoff from runway 4, La Guardia Field, New York. There were 101 persons aboard the aircraft - 95 passengers (which included 11 children) and 6 crew members. Of these, 20 passengers received fatal injury, 25 passengers and 3 stewardesses serious injury, and 50 passengers minor injury. The pilot, copilot, and flight engineer were uninjured. The aircraft received major damage from ground impact and was destroyed by subsequent ground fire.

History of the Flight

Northeast Airlines Flight 823, a DC-6A, N 34954, was scheduled to originate at La Guardia Field, a nonstop to Miami, Florida, with a departure time of 1445. This aircraft and the same crew, operating as Flight 822, had arrived at La Guardia from Miami at 1250. The crew consisted of Captain Alva V. R. Marsh, First Officer Basil S. Dixwell, Flight Engineer Angelo V. Andon, and Stewardesses Doris Steele, Catherine Virchow, and Emily Gately. A short time before the scheduled departure time the crew and passengers boarded the aircraft.

Snow, which had started at La Guardia at 1202, began to accumulate on the aircraft's horizontal surfaces after its arrival at the La Guardia ramp position. Snow removal by ground personnel, during preflighting, was ineffective because of the continuing snowfall. Accordingly, about 1600 the aircraft was taxied, with all occupants aboard, to a nose hangar on the west side of the airport for snow removal. This was accomplished and at 1745 the crew advised La Guardia ground control that they were ready to taxi from the nose hangar for the IFR departure to Miami.

Flight 823 was then cleared to runway 4 and was advised that the wind was northeast 10, the altimeter setting 30.12, and a time check of 1747-1/2. Air Route Traffic Control cleared the flight as follows: "Cleared to Bellemead, maintain 7,000 feet." A supplementary climb-out clearance was then given: "After takeoff, a left turn direct Paterson, direct Chatham, cross 081-degree

---

1/ All times herein are eastern standard based on the 24-hour clock.
* Index of subjects - last page of report.

radial of Caldwell 4,000 feet or above, cross Paterson between 5,000 and 6,000 feet and cross the northwest course of Idlewild not above 6,000 feet." Both clearances were repeated and acknowledged.

Takeoff clearance was issued at 1800 and a tower controller saw the aircraft airborne at approximately 1801.2/ The controller advised the flight to contact La Guardia radar departure control on 120.4 mcs. This message was acknowledged but the radar controller did not receive a call from the flight; however, he did observe a target on the scope that indicated an aircraft over the runway. The next two sweeps on the scope disclosed the target beyond the end of the runway. A subsequent sweep indicated that the target was turning left. The target then disappeared from the scope. The La Guardia tower controllers observed a large flash at approximately 1802 in the vicinity of Rikers Island, the approximate center of which is about one mile north of the point where the aircraft left the runway. It was learned at 1819, by telephone, that Northeast Airlines Flight 823 had crashed on Rikers Island.

At 1753 a La Guardia weather observation was as follows: Precipitation ceiling 500 feet, sky obscured; visibility three-fourths; light snow; fog; wind north-northeast 10; altimeter 30.12. An 1806 special weather observation, four minutes after the accident, was the same as at 1753 except that the ceiling was 800 feet and the wind velocity had increased to 15 knots.

Investigation

Part 1 - Experience of Carrier. Northeast Airlines has been a scheduled air carrier operating routes in the New England States for 24 years. The company was awarded the New York-Miami route in August of 1956. Before beginning this operation, on January 9, 1957, with leased aircraft, the carrier had sent a selected number of their pilots to DC-6 and DC-7 transition schools; a hundred or more of their personnel also attended maintenance courses of the aircraft manufacturer's school. Northeast Airlines had inaugurated its own DC-6 pilot and mechanic training courses and set up a flight dispatch system for the new route.

Part 2 - Experience of Pilots. Both pilots of Flight 823 had been captains of Northeast Airlines for over 14 years and both had acted in pilot supervisory capacities. Captain Marsh had been pilot in command for several thousand hours on four-engine aircraft for military contract operations during World War II. He had a total of 85 hours on DC-6 aircraft, of which 25 hours were acquired in December 1956 at the DC-6 transition course of a major air carrier; 56 hours were acquired during January 1957 in NEA pilot checks and scheduled flights between Boston, New York, and Miami. Captain Marsh had flown DC-6 aircraft exclusively during these two months. Investigation indicated that the instrument panel arrangement, and the instruments themselves, of the aircraft in the transition school and the Northeast aircraft were not identical. His actual DC-6 instrument time, as testified, was approximately 10 hours during training and checkouts and from 5 to 15 hours during scheduled operations. Captain Marsh acquired a rating on DC-6 and DC-7 aircraft from the Civil Aeronautics Administration upon completion of the transition course. Captain Marsh had been in command of two Northeast Airlines' Convairs involved in accidents at La Guardia Field.

2/ See attachment A - La Guardia Field and Rikers Island Chart.

One, in 1952, was found by the Board to be the result of pilot error culminating in a water landing during final approach. The other, in 1953, was determined by the Board to have been caused by propeller malfunctioning during the landing. Neither resulted in fatalities.

Captain Marsh underwent thorough medical examinations and flight checks after each of the above accidents. These examinations and flight checks disclosed no traits detrimental to airline piloting. With the exception of a short period after the 1952 accident Captain Marsh remained on continuous flight duty, without incident, until the accident of February 1, 1957.

Part 3 - Dispatch. Flight 823 was released by Northeast Airlines dispatch at Miami at 1301 to fly from La Guardia to Miami via airways on an instrument flight plan with the alternate West Palm Beach. Fuel was 18,000 pounds. Maximum gross weight authorized was 97,275 pounds. This figure was computed for runway 4 by adding 3,275 pounds to the basic figure of 94,000 pounds for this runway. The release for Flight 823 was based on the 1230 La Guardia weather, which showed a temperature of 34 degrees F. (allowing 1,375 pounds to be added to the basic figure) and a wind direction of northeast 11 knots (using only 10 knots of this permitted an additional 1,900 pounds to be added to the basic figure).

The maximum allowable weight was recomputed and found to be 98,840 pounds with consideration for runway gradients, wind velocity, and temperature. The gross weight of N 34954 at takeoff was 98,575 pounds, or 265 pounds under the maximum.

Northeast Airlines' minimums for DC-6 aircraft takeoffs on runway 4 at La Guardia are: Ceiling 100 feet, visibility one-quarter mile.

Flight 823 was scheduled for a 1445 departure but was delayed to clean the aircraft of snow. Northeast Miami dispatch continued to monitor the La Guardia weather. At 1750 La Guardia company radio advised Miami dispatch that the aircraft was leaving the hangar and proceeding direct to runway 4 for takeoff. At 1804 La Guardia company radio advised Miami that the flight was off the ground at 1801. At 1825 Miami dispatch requested further information on the progress of Flight 823, and was advised of the reported crash.

Part 4 - Weather. The surface temperature at La Guardia held steady at 31 degrees F. from 1423 through 1729 and dropped one degree to 30 degrees F. between 1729 and 1823. The temperature at 500 feet was approximately 28 degrees F., falling to about 25 degrees F. at 2,000 feet and returning to about 28 degrees F. at 5,000 feet. Above 5,000 feet, the temperature gradually decreased. Below freezing temperatures existed at all altitudes.

The relative humidity at the surface had been 94 percent or greater after 1323 and reached 100 percent by the 1724 observation. Very light snow began at La Guardia at 1202 changing to light snow at 1238 and continuing throughout the remainder of the day. By 1915 four inches of snow had fallen. Fog began at La Guardia at 1349 and continued throughout the rest of the day.

From 1350 until after the accident, ceilings ranged from 500 to 800 feet and visibilities varied from three-eighths to three-fourths mile. At 1753 the

La Guardia observation was: Precipitation ceiling 500 feet, sky obscured; visibility 3/4 mile; light snow and fog; wind north-northeast 10 knots; altimeter 30.12. At 1806 the La Guardia precipitation ceiling had risen to 800 feet and the wind had increased to 15 knots. Other items remained constant.

The regularly scheduled terminal forecast for La Guardia Field issued at 1122 for the period 1700-2300 forecast ceiling of 400 feet and occasionally 300 feet, sky obscured; visibility 1 mile, occasionally 3/4 mile; with a mixture of rain, snow, sleet, and fog and occasional freezing rain. An amendment to this forecast, issued at 1350 valid for the period 1350 to 2300, forecast ceilings 400, occasionally 300 feet, sky obscured; visibility 1/2 mile variable 1/4 mile; with light to moderate snow and fog and occasional sleet mixed. The next regularly scheduled terminal forecast for La Guardia Field issued at 1722, valid for the period 1800 to 2200, called for ceiling 600 variable to 300 feet, sky obscured; visibility 1/2 variable to 1/4 mile; with light snow and fog.

Part 5 - Snow Removal from Aircraft. When the aircraft was at the loading ramp, maintenance personnel started clearing it of snow. But continuing snowfall nullified this effort and about 1600 the aircraft was taxied, with passengers and crew, to a nose hangar near the Marine Terminal of La Guardia Field. There a crew of 12 men removed snow from the aircraft surfaces using brooms and an ice preventive fluid. All areas except a small portion on top of the fuselage cabin section were cleared. The fuselage aft of the trailing edges of the wings protruded through the canvas curtain of the nose hangar and was thus exposed during the operation. Testimony of maintenance personnel indicates that all horizontal tail surfaces were cleared of snow and ice preventive fluid was applied. At this time the rudder hinges were inspected for snow accretion.

After satisfactory inspection, the aircraft was turned over to the flight crew at 1745. During the taxiing to the runup position and during the takeoff roll snow was not sticking to the cleaned surfaces but was being blown off by propeller blast and movement of the aircraft, according to testimony of the flight crew and passengers. There was also testimony that other aircraft that had been parked outside and exposed to snowfall for a longer period accumulated snow on horizontal surfaces, but no ice.

Part 6 - Crew's Description of Flight. Captain Marsh stated that the takeoff roll, except for some sliding of the nose wheel at low speed, was normal and the aircraft became airborne after a normal ground run. He also stated that the landing gear was retracted immediately after becoming airborne and then, with a good rate of climb established, the wing flaps were retracted; further, that he remained on "solid" instruments from the boundary of the field until First Officer Dixwell exclaimed, "Al, ground!" Marsh said that at no time did any of the pertinent instruments on his panel indicate anything but a straight flight out the heading of runway 4 and in a climb with airspeed in the order of 135 knots.

First Officer Dixwell stated that he had been monitoring his own instruments and that his observations were the same as the captain's up to the time that his attention was given to the flight engineer starting the first power reduction. Both pilots stated there was no indication of a turn, from their instruments, and they did not physically sense a turn or abrupt movement of the aircraft. Captain Marsh said that his first thought after coming to a stop was that they were near the La Guardia range station or the Bronx tank.3/

3/ A large gas holder across Long Island Sound.

Part 7 - Evacuation. Very soon after the aircraft came to a stop the captain and copilot got out through the left cockpit window; the flight engineer via the right side crew door. These three testified that they were then unable to get on either wing to open emergency exits because of flames on both sides of the fuselage at the wing section. They assisted the egress of persons from other areas. A number of passengers seated in the forward part of the cabin were able to get out through a gaping hole torn in the left lower side of the cabin. Toward the rear of the cabin the stewardesses and many passengers were able to use window exits as well as a hole torn open on the right side of the cabin. Others opened emergency exits on the right side and got out on the right wing before the fire had developed to large proportions. The main cabin door had jammed because of fuselage deformation and could not be opened by the cabin attendants. Testimony indicated that those leaving the aircraft did so in less than two minutes after the aircraft came to a stop. Following the ground slide, the cabin filled with smoke; the lights went out as wiring separated, and very shortly fire entered the cabin. The safety belt sign had been on and the belts of the 89 passenger seats (19 double and 17 triple) were used and the seats remained in place. The cabin emergency exit impact lights did not go on because the first ground impact did not provide sufficient deceleration and the subsequent ground movement was comparatively smooth with stopping gradual. These impact lights derived their power from flashlight batteries and could not be operated manually.

Fire equipment and assistance were supplied promptly by personnel from the nearby city penal institution on Rikers Island. Those who had been able to leave the aircraft were conducted to shelter and given medical aid.

Part 8 - Scene of Crash. Rikers Island is irregularly oval with its greatest dimension, from east and west, approximately one mile. Its southern shoreline is some 600 yards north of the northeast corner shoreline of La Guardia Field. The northwestern area of the island is occupied by New York City penal buildings. The DC-6A came to a stop and was destroyed by fire a short distance south of these buildings.

Flight 823 first struck small trees while on a heading of 285 degrees magnetic. The left wing tip struck the ground first; the right wing tip struck 150 feet beyond. The aircraft, after striking the ground nearly level longitudinally, skidded approximately 1,500 feet and came to a stop on a heading of 241 degrees. The ground elevation differential between the initial impact point and the stopping place is less than 10 feet. It was determined that the angle of descent at impact was seven degrees. Groundspeed at impact, computed from propeller slash marks and engine r. p. m., was approximately 138 knots. Impact occurred approximately 60 seconds after start of the takeoff and after a left turn of approximately 119 degrees from the heading of runway 4.

Part 9 - Structure. The airplane struck the ground while descending in a slightly left wing low attitude. Numbers 1 and 2 engines separated from their nacelles and subsequently the entire left wing and outer right wing parted from the airplane as it skidded along the ground. There were many more pieces of the aircraft and its components strewn along the path of travel on the ground. Those near the point of initial impact showed no signs of fire damage. No pieces of the airplane were found back along the flight path beyond the point of initial impact of the airplane with the ground.

The main wreckage consisted of the fuselage, the right inboard wing, and the empennage. The fuselage belly had been flattened and torn away during the ground slide with the result that most of the fuselage floor came to rest in contact with the ground. Fire after this portion of the wreckage stopped, as evidenced by debris on the ground, completely burned out the right inboard wing and the fuselage from the cockpit windshield to the aft pressure bulkhead. The right inner wing, the fuselage nose section, and the aft pressure dome remained in their correct relative positions.

The tail section of the fuselage, with all tail surfaces still attached and bearing no gross distortion, came to rest centered approximately eight feet to the left of the main fuselage wreckage and canted approximately 28 degrees to the left of the main fuselage centerline, separation having occurred just aft of the main pressure bulkhead. The bottom skin of the fuselage tail section had been partially torn away by the ground slide and was on the ground stretched out to the left of its normal position with little to no fire damage. The tail anti-icing heater was found still attached to this stretched-out skin by the exhaust ducting and laying on the ground forward of the left stabilizer. No fire damage to the heater was found although it sustained severe impact damage. Ash from a burned-out landing flare was found on the ground below a burned-out area at the root end of the right stabilizer.

The basic structure of the horizontal tail surfaces remained intact although there were numerous holes punched through the skin from external forces, and the outside surface of the bottom skin bore numerous scratches at various angles up to 55 degrees running aft and to the left of the airplane's longitudinal axis.

The top and bottom skins of the left stabilizer had torn apart chordwise along the rivet lines at station 160 from the front spar to the rear spar, and between solid web ribs at stations 129 and 168 the skin was displaced outward. In this general area the skin had been pushed off the rivet heads of intermediate ribs by outward-acting forces and had separated from the spars partly by pulling out through the rivet holes and partly by tearing the skin at the rivet lines. The rib at station 168 was bulged in the outward direction. The web of the rear spar contains lightening holes and over the web is a sheet metal cover. This cover was pushed aft off its lower attachments and was partly torn off its upper attachments. Some of the previously mentioned diagonal scratches on the outer surface of the stabilizer bottom skin were continuous across the skin fracture at station 160. These scratches, which were continuous across the skin tear, ran aft and outboard at an average angle of approximately 48 degrees to the longitudinal axis of the airplane.

Although there was considerable scorching by fire inside the left horizontal stabilizer, none was found inside the anti-icing hot air duct. The inboard portions of the round hot air duct in the leading edge were flattened by pressures inside the stabilizer greater than those outside the hot air duct. Blackening by fire could be seen at many places inside the left horizontal stabilizer around holes which had been punched in the skin.

Part 10 - Powerplants. Investigation of the four powerplants gave conclusive indication that engine or propeller failures did not contribute to the accident. This is substantiated by the flight crew members who testified that no powerplant difficulty was experienced.

Extensive damage precluded functional tests of the engines and also complete examination of their accessories. Consequently, the possibility of minor malfunctioning cannot be positively excluded; however, no such conditions were reported by the flight crew. Some passenger testimony and a few of their statements indicate an engine fire on the left side. These were considered and discarded because examination of Nos. 1 and 2 engines (left side location) revealed no fire damage prior to or after impact.

Part 11 - Maintenance of the Aircraft. Under the agreement between Northeast Airlines and Flying Tiger Line, lessor of the subject aircraft, the latter would perform all major checks on the aircraft. These were intended to maintain the airplane in an airworthy condition except for day-to-day preflight maintenance and servicing which Northeast Airlines performed. The agreement did not limit Northeast to preflight maintenance and the last No. 9 check was conducted in Miami, Florida, by NEA personnel. Flying Tiger Line had a maintenance foreman stationed at Miami, Florida, available as advisor to Northeast maintenance personnel regarding maintenance of the aircraft. The previous Nos. 7 and 8 checks had been performed by Flying Tiger personnel at their New York International Airport (Idlewild) base.

The records reflected that the prescribed major checks and component changes had been accomplished within their alloted times. Entries in the aircraft log of malfunctioning items were signed off either as corrected or deferred. (Deferring corrective action is a common practice when the airworthiness of the airplane for the particular trip or trips to be involved is not compromised.)

The records of a No. 8 check by Flying Tiger Line at New York International Airport on January 16, 1957, reflected that the inverter frequency had been checked. However, investigation revealed that the necessary equipment to accomplish this check was not available and that the individual who signed off this item did not know what was required to make this check. The testimony of the CAA Air Carrier Safety Agent (Maintenance) assigned to Northeast indicated he was at the Flying Tiger base for about four hours while the No. 8 check was being accomplished.

The nature of this accident directed attention to direction indicating instruments, particularly the C-2 compass. The aircraft log sheets showed several entries of C-2 compass malfunction, the last of which was on January 23, Boston to Miami. Corrective action in this instance was "Changed amplifier." There were no subsequent entries regarding this instrument. Testimony of the crew was that this instrument functioned normally during the flight from Miami to New York preceding the accident. The only irregularity noted by the crew on the preceding flight was that No. 1 engine exceeded the normal takeoff r. p. m. by about 100 r. p. m. and it was controlled with no difficulty by use of the appropriate toggle switch.

Part 12 - Ground Navigational Facilities. At the time of takeoff No. 1 ADF was tuned to Paterson, New Jersey, and No. 2 ADF was tuned to the La Guardia range. Both of these ground facilities were found to be operating within their normal limits after the accident. The lights of runway 4 were fully operative and lighted during takeoff.

Part 13 - Rudder Trim Tab. One of the possibilities explored in detail was that of a snow- or ice-jammed rudder tab producing an abrupt left turn by sud-

denly breaking loose during flight. Although Captain Marsh testified that he encountered no difficulty with the rudder control system and that neither rudder pedal forces nor displacement were unusual, it was decided, nevertheless, to investigate this possibility.

All components and parts of the rudder tab, tab control system, and related structure were examined for evidence of failure or malfunctioning and for indications of unusual deformation that might be associated with a snow-jammed tab. Except for the relatively minor damage in the area sustained in the ground impact and fire, all pertinent parts and components were intact and functioning, and no unusual deformation was noted. The rudder spring tab cartridge was removed and tested for conformity with specifications at the Douglas Aircraft Company. The spring cartridge was properly assembled and the spring itself was within drawing specification. In further support of there being no control failure or malfunction, Captain Marsh testified that rudder control was available throughout the entire flight, and that he did not experience control abnormalities at any time.

Several test flights were made with DC-6 aircraft to evaluate the effect on flight characteristics of a rudder trim tab suddenly released. The last, and most conclusive, was made without the pilot being told of the nature of the test. In this test, unknown to the pilot, several units of left rudder trim were put into the rudder system while the rudder was held in neutral by the copilot's application of opposite rudder. The pilot was then told to uncover his eyes and correct for a deviation to the right. As he started the correction the copilot released the pressure he was applying to the right rudder pedal and the rudder deflected suddenly to produce a sharp left turning action. The aircraft banked and yawed mildly, the heading change was approximately 15 degrees (insignificant as compared to the 120-degree turn made by N 34954) and the pilot corrected this mild displacement and had the aircraft stabilized on its original heading - all within five seconds. Motion pictures taken of the instrument panel as the aircraft went through the maneuver showed that the turn-and-bank indicator, the gyro horizon, and the C-2 compass all indicated plainly the nature of the maneuver and provided adequate indication upon which to base corrective action.

Part 14 - Instruments.[4/] Examination of the pitot tubes and static vents disclosed that their heating elements were intact and capable of normal operation. Foreign material found in the openings of the two pitot tubes was determined to be pieces of charred wood, some with tree bark attached. A tar-like liquid was discovered in the pitot tubes and system tubing. The quantity of this material was too small to permit a complete analysis, however, it appeared to be the product of destructive distillation of the wood particles which were lodged in the hot pitot tubes. The pitot tubes had not been involved in ground fire.

No obstructions were found in the openings of the static system vents or in the static system tubing.

The remains of three altimeters were recovered. Examination disclosed that they had not been subjected to high impact loads. The positions of these instruments (captain's, copilot's, cabin altitude) when mounted in the aircraft could not be determined. The following barometric scale settings were determined for these instruments: 30.14 inches, 30.135 inches, and 30.20 inches. The altimeter setting given the crew at the time of takeoff was 30.12 inches.

4/ See attachment B - Photo of DC-6A instrument panel.

No information of value was obtained from examination of the remains of the one rate-of-climb indicator that was recovered.

Both ADF (automatic direction finder) indicators were recovered in a badly burned condition. It could not be determined which one had been installed in the captain's panel and which in the first officer's panel.

The cover glass of one indicator was cracked and smoky. It was removed to permit examination of the azimuth card and pointers. The card was found set at 15 degrees and seized. The dual pointer was seized at 210 degrees. The single pointer was slightly movable between 2 degrees and 4 degrees.

The cover glass of the other indicator was missing and the markings on its azimuth card were scarcely legible. The card was seized at 0 degrees. The single pointer was missing except for its hub. Portions of the dual pointer remained but the head and tail positions could not be determined. The pointer was seized in position and its approximate indication was either 30 degrees or 210 degrees.

Two Collins Course Indicators were installed in the aircraft. Both were recovered from the wreckage. They had been extensively damaged by fire but exhibited no signs of impact damage. The operating mechanisms of both were seized.

One instrument's readings were: Azimuth ring heading indication 282 degrees; course selection setting 288 degrees; heading selection 19 degrees. Readings of the second were: Azimuth ring heading indication 272 degrees; course selection setting 80 degrees; heading selection setting 314 degrees. The panel positions (left or right) of these instruments could not be determined by serial numbers; however, the second is believed to have been on the captain's panel, since he testified that he had selected a course setting of 81 degrees.

The aircraft was equipped with two Sperry Gyrosyn compass systems. One was a model C-2A Gyrosyn compass on the captain's instrument panel. The other was a model A-12 Gyrosyn compass, a component of the Sperry A-12 Gyropilot. This unit was located in the belly of the fuselage but its heading indication was repeated on the azimuth ring of the Collins Course Indicator located on the first officer's instrument panel.

Two flux valves, located in the tail cone of the aircraft, furnished magnetic heading information to the Gyrosyn compasses. These escaped damage and were found to be well within manufacturing specifications when tested at the Sperry Gyroscope Company.

The C-2A Gyrosyn compass was found to have been subjected to high heat which had extensively damaged its internal components. Its compass card was seized at an indicated heading of 153 degrees. The gyro assembly was found to be in gimbal lock position. The compass card was free from the rotor shaft and the shaft was free to move. The signal and Selsyn rotors were also loose on their shaft. The A-12 Gyrosyn compass had been almost completely consumed by fire; only the upper frame containing the compass card was found. The gyro assembly was found attached to the bottom of the frame by metal slag. Its compass card was still legible and seized at an indicated heading of approximately 179 degrees.

Both turn-and-bank indicators and the captain's gyro horizon indicator were recovered but fire damage was so extensive no useful information was obtained by their examination.

The electrical system of the aircraft was largely destroyed in the ground fire that followed impact. The four d. c. generators, Bendix model 30E02, were recovered, disassembled, and examined. Although they had suffered impact and fire damage there was no indication that they had failed electrically or mechanically before the accident.

In addition to the examination of recovered instrument components the Board initiated and supervised tests in which electrical system malfunctions were simulated in a similar aircraft and the effect upon the flight instruments noted. Laboratory tests were also performed wherein a gyro horizon indicator and a turn-and-bank indicator of the type installed in the aircraft were supplied with electrical power of abnormal voltage and frequency and their behaviors recorded. The results of these tests were made a part of the investigative record and will be discussed later in the Analysis section of this report.

Part 15 - Operation. According to crew testimony, the checklist and engine runup were completed and the radios set in the following manner before takeoff.

The No. 1 VHF navigation receiver was tuned to the Caldwell VOR which presented a plan view or map-like display on the captain's course indicator. The cross pointer indicator located on the left of his instrument panel presented information received from the same radio range. The No. 1 ADF receiver was set to Paterson radio beacon. The lower right cross pointer indicator was displaying the La Guardia ILS which was tuned on the first officer's receiver.

The No. 2 VHF navigation receiver was tuned to the La Guardia ILS presenting a pictorial display on the first officer's indicator. The first officer's cross pointer indicator and the captain's lower right cross pointer indicator also presented information from the La Guardia ILS. The No. 2 ADF receiver was tuned to the La Guardia low frequency range.

The ADF's were initially checked for bearings while the aircraft was on a heading of 285 degrees. The C-2A Gyrosyn compass was checked against the magnetic compass on that heading.

The captain's course indicator was not checked at run up position. The first officer's, however, was checked for direction against the magnetic compass but not against the captain's C-2A. When lined up on the runway for takeoff, the C-2A read 43-44 degrees and the first officer's No. 2 ADF indicator lined up with the La Guardia range.

On the takeoff Captain Marsh handled the throttles and requested the flight engineer to "level" them off at 59-1/2 inches. Marsh also handled nose wheel steering. During the roll down the runway, the first officer monitored the airspeed and called off V_1 and V_2 speeds. He handled the control yoke until V_1 at which time Captain Marsh took control. First Officer Dixwell testified that all flight and engine instruments appeared normal during the takeoff run. He toggled the No. 1 propeller switch to bring the r. p. m. back to 2,800. The captain lifted off at V_2 and went to instrument references. At this time Dixwell did not

notice any deviation from course on his deviation indicator nor did he notice any deviation for the remainder of the flight. Immediately after breaking ground, the landing gear was retracted by the flight engineer on the captain's order.

At 125 knots, Captain Marsh called for zero flaps and the flap control was actuated by the first officer. Marsh testified that at this time he concentrated on the airspeed, rate of climb, and direction. When questioned about directional instruments he stated that they would include the C-2A, artificial horizon, the turn-and-bank, and the ADF. He would be especially interested in the ADF, this being a primary and ideal instrument to use for direction. He also stated that he used the ADF as a directional instrument and that his course indicator was not utilized. He observed the rate of climb to be 800 feet per minute which reduced to 400 feet per minute.

First Officer Dixwell testified that he saw the flap indicator move toward zero as he monitored the flight instruments. He also observed that the airspeed continued to increase and that the rate of climb was normal. Further, he observed a heading of 40-45 degrees on his course indicator azimuth card; this was the last heading that he recalled. During this time Dixwell acknowledged the tower's instruction to change radio frequency. Captain Marsh testified that as the aircraft accelerated through 130-135 knots, he glanced at the flap indicator and noted that the flaps were retracting. He immediately looked back at his rate of climb, airspeed, and directional instruments. He had no recollection of looking at his altimeter this early in the flight.

Further testimony indicated that at 140 knots, Captain Marsh called for METO power and observed the flight engineer starting to reduce power. First Officer Dixwell heard this command, took his eyes from the flight instruments, and monitored the flight engineer's actions, observing him reduce manifold pressure and propeller control. Quite a few seconds later his attention was attracted to the outside; he saw the ground through his own windshield and immediately yelled, "Al, ground!"

Meanwhile, according to Captain Marsh, everything was normal. He believed that his only observation of altitude was going "through" 200 feet before, suddenly, Dixwell yelled, "Al, ground!" He immediately pulled back on the yoke, looked up, saw the ground, saw that he was in a left bank and started correction which was interrupted by ground impact.

Analysis

Part 1 - Dispatch. Conditions at the destination and alternate were still good at the time of actual departure and forecast to remain so. The maximum takeoff allowable gross weight computation was considered still valid in view of the weather conditions at La Guardia. Therefore, an amended release was not issued by Northeast dispatch center at Miami for Flight 823 nor was one required.

Part 2 - Weather. Between 1350 and the time of the accident 29 weather observations were taken at La Guardia Field. This would indicate that an adequate and close watch on terminal weather was being maintained. The terminal forecasts issued were accurate relative to the prevailing weather at La Guardia on the afternoon of February 1.

Below freezing temperatures at the surface and aloft produced snow which did not adhere to vertical surfaces and virtually eliminated any danger of significant clear icing. The aircraft had encountered no icing during its descent into La Guardia on its northbound flight, which was completed about 1250. No ice formation was noted on the wings during the snow removal. Other aircraft parked outdoors at La Guardia all afternoon also exhibited no ice formation. No aircraft departing La Guardia while the Northeast DC-6 was there reported difficulties from snow or ice on external surfaces. One aircraft did begin to pick up some wing icing at 4,000 feet but this was readily corrected by the use of the thermal de-icing system.

Ceiling and visibility were above the pertinent company takeoff minimums at the time of takeoff. Neither instability nor gustiness existed at low levels and any turbulence encountered by the flight would have been negligible and none was reported by the crew.

Part 3 - Snow Removal from Aircraft. It is apparent that snow did not affect flight characteristics and that the snow removal operation was effective. The aircraft, loaded to near maximum weight for the runway used, left the runway normally in the usual break ground area and the flight crew testified that a steady climb and increasing airspeed prevailed thereafter until they reached an approximate altitude of 300 feet. The captain also stated there was no indication of buffeting or abnormal control "feel."

Part 4 - Evacuation. It is believed that because of the sliding ground impact of not too great severity there were no fatalities or serious injuries caused directly by the impact or ground movement. The cabin floor remained fairly intact, before the fire, and the seats were not loosened from the floor. Unfortunately, the intense fire, fed by 3,000 gallons of fuel, caused the many fatalities and serious injuries. There was obviously some deformation of the fuselage during the 1,500-foot slide which jammed the main cabin door, and possibly other exits as well. Civil Air Regulations require that aircraft doors and emergency exits be constructed to minimize jamming in minor crashes. Obviously in impacts and ground movement of the magnitude of this accident there is no aircraft construction that would prevent fuselage deformation and consequent jamming of exits. (In later model aircraft having a passenger seating capacity of 40 or more persons, Civil Air Regulations require a second floor-level emergency exit on the side opposite the main cabin door. Where the total number of passengers exceeds 110, at least two (2) floor-level exits are required on each side of the fuselage. These are in addition to the window-type exits of which the required number will vary according to passenger seating capacity.)

The absence of lights in the cabin after the aircraft came to a stop undoubtedly hindered the evacuation of many occupants. The normal cabin lights, which were on, went off when electrical connections were separated during the ground slide and the deceleration was not sufficient to actuate the automatic impact lights with their independent source of energy.

The Board is concerned by the difficulties experienced in evacuating passengers after the airplane came to rest. The jamming of the main door and the nonoperation of the automatic lighting system apparently hindered speedy evacuation. The Board is studying this problem from the standpoint of adequacy of the regulations and their application.

Part 5 - Structures. Consideration of the wreckage distribution and detailed examination of the airframe wreckage disclosed no evidence of structural failure, control malfunction, or fire prior to ground impact. Testimony of the pilots and flight engineer also reflected no indication of structural failure, control malfunctioning, fire, fire warning, or unusual sounds during the brief time that the airplane was in flight.

The outward displacement and tearing of the left horizontal stabilizer upper and lower skins in the area of stations 129 to 168 are conclusive indications of an explosion having occurred inside the stabilizer. However, the continuous scratch marks across the station 160 tear in the lower skin are equally conclusive indications that the explosion occurred after the stabilizer was sliding across the ground at an average angle of 48 degrees to its normal line of motion. It is evident that the explosive in this case was a gasoline-air mixture. Although it has not been established whether the gasoline came from disruption of the tail anti-icing heater fuel lines on breakup of the fuselage just aft of the main pressure dome, or from breakup of the fuel storage areas of the wings, the specific source is not pertinent since it is obvious that the disruption of the left horizontal stabilizer contour occurred during the ground slide.

Part 6 - Maintenance. Records and documents embracing the entire operational life of this aircraft were reviewed minutely during the investigation. The first impression was that this airplane had experienced a higher than normal rate of electrical and instrument malfunctions. However, absence of a pattern on which to base a comparison invalidates any such conclusion. Absence of a record or report of difficulties of the electrical and instrument systems during the several flights immediately preceding the accident indicates that the final corrective measures, particularly with respect to the C-2 Gyrosyn compass, were adequate.

Responsibility for the day-to-day airworthiness of N 34954 while operated by Northeast was divided. Major checks had been conducted by both the Flying Tiger Line and Northeast Airlines. There was at least one irregularity in the maintenance of the operation. One item (inverter replacement) on the No. 8 check conducted by the Flying Tiger Line, though signed off, had not been accomplished. Necessary equipment to accomplish the check (voltage was checked but not frequency) was not available nor was the individual assigned to perform this check qualified. Despite these circumstances, based on the investigation in its entirety, it is concluded that maintenance of the aircraft had no bearing on the accident. It is considered pertinent that the crew involved in the accident had no items of an airworthiness nature to report at the termination of the previous trip nor were any noted during the predeparture and departure checks.

Part 7 - Trim Tab. In investigating the possibility of an ice or snow-jammed rudder tab as the cause of the accident, the Board explored all areas that would develop information in this regard. Although it appeared unlikely, in view of the existing temperature during the period involved, that sufficient ice or packed snow could accumulate in such a manner to cause jamming of the rudder tab, the Board concluded that it would be reasonable to assume that this could conceivably have occurred. However, the examination and study of the rudder tab and tab control system components and parts, a consideration of aerodynamic design forces involved, and, finally, the results of the flight tests conducted following the accident all lead the Board to the following conclusion:

If such a condition had existed Captain Marsh should have been sufficiently alerted, by his instrumentation, to effect immediate recovery. Accordingly, the Board has rejected this possibility as the cause of this accident.

Part 8 - Instruments. Pieces of charred wood found in the pitot tubes obviously came from trees struck by the aircraft as it slid over the ground. The charring of the wood and the finding of a tar-like liquid, presumably the product of destructive distillation of the wood, are indicative of residual pitot heater operation. The static vent heating elements were in good condition and, since they operated in conjunction with the pitot heaters, should also have been operating prior to the accident. It must be concluded, therefore, that there was no obstruction of the pitot system or the static system due to ice or foreign material.

Further indication that the pitot and static systems operated normally is the testimony of the crew that the aircraft responded normally to control pressures when lifted off the runway at the V-2 speed as indicated and that a normal rate of climb and normal increase in altitude were observed.

The crew reported seeing normal indications on their ADF indicators while the aircraft was on the ground shortly before takeoff.

The readings obtained from these instruments, after the accident, have been studied at length. They do not represent the indications that would have existed at the time of impact had they been indicating properly. Neither do they represent the indications that would have existed at impact had they ceased operation during the takeoff. One dual pointer indication was only a few degrees from a position that would be normal for a straight climb from runway 4. However, the position of this pointer did not coincide with the positions of the dual pointer of its companion instrument. The head and tail positions of the latter pointer could not be determined but the indication is either one of a turn of approximately 30 degrees having been made to the left after takeoff, or of a turn of approximately 150 degrees having been made to the right.

The ADF indicator is so constructed that its pointers are free to rotate in either direction if the instrument is shaken while operating power is removed. The magnitude and direction of movement is a function of the magnitude and direction of the applied load, needle balance, and internal friction. Although the instrument is not overly sensitive to shock loads, a change of pointer position is to be expected under the conditions that prevailed in this accident. During the ground slide the instrument panels would be subjected to greater than normal vibration and electrical power would become interrupted. Later, as fire destroyed the instrument panels, the instruments would fall free.

In consideration of the foregoing, it is believed that the pointer indications of the ADF indicators, as found after the accident, are random and meaningless for the purpose of this analysis.

Two Collins course indicators were installed in the aircraft, one mounted on each pilot's panel. One of the functions of the instrument is the indication of the aircraft's magnetic heading. This is accomplished by means of an azimuth ring which is slaved to the aircraft's compass system. The ring rotates as the aircraft's heading changes and the heading is read beneath a lubber line at the top of the instrument. The azimuth rings of the two course indicators were

slaved to separate compass systems. The captain's course indicator azimuth ring was slaved to the Sperry C-2A Gyrosyn Compass and that of the first officer was slaved to the Sperry A-12 Gyrosyn Compass, a component of the A-12 Gyropilot.

Examination revealed that the heading indication of the unit believed to have been installed in the first officer's panel was 282 degrees. A heading indication of 272 degrees was found on the unit believed to have been in the captain's panel. The course indicator is not, in itself, sensitive to heading. Its azimuth ring is slaved to a compass system and repeats the heading information derived from that system.

Examination of these indicators revealed only fire damage and no evidence of damage due to impact forces. Considering the nature of the azimuth ring's driving mechanism and the absence of impact damage, it is felt that the indicated headings are the result of operation of the instrument.

If electrical power is removed from a course indicator, the azimuth ring will remain at rest and cannot be moved by vibration or shaking. If the power interruption occurs while the ring is rotating, there will be a short coasting period before stoppage. The maximum rate of turn of the ring is approximately three r. p. m., which represents a very high aircraft turning rate. If electrical power to the instrument is interrupted at that rate of turn an overshoot of approximately 20 degrees will occur. The approximate average rate of turn of the aircraft immediately after takeoff was one r. p. m. If power were interrupted at that rate the overshoot would be approximately six to seven degrees. The lag between compass system heading indication and course indicator azimuth ring heading indication would be approximately one to two degrees at high rates of turn. It is apparent, in this instance, that lag and overshoot values are not of sufficient magnitude to be of significance. Considering this, together with the lack of impact damage and the insensitivity of the azimuth ring mechanism to external forces, the heading indications found must represent, quite accurately, the readings of the instruments and, consequently, the headings of the aircraft at the time power to these instruments was interrupted.

The 10 degrees difference in heading readings indicates that the two compass systems became inoperative at different instants during the slide of the aircraft. Initial contact of the aircraft was on a heading of approximately 285 degrees and the final heading was 241 degrees.

It appears that the first officer's compass system stopped functioning first at a 282-degree heading. This was followed by failure of the C-2A system at a 272-degree heading. One possible explanation of this behavior is that the A-12 Gyrosyn compass system units, which drive the first officer's course indicator azimuth ring, were located in the fuselage belly and might have been destroyed before the C-2A Gyrosyn compass system was affected, its components being above the cabin floor level.

The Board gave consideration to the possibility of the two azimuth rings having failed to rotate during the turn owing to some unknown malfunction that caused their respective compass systems to "hang-up" or hold the runway heading and, that following breakup of the aircraft, wherein the tail section was nearly separated, the flux valve wiring was destroyed permitting the magnetic slaving systems of the gyro compasses to precess them to the heading indications found.

The preceding hypothesis has been found unacceptable for several reasons. Simultaneous failure of two separate compass systems would be necessary. The maximum precession rate that could be commanded by the flux valve slaving system is approximately five degrees per minute; which means that a minimum period of 25 to 27 minutes would be required. This is considerably longer than the time required for fire to render the instruments inoperative.

Finally, electrical power would not have been available for so long a period. When engine rotation ceased all generator output was lost and the batteries became the only source of electrical energy. They, being located in the fuselage belly, were most probably destroyed early in the slide of the aircraft.

The captain testified that the C-2A Gyrosyn compass indication was checked and found to be normal when the aircraft was in the ramp position. The aircraft heading at that time was approximately 280 degrees. Shortly thereafter the instrument was again observed while the aircraft was in takeoff position and it was indicating 43 to 44 degrees, which agrees with the heading of runway 4. This indicates normal operation of the instrument up to that point.

The captain's course indicator azimuth ring receives its heading information from the C-2A Gyrosyn compass and its reading of 272 degrees after the accident indicates that the C-2A operated normally during the flight. The captain testified that he referred to the C-2A Gyrosyn compass for heading information and saw no indication of the turn made by the aircraft, only headings of approximately 40 degrees to 45 degrees being observed. To have occurred, the compass card of the C-2A would have had to become disconnected from its shaft after the aircraft was lined up on the runway. It would then, in some unexplained fashion, have had to indicate response of the aircraft to control actions in changing heading between 40 degrees and 45 degrees as the captain testified. Finally, in the period of time after the captain stopped viewing his panel until the instrument was destroyed in the ground fire, the disconnected compass card would have had to rotate to the 153-degree heading indication at which it was found.

A more plausible explanation of the occurrence is that the instrument behaved normally throughout the flight. Electrical power to the course indicator was interrupted after impact, causing the azimuth card to remain at a 272-degree heading indication. When fire consumed the instrument panel the C-2A Gyrosyn compass was released and fell, allowing the gyro assembly to go into gimbal lock condition. With the gyro still coasting, precession would cause the compass card to rotate until gyro rotation ceased.

Fire marks on one of the 8-day panel clocks indicated that fire destroyed the clock at seven minutes past the hour. This indicates that the instrument panel was involved in fire approximately five minutes after the accident occurred. The gyro of a C-2A Gyrosyn compass will coast for approximately 12 minutes after power interruption and it is reasonable to assume that the magnesium instrument panel was destroyed within that period of time.

A similar occurrence of gyro precession is indicated in the case of the A-12 Gyrosyn compass which was found at an approximate heading of 179 degrees while its repeater, the azimuth ring of the first officer's course indicator, indicated a 282-degree heading.

The captain recalled that he checked his gyro horizon indicator before takeoff and that it was in a level condition and appeared to be normal. He did not

recall whether or not he caged it; however, the caging mechanism is spring-loaded to the uncaged position and the gyro becomes uncaged when the caging knob is released. Also, while the instrument is caged a warning flag appears behind the cover glass.

The first officer recalled that he checked his turn-and-bank indicator and found its operation normal before the takeoff.

The captain's turn-and-bank indicator and gyro horizon indicator received their electrical power from the secondary side of the captain's instrument transformer. Similarly, the first officer's turn-and-bank indicator and gyro horizon indicator received their power from the first officer's instrument transformer. It is to be expected, therefore, that if one of the two paired units was operating normally, as the crew had indicated, its companion instrument would also be operating normally, discounting individual instrument failure or failure of circuit wiring common to only one of the two paired instruments.

If satisfactory operation were obtained during the rump prior to takeoff, indications of turn and attitude would be expected during the very short period of flight that followed, Even if all electrical power were removed from normally operating instruments, indications of heading changes and attitude would be available for some time afterward as gyro speed decreased.

Tests that were conducted on a similar aircraft, N 34953, at Chicago, Illinois, March 15, 1957, showed that at least two minutes passed after interruption of electrical power before the horizon tumbled. Tests conducted later at the Eclipse-Pioneer Division, Bendix Aviation Corporation, using a similar instrument mounted on a 7-1/2° Scorsby test table showed the rundown period until the gyro tumbled to be 3-1/2 minutes. Gyro speed at that instant was approximately 1,750 r. p. m.

Turn indications of a similar turn-and-bank indicator were checked while the instrument was rotated at 180°/min. on a turntable. At normal gyro operating speed the needle deflection was one-half inch. Three minutes after power interruption the deflection was 3/32 inch. If the rate of turn were increased to 360°/min., which was the approximate average rate of turn of the aircraft from takeoff to impact, the needle deflection after three minutes of coasting would have been approximately 3/16 inch.

The effects of improper a. c. power input were also considered. Normal power required for these instruments is 26 volts at 400 c. p. s. The manufacturer's tolerances for these values are plus or minus 10 per cent. Various combinations of voltage and frequency were explored, the worst condition being 50 per cent of a normal voltage at 250 c. p. s.

With this unorthodox input, the gyro of the gyro horizon indicator operated at approximately 12,000 r. p. m. This is equivalent to the speed of a normally operating gyro one minute after its power supply has been interrupted. The gyro of the turn-and-bank indicator rotated at approximately 13,500 r. p. m. or at the speed of a normally operating gyro after approximately one minute of coasting following power interruption. Needle deflection in a 180°/min. turn at this r. p. m. would be approximately three-eighth inch.

The basic electrical system of aircraft N 34954 was a single-wire, ground return, direct current system, operating at 28 volts. Four generators, one

nunted on each engine, supplied the electrical power for the system. Power for peration of a. c. electrical instruments and equipment was provided by two inverters with outputs of 115 volts at 400 c. p. s. Where necessary the 115-volt nverter output was reduced by stepdown transformers to 26 volts for operation of certain instruments.

Since the electrical system, as such, was destroyed in the ground fire, its ntegrity before impact must be established through an evaluation of crew and passenger statements, evidence obtained in the examination of system components, and results of tests performed during the accident investigation.

The four generators were recovered, disassembled, and examined. Although impact and fire had damaged them, there was no indication that they had failed electrically or had been in any manner incapable of normal operation prior to the accident.

Passengers reported that the cabin lights became dim and for some time were off altogether when the aircraft was at the hangar for snow removal operations. These reports do not indicate electrical system difficulty. The dimming of the lights indicates a gradual drop in bus voltage after the engines were stopped and the batteries became the only source of electrical power. The period during which the lights were off altogether represents the time during which the battery master switch was turned off to prevent discharge of the batteries.

Normal electrical system behavior was reported after leaving the hangar. All lighting, instrument, and radio operation were reported as being normal. The flight engineer noted that the output of all generators was normal during the engine runup.

It was reported that the cabin lights, "seat belt," and "no smoking" signs, cockpit lights, and landing lights all functioned normally throughout the takeoff and short flight.

There can be little doubt that the basic d. c. electrical system of the aircraft was functioning normally.

The crew testified that the inverters had been turned on in the normal manner, i. e., captain's inverter switch, "up" position; first officer's inverter switch, "down" position; engine instrument inverter switch, "down" position.

In this configuration, Phase A of the upper inverter supplies power to the following receivers: No. 1 VHF Navigation, No. 1 VHF Communications, and No. 1 ADF. Phase C supplies power to operate the captain's course indicator and the indicator system of No. 1 ADF. Both phases are used in supplying power to the -2A Gyrosyn compass.

There exists ample evidence that both phases were intact and supplying power before takeoff and during the flight. Phase A power is confirmed by the normal reception of tower communications on No. 1 VHF receiver up to and including the instruction received after becoming airborne to change to departure control frequency. No difficulties were reported in the operation of No. 1 VHF navigation receiver and No. 1 ADF. Phase C is confirmed by normal indications of No. 1 ADF observed prior to takeoff. The indication of a 272-degree heading

on the azimuth ring of the course indicator, after the accident, confirms operation of this instrument during the flight. Since the course indicator repeats C-2A Gyrosyn compass heading, that unit must have operated normally. The C-2A Gyrosyn compass uses both Phase A and Phase C power.

The captain's turn-and-bank indicator and gyro horizon indicator were powered by both Phase A and Phase C of the upper inverter. The 115-volt output was dropped to 26 volts for operation of these instruments by means of an instrument transformer. Fuses were installed in the primary and secondary circuits of the transformer. A relay controlling power to the captain's inverter failure warning light was connected across Phase A and Phase C of the secondary side, at a point between the secondary fuses and the instruments. In this fashion the relay would sense the Phase A to Phase B voltage and act to turn on the warning light when voltage dropped below a pre-set amount.

It is apparent that the Phase C power was available beyond the transformer, and to the relay, since the warning light did not come on as it did in the tests on N 34953 whenever the Phase C primary or secondary fuses were removed. These tests also revealed that the warning light would come on immediately whenever the Phase A secondary fuse was removed. Absence of a warning light indicates that this fuse was also intact.

One other condition remains to be explored; loss of Phase A primary voltage due to melting of the Phase A primary fuse. It was demonstrated in the tests on N 34953 that removal of this fuse did not result in immediate inverter failure warning light indication. Secondary voltage decayed over a period of approximately five minutes before the light came on. The voltage at that time was approximately 23 volts. The gyro horizon had not tumbled at that time but continued to function for approximately two more minutes. The drop-out voltage specified for the relay is 18.5 volts. It is apparent that the relay installed in N 34953 was set at a higher value. Had it operated at 18.5 volts, the light would have remained off for a longer period and it is possible that the gyro horizon might have tumbled before the light came on.

One area that cannot be explored is the possible failure of an electrical connection or wire at or within one of these instruments. Such a condition would result in an inoperative instrument without the appearance of a warning light.

Power to operate the engine instruments and the wing flap position indicator is taken from Phase A of the lower inverter, at a point ahead of the Phase A, 115-volt circuit breaker. The voltage is then stepped down to the 26 volts required by these instruments by means of an auto-transformer. All engine instrument indications were reported as being normal in flight and the operation of the wing flap position indicator was observed as the flaps were retracting. This indicates that the Phase A output of the lower inverter was normal and that its circuit was intact from the inverter to the point of the engine instrument power takeoff.

Continuing along the circuit, there is evidence that the Phase A circuit breaker and the first officer's inverter selector switch were intact and conductive before the takeoff and during the flight. This is substantiated by the crew's report of normal reception of the La Guardia ILS on the No. 2 Navigation

receiver, normal reception of the La Guardia range station on No. 2 ADF receiver, and normal indication of the No. 2 pointers of the ADF indicators. Each of the aforementioned items is operated from the 115-volt Phase A of the lower inverter, when the inverter switches are positioned as described.

Evidence that Phase A power remained available during the flight is the finding of the first officer's course indicator azimuth ring indicating 282 degrees when recovered from the wreckage. This heading presentation indicates that the instrument was operating properly and receiving proper heading information during the flight. Both the course indicator and the A-12 gyropilot, which supplies it with heading information, are powered by Phase A.

The first officer's turn-and-bank indicator and gyro horizon indicator were powered by both Phase A and Phase C of the lower inverter. These, incidentally, were the only items powered by Phase C of the lower inverter. The circuits supplying power to these instruments are identical to those supplying the captain's instruments, and, therefore, they lend themselves to a similar analysis. Briefly, it is considered possible to lose the Phase A primary fuse and have the gyro horizon tumble before receiving an inverter failure warning indication. The other three fuses must have been intact. It is equally possible to have a failure of an electrical connection or wire at or within one of these instruments, as with the captain's instruments, resulting in an inoperative instrument and no warning light indicator.

In summary, loss of power to both the gyro horizon indicator and the turn-and-bank indicator of the captain's panel, without receiving an inverter failure warning, can occur as the result of a single failure; however, this failure will not cause loss of power to the similar instruments on the copilot's panel. At least one additional and similar failure or two additional unrelated failures would be required to lose power to both sets of gyro horizon and turn-and-bank indicators. At least two additional failures would be required to lose indication of both ADF receivers.

Part 9 - Operations. In analyzing the operational phase of this flight, a careful study was made of all known facts in conjunction with the testimony of the crew. In the analysis it must be borne in mind that the aircraft was airborne approximately 31 seconds during which time it traveled a distance of some 6,600 feet and turned approximately 119 degrees to the left.

Both Captain Marsh and First Officer Dixwell testified that the takeoff was normal and that they observed no indication of any irregularity or deviation from the takeoff heading. Testimony of the crew and passengers appears to be in general agreement in that the aircraft was not banked when it passed over the runway and there was no feeling of any abrupt changes in attitude during the flight. One passenger, with 400 hours of piloting experience, testified that the aircraft was in a steep left bank just prior to the time he observed a leveling action of the aircraft immediately prior to impact. Considering this testimony, the time consumed in reaching the end of the runway, and the time involved in attempted recovery, it must follow that the turn, although steep, was a coordinated one and was accomplished within a period of some 20 seconds. Thus, the rate of turn was in the magnitude of six degrees per second.

From the testimony, it is evident that the aircraft's acceleration after takeoff was normal and that Captain Marsh followed the prescribed company pro-

cedures in ordering the landing gear to be retracted, the wing flaps raised, and power reduced to METO. Considering the short time involved in the execution of these commands, it is considered highly probable that, when the power was being reduced to METO, the wing flaps were still either in the process of retracting or were just completing the retraction. During this period, in which the configuration of the aircraft was progressively changing to en route climb, it would be imperative that the pilot devote his full attention to his flight instruments in order to control the aircraft effectively.

Captain Marsh testified that he observed the flight engineer in the process of reducing to METO power. Without reference to the proper flight instruments at this time, Captain Marsh would be unable to take the proper control action. Captain Marsh stated that his prime concern was the airspeed, rate of climb, and direction. Further testimony indicated that he used his ADF indicator as a primary directional instrument, took little advantage of the C-2A Gyrosyn compass or azimuth card of the course indicator, and made little reference, if any, to the artificial horizon or turn-and-bank indicator. He did not use the magnetic compass.

Captain Marsh testified that he knew at the time that the C-2A Gyrosyn compass had been somewhat unreliable. This fact, and the knowledge that the course indicator was a repeater, should have alerted the captain to check the C-2A Gyrosyn compass against the magnetic compass at the engine run up position. Following takeoff he also disregarded the altimeter and substituted the rate of climb indicator, referring to the altimeter only on every third or fifth scan of the panel, attaching little importance to this instrument. From this testimony it is evident that Captain Marsh did not take advantage of his full instrumentation nor did he rely upon primary instruments.

A consideration that cannot be overlooked is the possibility of the pilot becoming disoriented by reason of attempting to remain visual for too long a period after takeoff and losing visual contact before the transition to instrument flight. However, Captain Marsh was very emphatic in his testimony that he went on instruments when the gear was retracted and did not look out again until he saw the ground immediately prior to striking it. Snowfall occurring during the takeoff at night, with the landing lights on, could have produced a glaring effect or a period of temporary blindness, and the time involved after reference to the instruments may not have been sufficient to allow return to normal vision. This consideration cannot be completely ruled out; however, because of Captain Marsh's testimony, it would appear not to have been a major contributing factor.

Both pilots stated that they went on instruments shortly after takeoff. They described their duties and manner in which they performed such duties. Both stated everything was normal. Neither pilot was able to give a reasonable explanation for the unusual attitude of the aircraft.

The possibility of pilot fatigue was considered. The crew reported on duty some 10 hours prior to the accident. Total flight time involved a period of approximately four hours. A delayed departure and waiting for the aircraft, which was fully loaded with passengers for several hours, to be released for flight may have caused the crew some concern; however, there was no evidence to indicate that fatigue was a factor in this accident. Had the flight to Miami been completed in the planned time the total duty hours of the crew would not have exceeded their contract limits.

It is customary for the first officer to monitor the flight instruments during an instrument climb-out. According to his testimony, First Officer Dixwell monitored the engine instruments and the flight instruments until the command was given for METO power. He then devoted his attention to monitoring the flight engineer's actions without further reference to the flight instruments. This action, according to his testimony, consumed quite a few seconds and lasted until his attention was attracted to the outside immediately prior to striking the ground. Had First Officer Dixwell had opportunity to devote his attention to the flight instruments during this critical period in the flight he would undoubtedly have detected the deviation from course.

The cockpit of N 34954 was equipped with both electrical and pitot static flight instruments. With the exception of the C-2A Gyrosyn compass and one cross-pointer indicator, the instrumentation was identical on the pilot's and copilot's panels. Captain Marsh testified that, with the exception of a turn from 40 toward 45 degrees, no turns were made during the flight and that no indication of a turn or bank was displayed on any of the flight instruments. Both pilots testified that there was no warning of any instrument failure. Assuming that there had been a failure of a directional instrument and that the indicator either remained in a fixed position or assumed a rotational motion, the perceptibility of a turn not evident in that instrument would be evident on other instruments as would a turn to follow a rotating directional indication. Similarly, a failure of an attitude instrument and any attempt to follow an erroneous reading would be revealed by other attitude and directional instruments.

There is no evidence that any such irregularities did occur and there appears to be no reason why the radical departure from course would not be displayed on the instrument panel. Based on this and other facts of record the Board can only conclude that Captain Marsh either did not properly observe his flight instruments or failed to refer to the proper instruments in his control of the flight.

In conclusion, the Board has conducted an intensive study of the evidence accumulated in this investigation in an effort to arrive at a reasonable solution of the facts. It has been shown beyond a reasonable doubt that the aircraft and its accessories were functioning normally throughout the short flight. This being so, we must conclude with reasonable certainty that the events leading up to this accident point to the actions of the captain, who was at the controls and in complete command, in that he did not demonstrate the skill and care required of an airline pilot in the performance of his duties. The captain's contention that he thought everything was normal until the first officer sighted the ground and quickly advised him, further substantiates the Board's opinion that the captain did not have control of the aircraft.

Findings

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

1. The aircraft, crew, and carrier were currently certificated.

2. The gross takeoff weight of the aircraft was under the maximum allowable and properly distributed.

3. The weather at the time of takeoff was above the prescribed company minimums.

4. The aircraft, immediately following takeoff, made a left turn of approximately 119 degrees and a descent.

5. The pilot and flight crew did not observe or interpret any instrument indication of a left turn or descent.

6. The heading indications of both fire-seized course indicators corresponded closely to the impact heading of the aircraft.

7. These instruments had been functioning properly until the time of impac

8. There was no failure or malfunction of the powerplants.

9. There was no airframe failure or control malfunction.

10. There was no electrical power failure or malfunction of instruments prior to ground impact.

11. There was no fire prior to ground impact.

12. As a result of fuselage deformation the main cabin door jammed, hindering evacuation of passengers.

13. The main cabin lighting system became inoperative during deceleration and the emergency inertia lights did not actuate.

Probable Cause

The Board determines that the probable cause of the accident was the failure of the captain to (1) properly observe and interpret his flight instruments and (2) maintain control of his aircraft.

BY THE CIVIL AERONAUTICS BOARD:

/s/ JAMES R. DURFEE

/s/ CHAN GURNEY

/s/ HARMAR D. DENNY

/s/ G. JOSEPH MINETTI

/s/ LOUIS J. HECTOR

SUPPLEMENTAL DATA

Investigation and Hearing

The Civil Aeronautics Board was notified of this accident at 1825, February 1, 1957. 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 was ordered by the Board and was held in New York, New York, on April 2, 3, 4, 5, 8, 9, 10, 11, 1957. Depositions were also taken in New York on May 9-10, 1957.

Air Carrier

Northeast Airlines, Inc., is a Massachusetts corporation with its principal offices located in Boston, Massachusetts. The company is engaged in the transportation by air of persons, property, and mail under a currently effective certificate of public convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Civil Aeronautics Administration. The company conducts scheduled operations over the route involved and over routes in the northeast part of the United States.

Flight Personnel

Captain Alva V. R. Marsh, age 48, was employed as a pilot by Northeast Airlines in 1938, and was rated as a captain on May 1, 1939. He held a valid airman certificate with an airline transport rating and type ratings on DC-3, DC-4, Convair 240, DC-6, and DC-7 aircraft. Captain Marsh had, according to company records, a total of 16,630 pilot hours, of which 85 hours were acquired in DC-6 equipment. His last physical examination was successfully passed on August 28, 1956. The dates of his last instrument proficiency and line checks (on DC-6 aircraft) were January 5, 1957, and January 10, 1957, respectively.

Captain Basil S. Dixwell (copilot on Flight 823), age 40, was employed by Northeast Airlines as a pilot in 1942, and was rated as captain on March 18, 1943. He held a valid airman certificate with an airline transport rating and type ratings on DC-3, DC-4, Convair 240, and C-46 aircraft. Captain Dixwell had, according to company records, a total of 8,943 pilot hours, of which 17 hours were acquired in DC-6 equipment. His last physical examination was successfully passed on August 29, 1956. His last line check was on December 12, 1956. His DC-6 copilot qualification was on January 18, 1957.

Flight Engineer Angelo V. Andon, age 33, was employed by Northeast Airlines as a mechanic July 19, 1946. He held a valid airman certificate with ratings of flight engineer and airplane and engine mechanic. His date of employment as flight engineer was December 21, 1956, and his last physical examination was on the same date. He received a flight engineer proficiency check on January 18, 1957. His total time on DC-6 equipment was 168 hours.

Stewardess Doris Steel was employed by Northeast Airlines July 16, 1946. She had qualified on DC-6 equipment January 10, 1957, and had received U. S. Coast Guard ditching procedure on September 4, 1956.

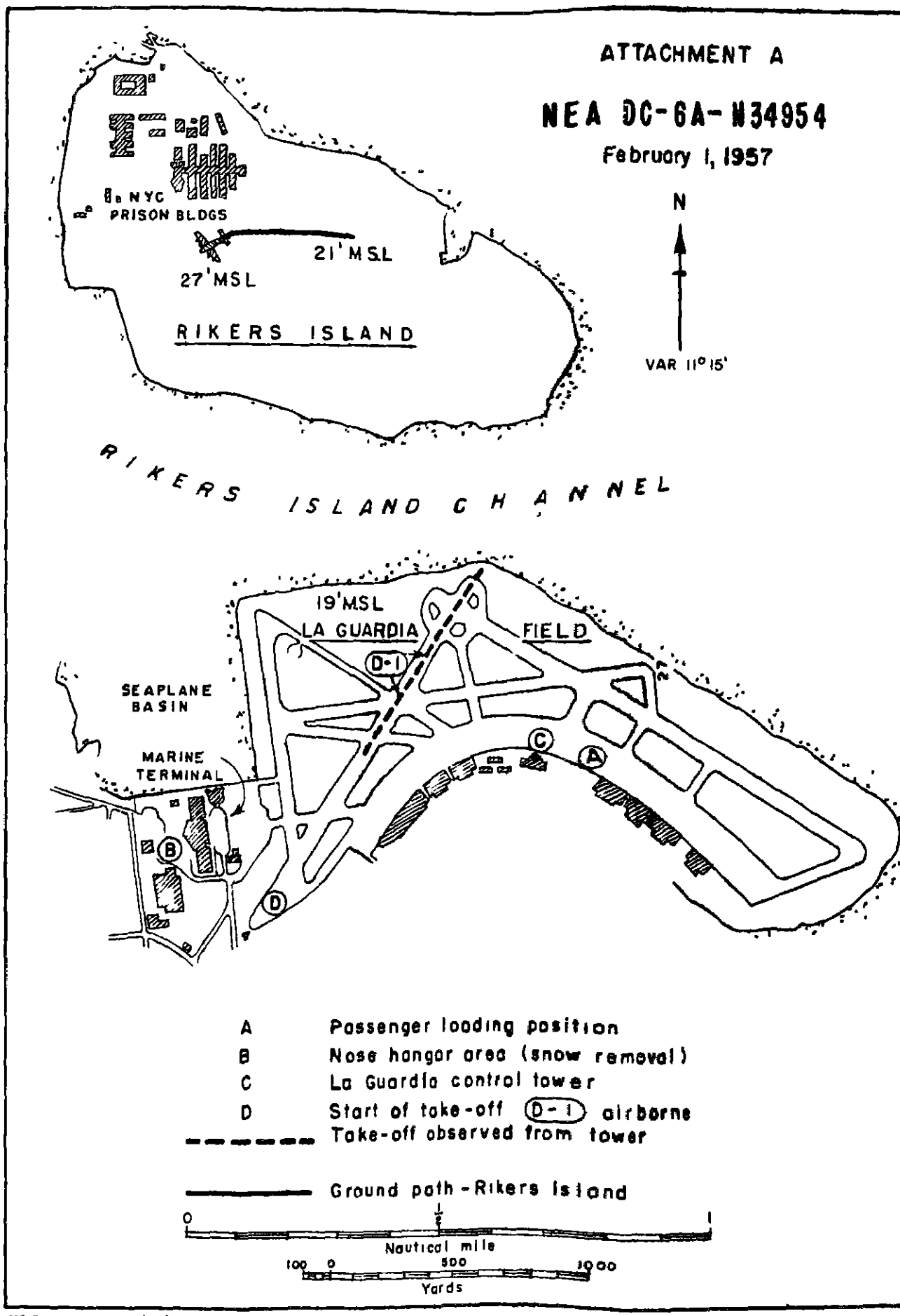
Stewardess Catherine Virchow was employed by Northeast Airlines June 24, 1953. She was checked out on DC-6 equipment January 21, 1957, and received U. S. Coast Guard procedure on September 5, 1956.

Stewardess Emily Gately was employed by Northeast Airlines on June 21, 1956. She has received training on DC-3 and Convair equipment and had received U. S. Coast Guard ditching procedures September 20, 1956. Miss Gately was being oriented on DC-6 equipment on February 1, 1957, prior to actual scheduling.

The Aircraft

Douglas DC-6A, serial number 44678, N 34954, was manufactured January 12, 1955. Total time on the airframe was 8,317 hours, with 58 hours since last maintenance operation. The aircraft was equipped with four Pratt and Whitney R-2800, CB-17 engines, and four Hamilton Standard model 43E60-375 propellers with 6895E-8 blades. Total time on the engines ranged from 5,152 hours to 6,638 hours, with last overhaul times between 631 hours and 1,378 hours. Total time on the propellers ranged from 5,055 hours to 8,550 hours, with last overhaul times between 11 hours and 3,232 hours. The aircraft was owned by the Main-Elford Corporation and leased to the Flying Tiger Line, Inc., who in turn subleased the aircraft to Northeast Airlines.

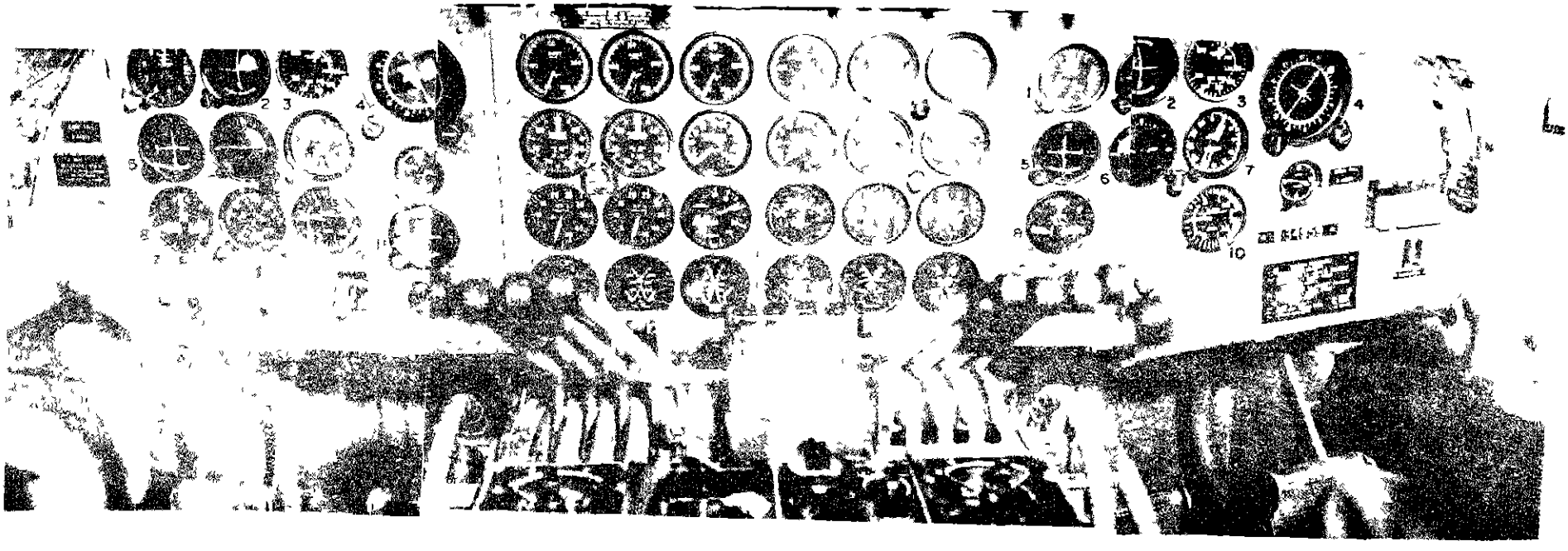
INDEX



USCOMM-DC-10401

ATTACHMENT B

NORTHEAST AIRLINES, INC. DC-6A N34954
RIKERS ISLAND, N.Y
FEBRUARY 1, 1957



1 ALTIMETER
2 ZERO READER
3 AIR SPEED
4 COURSE INDICATOR
5 DEVIATION INDICATOR
6 ARTIFICIAL HORIZON
7 DUAL ADF
8 TURN & BANK
9 C-2A GYROSYN COMPASS
10 RATE OF CLIMB
11 DEVIATION INDICATOR (SLAVED TO CO-PILOT SIDE)

FTL DC-6A N34959 INSTRUMENT PANEL SIMILAR TO PANEL OF N34954

USCOMM-DC-10320