

CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted: April 3, 1958

Released: April 8, 1958

FRONTIER AIRLINES, INC., DOUGLAS DC-3C, N 65276,
NEAR PHOENIX, ARIZONA, APRIL 21, 1957

The Accident

At approximately 1344,^{1/} April 21, 1957, a Douglas DC-3C, N 65276, owned and operated by Frontier Airlines, struck a mountain ridge approximately 40 miles north of Phoenix, Arizona, and lost approximately 12 feet of the outer portion of its left wing. The aircraft, although substantially damaged, landed safely at Phoenix. The 26 occupants were not injured.

History of the Flight

Flight 7, of April 21, 1957, was scheduled between Denver, Colorado, and Phoenix, Arizona, with intermediate stops at Pueblo, Alamosa, and Durango, Colorado; Farmington, New Mexico; and Winslow, Flagstaff, and Prescott, Arizona. At Farmington a scheduled crew exchange was made with the crew of Frontier's Flight 8 which was Denver bound from Phoenix. With this method of crew scheduling each crew flew to Farmington and returned to its respective departure point. The aircraft, however, continued to the scheduled destination. Flight 7 was routine to Farmington. The new crew consisted of Captain Dale R. Welling, First Officer Herman B. Wrasse, and Stewardess Donna J. Bailey.

Prior to departing Phoenix that morning on northbound Flight 8, Captain Welling reviewed, at the company office, the available en route and terminal weather reports and forecasts. A flight plan was then filed with the company to fly VFR (visual flight rules) to Farmington and return to Winslow and to fly IFR (instrument flight rules) the remaining portion of the flight to Phoenix; refueling was planned at Prescott. This flight plan was approved by the company's dispatch office at Denver.

Flight 7 departed Farmington at 1059 and flew to Winslow as planned. At Winslow the captain decided because of his visual observation of existing weather conditions to continue the flight VFR. Accordingly, the flight proceeded to Flagstaff and then to Prescott, arriving there at 1316. Captain Welling said that during the approach to Prescott he looked toward Phoenix and that the weather in that direction appeared to be all right for a continuance of VFR flight. Therefore, on landing at Prescott he informed the company dispatcher at Denver to change their flight plan from IFR to VFR to Phoenix and to cancel the refueling scheduled at Prescott.

The flight departed Prescott at 1321, 11 minutes late, with 21 revenue passengers and one nonrevenue passenger on board. At the time of takeoff the

^{1/} All times herein are mountain standard and based on the 24-hour clock; all altitudes are mean sea level except weather reports and references to cloud levels.

gross weight of the aircraft was 24,368 pounds, which was 978 pounds below the allowable gross takeoff weight, and the load was properly distributed.

Following takeoff the aircraft was climbed to a cruising altitude of 6,500 feet and the flight proceeded to a point approximately 35 miles from Prescott. At this point the company's office at Phoenix was called and the latest Phoenix weather was requested. The call was made at 1335, and the 1330 U. S. Weather Bureau Phoenix weather report was immediately given as: 1,500 scattered, 3,000 broken, 10,000 overcast; visibility 12 miles; wind west 18 to 30 knots; light rainshowers. The flight acknowledged this message at 1339 and said that it was approaching Knob intersection and requested an ARTC (Air Route Traffic Control) clearance to Phoenix. Five minutes later the company relayed to the flight the following clearance: "ATC clears Frontier 7 from Knob intersection to Phoenix omni, maintain 7,000." As there was no acknowledgment or readback of this clearance as is customary, the radio operator immediately called the flight again and asked if they had received the message. The flight answered and said: "Just hit a downdraft, declaring an emergency, changing to tower frequency." Following this transmission the flight contacted Phoenix approach control and received the current Phoenix weather and approach clearance.

At 1400 Flight 7 advised the company that it was coming in and had lost a portion of its left wing and aileron. After this message the flight again changed to approach control frequency and was given the appropriate approach instructions and landing clearance.

As the flight was approaching the airport the tower alerted all available emergency equipment to stand by. This was done and at 1405 the aircraft landed on runway 26L without further incident.

Investigation

The separated portion of the left wing was located at an approximate elevation of 4,600 feet on the west ridge of a mountain, the peak of which is 5,000 feet. This mountain is located approximately six miles east of New River, Arizona.^{2/} The examination of the terrain at the scene of the accident, and the wreckage itself, showed that the left wing of the aircraft had struck a small tree, some large rocks, and a large cactus plant. Investigation revealed that the aircraft struck the mountain in a nose-up attitude. The portion of the left wing and the aileron torn off was from station 286.4 outboard to the tip. This sheared portion of the wing broke into small pieces which were crushed, twisted, and distorted.

The leading edge of the damaged left wing, which remained attached to the aircraft, was dented and distorted approximately three feet inboard of the tear. Deep span-wise compression wrinkles were found in both the upper and lower wing surfaces throughout the entire wing between the front and rear spars. A portion of the trailing edge of the left aileron was buckled upward and impact forces had damaged this aileron so that it was locked in the neutral position. The aileron cables in the left wing were attached to their respective terminals and were not damaged. A functional check of the aileron control system revealed that the travel of the right aileron was limited to seven degrees up and two degrees down. The limitation of right aileron travel was caused by the locked left aileron.

^{2/} See Appendix A.

A thorough examination of the entire aircraft showed that all damage was confined to the left wing and aileron assembly.

A review of the aircraft and engine logbooks indicated that N 65276 had been properly maintained and was in an airworthy condition prior to the departure of the flight. These records also showed that all minor discrepancies written in the logbook had been corrected prior to the accident.

The surface synoptic weather map for 0830, April 21, 1957, showed that an occluded front was approaching the coast of Washington, a stationary front was lying just north of the Canadian border, and weak low centers were over the states of Oklahoma, Montana, and southern Nevada. At that time there was little indication of a cold front extending southward from the Nevada low pressure center. By 1130 the low pressure area was still located in southern Nevada and a distinct wind shift and temperature drop at Phoenix and Litchfield Park (immediately west of Phoenix) indicated that a cold front was developing in that area. Hourly weather reports indicated that this front had passed Phoenix by 1130, Tucson by 1230, and Prescott by 1430, and that it was moving in a general east-northeast direction. By 1430 it had moved to a position between Prescott and Winslow.

Many of the en route stops on this scheduled flight, including Prescott, were one-engine stops^{3/} and the crew did not leave the aircraft. In this situation appropriate weather information was taken to the aircraft and given to the crew by ground personnel. Forecasts for the period 1200-2400, available to the crew at Winslow prior to departure, indicated that showery conditions and some local thunderstorms might be expected in the mountains and the higher terrain of northwestern Arizona. Cloud bases in the showers were estimated to be 3,500 to 4,500 feet above the ground with tops 18,000 to 20,000 feet m. s. l. and above; the freezing level was forecast to be at 6,000 feet in southwestern Arizona, sloping up to 13,000 feet east of the Pecos Valley. Moderate turbulence with moderate to heavy icing was forecast in the thundershowers.

The Prescott forecast for the period 1200-1800 indicated a ceiling of 2,500 overcast, 1,500 scattered; with light rainshowers; wind south-southwest at 20 knots.

Captain Welting said that the flight to Farmington and return to Winslow was as planned in every respect; that moderate turbulence was usually encountered over this route, as it was this day, and that the turbulence experienced throughout this flight was the washboard type rather than the more pronounced updrafts and downdrafts. He said that the cold front which was expected to be in the vicinity of Winslow upon the flight's arrival was not there and therefore they were able to fly to Prescott VFR. He also said that the decision to fly VFR to Phoenix was based largely on the crew's ability to see a considerable distance in that direction and that the weather appeared to be the same as that which they had just flown through.

According to the testimony of the crew at the time of departure from Prescott there was an overcast of 2,800 feet, scattered clouds at 1,800 feet, and it had been raining intermittently. The aircraft was climbed to a cruising altitude of 6,500 feet, and a course was taken toward Phoenix following the

^{3/} A "one-engine" stop means that only one engine (on the landing side) is completely stopped. The purpose of such a stop is to facilitate a more rapid departure.

Black Canyon Highway, which lies east of the Bradshaw mountains. The flight continued beneath the overcast and free of all clouds until in the vicinity of Rock Springs, Arizona (approximately 45 miles south of Prescott). There was only mild turbulence throughout this portion of the flight. Nearing Rock Springs the weather ahead appeared to be worsening. The captain said that the overcast was definitely lowering and the scattered clouds which had been beneath them appeared to be forming an almost solid cloud deck. The cloud layers were converging and in the distance ahead there were large cloud buildups. Because of this weather condition it was decided that an IFR flight plan should be requested. Accordingly, the flight called the company at Phoenix and requested the latest weather. This was given them. The crew then tried to call Phoenix approach control to obtain an IFR clearance and being unsuccessful in reaching them again called the company and said that it was approaching Knob intersection and wished an instrument clearance from ARTC. This latter transmission was made at 1339. At this time the flight changed its course to a heading which would intercept Knob intersection.

The captain said the decision to fly to Knob intersection and then to Phoenix was made because the flight could be made over this route at a lower altitude, thereby saving time. At 1344 the flight received its clearance to fly from Knob intersection to the Phoenix omni and to maintain an altitude of 7,000 feet.

The crew further testified that immediately following receipt of this clearance the climb to 7,000 feet was begun. As climb power was applied the aircraft began to settle. At first this settling was not seriously considered; however, as it continued, additional power was applied. The fact that the aircraft was settling became known to the crew first by a drop in airspeed from 130 knots to approximately 115 knots. The rate-of-climb indicated a gradual rate of descent; however, as the settling continued, a rate of descent of approximately 1,000 feet per minute was observed. As it became increasingly noticeable that the added power was not stopping the descent, even more power was added. Since this power was also not effective the throttles were placed in the full open position and the propellers in full low pitch. By this time the aircraft had settled into a snow squall which seriously impaired visibility. The airspeed at that time indicated 90 knots and the mountain peak below was hazily visible through the storm. Despite all efforts to the contrary, the settling continued until the left wing of the aircraft struck the ground. According to the captain, immediately following impact the aircraft staggered, rolled to its left, and continued to settle. Power was immediately reduced on the right engine and full right rudder was applied. With the return of full power to the right engine the aircraft regained airspeed and slowly returned to level flight and, although aileron control was seriously restricted, the aircraft was climbed to its assigned altitude and the flight to Phoenix was continued. The crew said that instrument weather prevailed from the time of impact until the final descent at Phoenix.

Captain Welling described the air through which the aircraft descended 1,900 feet as a "soggy airmass." He said the downdraft was not precipitous and caused little or no pressure of the body against the seat belt. He was positive that the flight did not enter clouds from the time of takeoff until the descent prior to impact was made.

Written statements were obtained from passengers on board the aircraft. Depositions were taken of those from whom it was believed the most pertinent information could be obtained. Their testimony was in decided variance with

the testimony of the crew on several points. The consensus was that following takeoff from Prescott the aircraft was flown near the base of the overcast and for the first few minutes of flight was free of all clouds; that as the flight progressed southward clouds were intermittently flown through which completely obscured vision; and that four or five minutes prior to impact the aircraft was flying in dense clouds. None felt or sensed any downdraft nor did they hear application of power beyond that which was used in cruise configuration. Some passengers, especially those who were accustomed to flying as airline passengers and two who flew their own aircraft, testified that the cloud deck beneath which the aircraft was flying appeared to be lowering as the flight progressed southward and that although they were not able to determine definitely the altitude of the aircraft they believed that it was flying lower than usual. They based this belief on the fact that when free from clouds they were able to clearly see and identify objects on the ground. Several passengers said they believed that just prior to impact the aircraft was flying in level flight.

One passenger, a former Air Force pilot officer, said that on the day of the accident he was flying his own airplane from Albuquerque, New Mexico, to Los Angeles, California, and landed at Prescott about 1100. He said the weather briefing he received from the U. S. Weather Bureau personnel indicated the weather between Prescott and Phoenix would be marginal for a continuation of VFR flight. Dark clouds and rain squalls were plainly visible in the direction of Phoenix. Because of the weather conditions he decided to leave his airplane at Prescott and continue his trip by airline. He said that although he possessed an instrument rating he preferred not to fly a single-engine aircraft in instrument weather.

The stewardess on duty testified that she was standing in the aisle near the front of the cabin and was talking to one of the passengers when impact occurred. The actual striking of the mountain and the subsequent recovery maneuvers caused her partially to lose her balance. However, she did not feel any sensation of a downdraft prior to impact. She immediately went to the cockpit to ask what instructions she should give to the passengers and was told to advise them that everything would be all right. There was no disorder among the passengers.

All flights were dispatched by the company from its Denver office. The responsibility for the dispatching of flights is the joint responsibility of both the captain and the dispatcher at Denver. The company dispatcher who was on duty the day of this flight said that en route weather conditions were monitored very closely and that he realized that the weather conditions throughout the latter portion of the flight were marginal. However, because the flight was a considerable distance from Denver and because the captain had an on-the-scene observation of weather conditions which he did not, he agreed to amend the flight plan when the captain requested that the flight be continued from Prescott VFR. He said this decision was not unusual in any way and one which was followed customarily by company dispatchers. The primary means of communication between the office of dispatch and the aircraft is by means of long-line to the nearest company station and then to the aircraft. When conditions permit, direct VHF communication is available for use between Denver dispatch and the aircraft.

The chief pilot testified with regard to the company's pilots flying in marginal weather conditions as follows: ". . . the manual we think clearly states that when operating VFR they will definitely maintain the requirements

of VFR operations pertaining to visibility and ceiling. If there is any question about that type of operation then we should certainly convert to IFR and plan accordingly with reference to fuel or any other requirements which should be met."

The company's station agent at Phoenix, on duty when the accident occurred, said that a part of his duties and responsibilities consisted of handling all teletype communications and transmitting and receiving all radio communications pertinent to company aircraft in flight. It was also his duty to maintain the radio log. The April 21 log had several messages pertaining to Flight 7. This log indicated a message sent by the flight and received at 1339 as follows: "Knob XSN (intersection) 39, request ATC " The station agent testified that the message received actually stated that the aircraft was approaching Knob intersection. He said that the word "approach" was not included in the log entry. Another entry indicated that the ARTC clearance was transmitted to the flight at 1344. The agent also said that when this transmission was not acknowledged by the flight as usual, after waiting approximately one minute he again called the flight and asked if the clearance had been received. The log entry showing the response to this transmission was: "Received clearance just hit downdraft, am declaring an emergency. Changing to approach control." The next entry in the log was a transmission from the flight received at 1400: "Coming in. Lost part of left wing. Most aileron . . ." Following these log entries were entries indicating that the aircraft landed safely.

Analysis

Flight 7 was 11 minutes late departing Prescott because of en route headwinds. Whether this in any way affected Captain Welling's decision to fly VFR to Phoenix is not definitely known. The two airway routes from Prescott to Phoenix, V-105 (Red 5L) and V-105E, have minimum en route IFR altitudes out of Prescott of 10,000 and 9,000 feet, respectively. Since the elevation of the Prescott airport is 5,042 feet an IFR clearance using either of these airways would necessitate a time-consuming climb. Considering also the possibility of additional delays as a result of IFR flight it is probable that these factors did contribute to the captain's decision not to file an IFR flight plan.

In the original preparation for this flight the captain decided, after studying all the available weather data, that a cold front would be in the vicinity of Winslow when the flight arrived there. The fact that he did not encounter the cold front between Winslow and Prescott as expected, combined with the continuing rain at Prescott, should have forewarned the captain that a front might be encountered between Prescott and Phoenix. A check of the sequence weather reports would have confirmed this probability. A study of the available weather information at Prescott should have further indicated to the crew that VFR flight would be extremely marginal. Since the company, through written instructions in its flight manual and through verbal instructions by the chief pilot, instructed all pilots that whenever marginal conditions were encountered an IFR clearance must be obtained, it is apparent that in this case these instructions were disregarded.

The testimony pertaining to the company's dispatching procedures has been reviewed and the Board finds that although the company recognizes that it is the dual responsibility of both the dispatcher and captain to see that each flight is

properly dispatched, the actual decision regarding conditions of flight is made by the captain. The dispatcher testified that rarely is the captain's decision countermanded or questioned. The dispatcher also testified that the weather through which Flight 7 flew from Prescott to Phoenix was marginal for VFR flight. However, he did not question the captain's request to fly VFR because the captain was better able to judge the local weather conditions.

The captain stated that he did not at any time during the flight fly through clouds prior to impact except during the uncontrolled descent caused by the downdraft. The passengers aboard the aircraft, and the stewardess, testified that the aircraft intermittently flew through clouds and that for a few minutes before impact it was flying in solid instrument weather. It is recognized that the view which the passengers have from their windows would differ greatly from the view which the crew has from the cockpit. However, the testimony that the aircraft at times was flying in clouds was so clear that the Board believes this condition existed.

The request for an ARTC clearance was made at 1339. The clearance was given the flight at 1344. One minute later the station agent at Phoenix acknowledged a transmission from Flight 7 in which the captain acknowledged the clearance and advised that he was declaring an emergency. The captain also said that at the time the flight first encountered a downdraft it was either at an altitude of 6,500 feet or was between 6,500 and 7,000 feet. Since the elapsed time between the last two messages was approximately one minute the aircraft must have descended approximately 1,900 feet during that time. It is not reasonable to believe that the crew, the stewardess, or the passengers would not have sensed a rapid descent of this magnitude. Captain Welling described this unusual downdraft as being associated with a "soggy" air mass and that such an air mass would readily explain why no one felt the precipitous descent. The captain stated that throughout the descent power, beyond that needed for cruising, was added three times and that the final application of power was made by placing the throttles fully forward. Again, none of the passengers in the aircraft cabin heard any additional power being applied. It is understandable that if power was applied some of the passengers might possibly have heard it but paid no attention. However, the two passengers who are pilots and whose ears are sensitive to changing engine sounds were seated in the aircraft where they could hear these sounds and did not.

In conclusion, the Board believes that Flight 7 after departing Prescott attempted to fly beneath the overcast. The Board further believes that the overcast lowered as the flight progressed towards Phoenix and that intermittently the aircraft flew through clouds ultimately going on solid instruments several minutes before the crash.^{4/}

Also, meteorological conditions were not conducive to the presence of a sustained downdraft of the magnitude described by the captain. The low-level winds were westerly and therefore crossed the mountain ridge in a manner actually more likely to produce updrafts rather than down drafts. Added to this, the Board believes that a downdraft of this proportion, occurring in such a short time, would have been apparent to the passengers. The Board believes therefore that the aircraft

^{4/} CAR 60.30 Visual Flight Rules (VFR). Ceiling and distance from clouds - Aircraft shall comply with the following requirements as to ceiling and distance from clouds. . . . (c) Elsewhere. (1) When at an altitude of more than 700 feet above the surface, aircraft shall not be flown less than 500 feet vertically under, 1,000 feet vertically over, and 2,000 feet horizontally from any cloud formation.

was being flown at a dangerously low altitude over mountainous terrain. 5/

In analyzing the evidence of this accident the Board concludes that certain corrective measures should be taken by the company in an effort to prevent a similar type of accident in the future. Strict adherence to the provisions of the company's operations manual should be reemphasized, especially the criteria for choosing between an IFR and VFR flight plan. Also, the company's dispatching system should be carefully reevaluated with a view to ensuring that the dispatcher enjoys the status contemplated by the regulations.

Findings

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

1. The crew, the aircraft, and the carrier were currently certificated.
2. The gross load of the aircraft was under the maximum allowable and was properly distributed.
3. The flight departed Prescott flying VFR.
4. After departing Prescott the weather deteriorated and at times the flight entered clouds and several minutes prior to the accident the flight flew in solid instrument weather conditions.
5. Approximately 18 minutes after leaving Prescott the flight requested an IFR clearance.
6. About the time the IFR clearance was received (five minutes after the request) the aircraft struck a mountain ridge at an elevation of 4,600 feet.
7. There is insufficient evidence to support a sustained downdraft condition immediately prior to impact.
8. There was no evidence of failure or malfunctioning of the aircraft or its components prior to impact.

5/ CAR 40.408 Flight Altitude Rules. (a) Day VFR passenger operations. No airplane engaged in passenger operations shall be flown at an altitude less than 1,000 feet above the surface or less than 1,000 feet from any mountain, hill, or other obstruction to flight.

Probable Cause

The Board determines that the probable cause of this accident was the attempt by the pilot to fly over mountainous terrain by visual reference to the ground in weather conditions which severely restricted forward visibility and necessitated a descent to a dangerously low altitude.

BY THE CIVIL AERONAUTICS BOARD:

/s/ JAMES R. DURFEE

/s/ CHAN GURNEY

/s/ HARMAR D. DENNY

/s/ G. JOSEPH MINETTI

/s/ LOUIS J. HECTOR

S U P P L E M E N T A L D A T A

Investigation and Taking of Depositions

The Civil Aeronautics Board was notified of the accident the afternoon of April 21, 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. Depositions, ordered by the Board, were taken at National City, California, June 14; Phoenix, Arizona, June 17-18; Prescott, Arizona, June 19; Denver, Colorado, June 21; and New York, New York, June 27, 1957.

Air Carrier

Frontier Airlines, Inc., a Nevada corporation, is a scheduled air carrier with its principal offices at Denver, Colorado. The company possesses 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 which authorize the carriage of persons, property, and mail over the route described in this report.

Flight Personnel

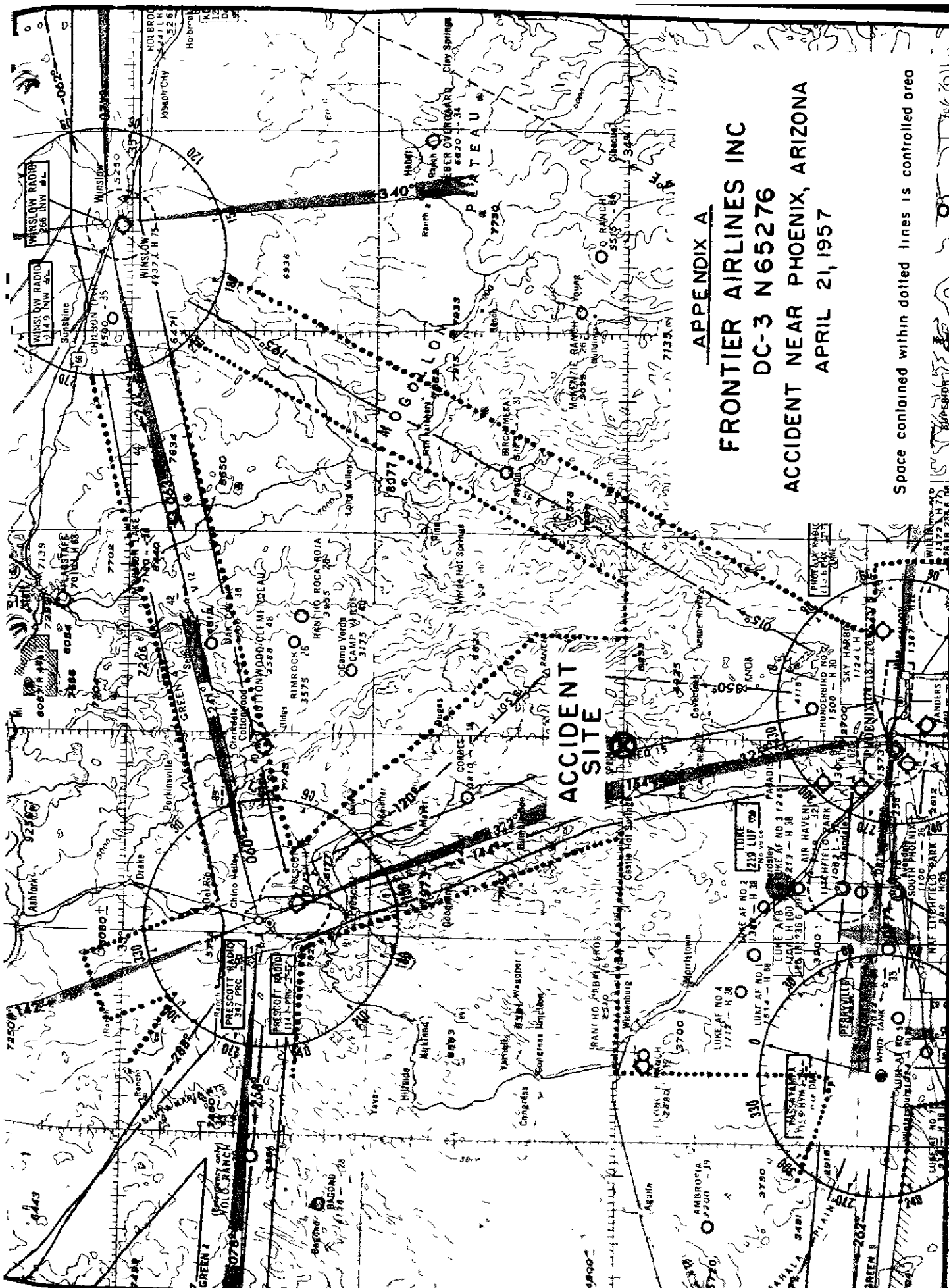
Captain Dale R. Welling, age 35, was employed by Frontier Airlines July 10, 1948. He held a valid airman certificate with an airline transport rating and type rating for DC-3 aircraft. According to company records he had a total of 13,679 flying hours, of which 8,371 hours were acquired in DC-3 equipment. His last CAA first-class physical examination was passed January 2, 1957. The date of his last line check was December 24, 1956, and his last instrument test was taken October 22, 1956.

First Officer Herman B. Wrasse, age 29, was employed by Frontier Airlines August 13, 1956. He held a valid airman certificate with an airline transport rating and type rating for DC-3 aircraft. According to company records he had a total of 1,946 flying hours, of which 787 were in DC-3 equipment. His last CAA first-class physical examination was passed on August 9, 1956. His last instrument check was in November 1956.

Stewardess Donna J. Bailey, age 21, had been employed by the company since January 1, 1957. Her training was completed January 31, 1957.

The Aircraft

Douglas DC-3C, serial No. 19202, had a total time of 26,844 hours. The aircraft had 5,886 hours since the last overhaul, 151 hours since the last company No. 3 inspection. It was equipped with two Pratt and Whitney R-1830-S1C3-G engines and Hamilton Standard model 23E50 propellers.



APPENDIX A
FRONTIER AIRLINES INC
DC-3 N 65276
ACCIDENT NEAR PHOENIX, ARIZONA
APRIL 21, 1957

Space contained within dotted lines is controlled area