AIRCRAFT ACCIDENT REPORT

Adopted: September 5, 1968

PIEDMONT AVIATION, INC.

PIEDMONT AIRLINES DIVISION

BOEING 727, N68650

LANSEAIR INC., CESSNA 310, N3121S

MIDAIR COLLISION

HENDERSONVILLE, NORTH CAROLINA

JULY 19, 1967

NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
WASHINGTON D.C. 20591

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SA-400 File No. 1-0005

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SYNOPSIS

On July 19, 1967, at 1201:18 e.d.t., Piedmont Airlines Flight 22, a Boeing 727, N68650, and a Cessna 310, N3121S, owned by Lanseair, Inc., were involved in a midair collision at an altitude of 6,132 feet in the vicinity of Hendersonville, North Carolina, approximately 8 miles southeast of the Asheville Municipal Airport. All occupants of the Boeing 727, five crewmembers and 74 passengers, and the three occupants of the Cessna received fatal injuries. The two aircraft were destroyed by collision forces, ground impact and ensuing fire.

Both aircraft were operating on Instrument Flight Rules (IFR) flight plans and were in radio contact with Asheville Tower, the facility which was providing air traffic control service when the collision occurred.

Piedmont Flight 22 had departed from Runway 16 at the Asheville Airport and was cleared to proceed via the Asheville VOR en route to Roanoke, Virginia. The Cessna, inbound to the Asheville Airport, had been cleared from over the VOR to the Asheville radio beacon and had

reported passing the VOR at 1158:20. The Asheville radio beacon is located 17.4 miles northwest of the VOR on the 298° radial. The collision occurred at a position approximately 9 miles southwest of the VOR on approximately the 243° radial.

The weather at Asheville as reported by the Weather Bureau just prior to the accident was estimated ceiling 2,500 feet broken clouds with visibility 4 miles in haze.

The Safety Board determines that the probable cause of this accident was the deviation of the Cessna from its IFR clearance resulting in a flightpath into airspace allocated to the Piedmont Boeing 727. The reason for such deviation cannot be specifically or positively identified. The minimum control procedures utilized by the FAA in the handling of the Cessna were a contributing factor.

1. INVESTIGATION

1.1 History of the Flight

A Piedmont Aviation, Inc. (PAI), Boeing 727, N68650, operating as Flight 22, and a Cessna 310, N3121S, owned by Lanseair Inc., collided at an altitude of 6,132 feet m.s.l., approximately 8 miles southeast of the Asheville Municipal Airport, Asheville, North Carolina, at 1201:18 1/ on July 19, 1967. All occupants of the Boeing 727, five crewmembers and 74 passengers, and the three occupants of the Cessna received fatal injuries Both aircraft were destroyed.

The Cessna, which was being utilized for a company business flight was en route from Charlotte, North Carolina, to the Asheville Municipal Airport. Prior to departure from Charlotte, a telephone weather briefing for this flight was provided by the Weather Bureau (WB) to one of the occupants of the aircraft. Included in this briefing was the terminal forecast for Asheville covering the aircraft's estimated time of arrival at Asheville. This forecast was, in part, estimated ceiling 1,500 feet broken clouds, visibility 4 miles in haze. The existing Asheville weather at this time was reported as sky partially obscured, visibility three-quarters of a mile in fog, temperature 61°F., dew point 61°F. No flight plan was filed at this time. Other preflight preparations by the crew could not be determined.

During taxi-out for takeoff, the flight requested and received the local weather conditions which were reported by the tower as "estimated

1/ All times herein are eastern daylight based on the 24-hour clock.

ceiling two thousand broken, visibility seven (miles)." At that time, after the pilot requested an IFR clearance to "on top" [2/] a complete flight plan to Asheville was filed with Charlotte Tower. Subsequently, the Cessna received an Air Traffic Control (ATC) clearance to the Asheville VOR, via a direct route, to maintain 6,000 feet. The Cessna departed from Charlotte at approximately 1130, and was subsequently cleared by the Atlanta Air Route Traffic Control Center to maintain 8,000 feet.

The climbout and en route portions of the flight were uneventful, and at 1151:45, the Center cleared the Cessna ". . . to the Asheville VOR, descend and maintain seven thousand, expect ILS approach at Asheville." The flight acknowledged this clearance was was subsequently advised that radar service was terminated and to contact Asheville Approach Control on frequency 125.3 MHz.

Initial contact with Approach Control was made at 1153:10, and at 1153:49, in response to a request for a position report, the Cessna reported passing the 340° radial of the Spartanburg VOR. (See Attachment No.

At about this time PAI Flight 1022, inbound from Atlanta, was cleared by Approach Control (on 125.3 MHz) for an ILS approach to Asheville, and was advised to plan a circling approach to Runway 16.

At 1156:28, Approach Control issued the following clearance to the Cessna:

> "three one two one Sugar cleared over the VOR to Broad River, correction make that the Asheville radio beacon . . . over the VOR to the Asheville radio beacon. Maintain seven thousand report passing the VOR."

2/ An IFR clearance through a cloud layer to a point where the aircraft can be flown in VFR conditions "on top."

The flight acknowledged the clearance at 1156:43:

"Thr - two one Sierra"

At 1158:07, PAI 22 began its takeoff roll on Runway 16. The flight had previously been issued an IFR clearance in accordance with its company stored flight plan 3/ via a direct course to Valdese Intersection, 4/ and Route 53 to Pulaski, and Victor 16 to Roanoke, Virginia. The assigned flight altitude was 21,000 feet.

Prior to being cleared to takeoff, a departure restriction had been placed on PAI 22 by the tower to maintain runway heading until reaching 5,000 feet. The controller who was coordinating the separation of PAI and the Cessna stated that this restriction was placed on PAI 22 to keep the aircraft on a southeasterly course until the Cessna had reported over the VOR.

At 1158:20, while PAI 22 was still on its takeoff roll, the following position report was received by Approach Control from the Cessna.

> "Two one Sierra just passed over the VOR, we're headed for the . . . (pause) 5/ . . . for . . ah . . Asheville now."

This report was acknowledged by Approach Control, "Two one Sugar roger, by the VOR, descend and maintain six thousand." The Cessna replied, "We're leaving seven now."

3/ A precomputed IFR flight for a specified route, stored in the Atlantic Center and activated on request.

4/ Valdese Intersection is located 40 miles northeast of the Asheville (063° radial) on Victor Airway 222.

5/ The pause in the main transmission is approximately 4 seconds long. Background conversation is audible during this pause; however, despite extensive examination no reliable intelligence could be determined.

At 1159:44, the Asheville Tower cleared PAI 22 to ". . . climb unrestricted to the VOR, report passing the VOR." The crew's acknowledgment of the transmission was the tower's last communication with the flight. 6/

At 1200:02, Approach Control cleared the Cessna for, ". . . an ADF-2 approach to runway one six, report the Asheville radio beacon inbound." This clearance was acknowledged by the word "roger" and is the last known radio transmission from the Cessna.

Personnel on duty in the tower at the time PAI 22 departed stated that they observed the aircraft during takeoff and while it was climbing southeast-bound on runway heading. Their last observation of the jet was at a position estimated to be between 4 and 5 miles from the airport, slightly to the left of the extended runway centerline, and in a "shallow" left turn.

According to the available evidence, PAI 22 was in a climbing left turn proceeding from south to southeast, with the Cessna proceeding in a westerly direction, at the time of the collision. The Cessna appeared to be in level flight; however, just before the collision it was observed to pull up sharply, with impact occurring between the nose of the Cessna and the left forward fuselage section of the Boeing 727. The jet continued straight ahead momentarily, then nosed over and fell rapidly to the ground The Cessna was not observed at any time following the collision.

The accident occurred at approximately high noon in daylight condition

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6/ There was one brief radio transmission found on the recording of tower communications which occurred at 1201:17. That transmission was "(--- mont) twenty-two is . . ." Investigation revealed the transmission originated on the flight deck of PAI 22 approximately 1 second before the collision.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other
Fatal	5 (Boeing 727) 2 (Cessna 310)	74 (Boeing 727) 1 (Cessna 310)	0
Nonfatal	0	0	0
None	0	0	

1.3 Damage to Aircraft

The Boeing 727 was destroyed by the collision forces, ground impact and post-impact fire. The Cessna disintegrated in flight at the time of collision.

1.4 Other Damage

None.

1.5 Crew Information

The crews of both aircraft were properly certificated and qualified to conduct their respective flights. (For detailed information see Appendix A.)

1.6 Aircraft Information

Both aircraft were properly certificated and maintained in accordance with existing requirements.

The weight and center of gravity of each aircraft were computed and found to be within respective limitations. The Boeing 727 had been serviced with Jet A turbine fuel and the Cessna was serviced with 100 octane aviation gasoline. (For detailed information see Appendix B.)

1.7 Meteorological Information

The surface weather observation taken at 1156 by the WB at the Asheville Municipal Airport just prior to the accident was: estimated 2,500 feet broken clouds, visibility 4 miles in haze, temperature 74°F., dew point 63°F., wind 160° at 5 knots, altimeter setting 30.26 inches.

The terminal forecast for Asheville issued by the WB valid for the period 1000-1400 was in part as follows:

1000-1200, ceiling 600 feet broken, 12,000 feet broken, visibility 3 miles in haze, lower broken variable to scattered.

1200-1400, ceiling 1,500 feet broken, 12,000 feet broken, visibility 5 miles in haze.

Reports from pilots who were flying in the Asheville area about the time of the accident indicate that a broken cloud condition existed with tops between 6,000 and 7,000 feet and bases at approximately 3,000 feet. In-flight visibility was reported by these pilots as between 2 and 5 miles in haze. The area in the immediate vicinity of the collision site was generally reported by witnesses to have been clear of clouds.

1.8 Aids to Navigation

There were no reported outages of any of the navigational radio aid (NAVAIDS) or associated components at Asheville during the period that PAI 22 and the Cessna were operating in this area.

Immediately following the accident, all of these NAVAID facilities and system components were flight checked by the FAA and found to be operating satisfactorily within established tolerances.

There was no airport surveillance radar installation at Asheville.

There were four standard instrument approaches published for the Asheville Airport: The VOR approach, an ADF-1 approach, an ADF-2 approach, and an ILS Runway 34 approach. These approaches were depicted on Coast and Geodetic Survey (C&G) approach charts (see Attachment No. 2) and Jeppesen approach charts.

All of these instrument approach procedures were based upon facilities in the Asheville area.

The ADF-1 approach procedure utilizes the Broad River non-directional radio beacon (RBN) which is located 9.7 nautical miles southeast of the airport on the extended runway centerline for Runway 34. The Broad River RBN is located 12.7 miles southwest of the Asheville VOR on the 232° radial

The ADF-2 procedure utilizes the Asheville non-directional RBN which is located 5.8 miles northwest of the airport on the extended centerline for Runway 16. The Asheville RBN is located 17.4 miles northwest of the Asheville VOR on the 298° radial of that facility. This procedure requires a course of 340° to be flown outbound from the Asheville RBN with a procedure turn to be executed within 10 miles at or above 5,500 feet, then an inbound course of 160° to cross the Asheville RBN not lower than 4,20 feet, at which point descent to the authorized minimum is commenced.

The ILS procedure utilizes the Broad River RBN as the primary approach fix. It is required that a procedure turn be executed on the outbound course of the localizer, southeast of the Broad River RBN, to

cross the Broad River RBN inbound on the localizer course not lower than 5,000 feet, at which point descent to the authorized minimum is commenced.

The VOR procedure utilizes the Asheville VOR and the Spartanburg VOR.

The frequencies and locations of all of these facilities can be found on the Low Altitude En Route Chart (L-20), the applicable Instrument Approach Procedure Chart, or in the Airman's Information Manual. Information concerning the frequency and location of any facility or of any public instrument approach procedure can be obtained by radio from the appropriate FAA Air Traffic Control facility.

It is noted that information relative to IFR departure procedures established for terrain/obstruction avoidance purposes was disseminated in an FAA Advisory Circular (AC No. 90-29) effective September 16, 1965. The circular states in part that information concerning terrain/obstruction departure procedures is referenced on the appropriate C&G approach chart, and that prior to departing an airport on an IFR flight a pilot should determine whether a departure procedure has been established for terrain/obstruction avoidance and that he will be able to comply with such procedures as necessary.

The following IFR departure procedure relating to a south departure is printed on the ADF-1, ADF-2 and ILS approach charts:

> "Take-offs to south will climb on course 161° over the OM and continue on course 161° to Broad River RBN. Upon reaching 5,000 or higher as directed by ATC, continue climb on course."

FAA representatives stated that this IFR departure procedure pertains terrain clearance and is not a mandatory procedure 7/ for departing IFR aircraft when terrain clearance can be effected by visual means.

C&G approach charts were found among other debris of the Cessna at the accident site. The only approach chart for Asheville found was a torn but recognizable portion of the ILS/ADF-1 procedure dated 17 July (the then current approach chart for this procedure bore the date 7 January 1967). Other en route and approach charts were found in the wreckage, most of which were dated 1964, but none related to the Asheville area. It could not be determined if these charts were being used by the crew of the Cessna or if current charts were also aboard the aircraft or were being utilized.

1.9 Communications

There were no reported difficulties with air/ground communications between Approach Control and the Cessna or between the tower (local control) and PAI 22.

The air/ground communications equipment at the Asheville Tower was flight checked following the accident. Approach Control frequency 125. MHz and Local Control frequency 121.1 MHz were found to be operating satisfactorily under all conditions of transitions and approaches.

7/ Federal Aviation Regulations (FAR) 91.87 Operation at airports with operating control towers:

(f) Departures. No person may operate an aircraft taking off from airport with an operating control tower except in compliance with the following:

(1) Each pilot shall comply with any departure procedures established for that airport by the FAA.

1.10 Aerodrome Information

Asheville Municipal Airport is located in an area of mountainous terrain at an elevation of 2,161 feet m.s.l. It has one landing strip constituting runways 16/34, which is 6,500 feet long and 150 feet wide.

1.11 Flight Recorders

PAI 22 was equipped with a flight data recorder and a cockpit voice recorder (CVR), both of which were recovered from the wreckage in satisfactory condition.

The flight data recorder installed was a Fairchild Model 500, S/N 5218 The recording medium containing the pertinent flight record was readable, with all parameters functioning normally throughout the flight. The recorder readout indicated that the duration of the flight from lift-off to the collision was approximately 2 minutes 37 seconds. It also showed that a heading of approximately 160° was maintained for approximately 1 minute 7 seconds after lift-off to an altitude of approximately 4,200 feet m.s.l. At this point, a left turn was initiated and maintained for approximately 1 minute 20 seconds, at which time the collision occurred. The average rate of turn during this period was approximately 1.3° per second, with an average rate of climb of about 1,428 feet per minute. At the time of impact with the Cessna, the Boeing 727 was on a heading of 100°, climbing through an altitude of 6,132 feet m.s.l., and at an airspeed of 230 knots.

It was noted that the vertical acceleration (G) trace was fairly constant up to a point approximately 1 minute 35 seconds after lift-off and corresponding to an altitude of approximately 4,600 feet m.s.l. At

this point, mild excursions in the G trace on the order of 0.25G appear and continue until approximately 10 seconds prior to impact.

No flight recorder was installed on the Cessna nor was one required

A Fairchild CVR, Model A-100, S/N 485, was installed in the Boeing. The recording tape of the unit was recovered from the wreckage undamaged and a transcript of pertinent cockpit conversation, commencing with the takeoff clearance issued by the tower, was prepared. The approximate time period covered by the transcript was 3 minutes 15 seconds.

The conversations recorded on the tape concerned primarily with the operation of the aircraft and nothing was found of a probative value to the investigation. There was no indication that any of the crewmembers observed the Cessna prior to the collision.

No CVR was installed in the Cessna nor was one required.

1.12 Wreckage

The wreckage of the two aircraft was scattered over an area 1-1/2 miles long and 1/2 mile wide along a path to the north and northwest of the final impact point. Most of the Boeing 727 components were found in the main wreckage area with other fragmented portions scattered back along the flightpath. It was determined that the Boeing 727 impacted the ground in an inverted position on a heading of 340° and at an angle of descent approximately 90°.

The Cessna was severely fragmented and spread as far back as 1-1/ 2? miles from the main wreckage area. The only identifiable portion of the

Cessna found at the main wreckage site was the left engine, which was imbedded in the lower forward fuselage of the Boeing 727.

The Boeing 727 was painted white and blue with red piping. The Cessna was red with white and gold trimming.

Examination of the Boeing 727 flight control system revealed no evidence of failure or malfunction prior to impact. The landing gear, flaps, wing leading edge slats, and spoilers were all found in the retracted position. Stabilizer jackscrew measurements corresponded to a 1/2° nose-down trim position. No evidence was found of any in-flight fire or structural failure prior to impact.

Examination of the recovered portions of the Cessna flight controls revealed no evidence of pre-impact failure or malfunction. The landing gear was in the retracted position at impact. No evidence was found of any pre-impact failure of the structural components of the aircraft.

All three engines of the Boeing 727, and the two engines and propellers of the Cessna were examined, and no evidence of pre-impact failure or malfunction was found.

A partial, three-dimensional mockup of the forward fuselage of the Boeing 727 and a two-dimensional (plan view) layout of the Cessna 310 were constructed to aid in the determination of the collision angle of the two aircraft. The initial contact of the two aircraft was concentrated on the left lower nose section of the Boeing 727 and the Cessna's left outer wing. The relative position of the Cessna was such that it initially

penetrated the Boeing 727 fuselage at the lower 41 section, with parts of the Cessna exiting from the right side of the Boeing 727 forward of the galley doorframe.

There were numerous paint smears and scratch marks made by the Cessna on the Boeing 727. They were found predominantly on the left side starting at the aft left nose wheelwell door, proceeding upward and through the fuselage, and exiting near the top position of the galley. Measurement ments of these paint smears and scratch marks indicated an average angle of 18° between the longitudinal axis and the horizontal path of relative motion between the two aircraft. In the vertical plane, the scratch marks running aft and upward indicated an angle of 25° between the long tudinal axis and the vertical line of relative motion.

Disintegration of the Cessna was to the extent that similar marks on the sections involved could not be determined.

Damage to the cockpits of PAI and the Cessna was extensive; however some information from the pertinent flight instruments and radio equipment of both aircraft was determined through examination.

The following information was obtained from the Boeing 727:

No. 1 VHF communications radio . . . 129.75 MHz (PAI company frequency)
No. 2 VHF communications radio . . . 121.1 MHz (Asheville Tower)
No. 1 VHF navigational radio (VOR).. 115.9 MHz (Pulaski VOR)
No. 2 VHF navigational radio (VOR).. 112.2 MHz (Asheville VOR)

The No. 2 Radio Magnetic Indicator (RMI) was found on a heading of 097°. The course indicator of the flight director system was found set at 063°, and the heading on the pictorial deviation indicator (PDI) compass card was 086°.

The autopilot mode selector was in the "manual" setting and the altitude hold switch was "off."

Only a part of one altimeter was recovered. Its barometric pressure was set at 30.26 inches Hg.

The following information was obtained from the Cessna

Two VHF communications radio selector panels were found. One of the tuning heads read 125.54 MHz, the other read 125.--MHz (tenths/hundredth dial missing).

One VOR receiver tuning head was set at 110.5 MHz (Asheville ILS). The other VOR receiver installed in the aircraft was recovered but no information could be obtained as to its frequency setting.

The aircraft was equipped with one ADF receiver (Lear Model 12D). The tuning head of this unit was recovered from the wreckage in a crushed and damaged condition. Examination of the dial frequency indicator revealed a setting of between 378 kHz and 380 kHz. Measurements taken from the tuning condenser plates indicated a frequency setting of between 371.0 kHz and 386.93 kHz. (Broad River RBN frequency 379 kHz.)

One altimeter was recovered and revealed a barometric setting of 30.20 inches Hg. The pointers were rotationally free and disconnected internally.

No other useful information could be obtained from the instruments and radio components because of the severity of damage received in the accident.

1.13 Fire

Neither aircraft exhibited evidence of any in-flight fire prior to collision. An extensive ground fire consumed most of the Boeing 727 fuselage following impact with the ground.

1.14 Survival Aspects

This was a nonsurvivable accident. All persons aboard the two aircraft died of traumatic injuries sustained in the accident.

A review of the medical records and post-mortem examination of all the involved pilots revealed no evidence of any pre-existing disease or impairment which would have compromised the safe operation of the aircraft

1.15 Tests and Research

Cockpit Visibility Study

A cockpit visibility study was conducted by the Safety Board to determine the physical limitation of visibility from the flight crew seats in each aircraft involved, and to reconstruct the flightpath of each to determine if those physical limitations would hinder the crews in their detection and observation of the other airplane.

The data developed by the flight recorder readout were used to establish the flightpath of the Boeing 727. Since no detailed data comparable to that obtained for the Boeing 727 were available on the Cessna, the flightpath parameters chosen were based on the best available information. The scratch marks indicated that, at the moment of impact, the bearing of the Cessna from the Boeing 727 was 18°. In order to determine the heading of the Cessna at the time of impact, it was necessary to select two airspeeds considered to be the reasonable cruising

speed extremities. The two speeds were 140 knots and 200 knots. By method of vector diagrams it was determined that at an airspeed of 140 knots, the heading of the Cessna would have been 230° to impact, and at 200 knots, it would have been 240°. At any intermediate airspeed, the heading would vary within this envelope.

The altitude variation of the Cessna 310 was computed by determining the descent from 7,000 feet m.s.l. 8/ to 6,132 feet (collision altitude) within the known time parameters. It was found that the Cessna descended 808 feet in 2 minutes 32 seconds, or an average rate of descent of 5.3 feet per second.

The ground track for the Boeing 727 and the two ground track parameters for the Cessna were plotted. From these ground tracks, ranges and bearings between the two aircraft were obtained covering the last 35 seconds of flight. This time period was chosen as the maximum time that one aircraft would have been visible to the other, based on the speed of the two aircraft and a median in-flight visibility of approximately 4 miles.

In order to determine the physical limitations of vision from each cockpit, binocular photographs were taken of a Cessna 310 and a Boeing 727 by the FAA's National Aviation Facilities Experimental Center. These photographs utilized a fixed seat and eye position which were obtained through investigation and design eye position.

8/ The altimeter of the Cessna was found at a barometric setting of 30.20 inches Hg. Since the Asheville barometric setting was 30.26 inches Hg the aircraft would have been at 6,940 feet m.s.l. when its altimeter read 7,000 feet m.s.l.

From these studies, it was ascertained that for the last 35 seconds of flight, the bearing from the Boeing 727 to the Cessna varied from 3? to 18°, and from 39° to 18°, with a Cessna speed of 140 knots and 200 knots, respectively. The bearing from the Cessna to the Boeing 727 varied in a similar manner from 41° to 32° and from 30° to 22°.

The closure rate between the two aircraft at the Cessna speed of 140 knots varied from 528 feet/second at 35 seconds from impact to 590 feet/second at 1 second from impact. At 200 knots the closure rate varied from 638 feet/second at 35 seconds from impact to 700 feet/second at 1 second from impact.

Based on the visual angle (angle subtended by the viewed object) resulting from the size of the target, 9/ 10/ it was determined that the crew of the Boeing 727 would have to look directly at the Cessna in order to detect it when they were separated by 35 seconds. Had the vision from the Boeing 727 been completely unobstructed and had the crew been looking directly forward, the Cessna could be detected at 20° to the right or left

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9/ Lockheed Aircraft Corporation publication, "Collision Avoidance Visibility", LRM 790 L/STR #1004 (SST).

10/ Targets referred to are point sources. It should be noted that as aircraft converged the visual angles of the targets would increase.

The following table shows the visual angles presented from both aircraft at the time and speeds indicated:

C-310 Speed	Distance between A/C	Seconds to Impact	Visual Angle of C-310	Visual Angle of B-727
200	22,250'	35	3'	17'
200	700'	1	1°42'	8°51'
140	18,450'	35	5'	20'
140	590'	1	2°1'	11°11'

of the fovea at a range of about 7,100 feet. At closing rates of 700 feet/second and 590 feet/second, the time from such detection to impact is 10.1 seconds and 12 seconds, respectively. The Boeing 727 target would be detectable from the Cessna, providing the pilot had an unobstructed view, from 35 seconds before the impact to the time of impact.

Each aircraft had cockpit window configurations resulting in some restrictions to vision of a point target source of the other aircraft. From the normal eye positions of the Boeing 727 captain and copilot, the Cessna would be partially obscured by the windshield posts. The Boeing 727 as viewed from the Cessna pilot's normal position, would have been partially obscured by the windshield center post at an airspeed of 200 knots and completely visible in the copilot's window at a speed of 140 knots. From the Cessna's copilot position, the Boeing 727 would have been partially obscured at the higher speed and behind the post at the lower speed. As was stated previously, the paths of the target aircraft plotted on the windshields were based on fixed eye reference points. If the crewmembers shifted their head positions, these paths would have changed.

The study does not take into consideration any restrictions to visibility such as haze and cloud obstructions.

1.16 Pertinent Information

Crew Positions - The Cessna

In order to determine the aircraft seating position of the occupant of the Cessna, personnel at the Charlotte Airport who observed the crewmembers prior to departure were interviewed. The only person who actually

witnessed the departure of the aircraft was the line boy on duty at the time. From photographs, he identified the occupant of the left (pilot) seat as Mr. Reynolds. He could not identify the seating position of the other two occupants of the aircraft.

Voice identification was made from communications recordings of Charlotte Tower, Atlanta Center, and Asheville Tower. The voice of Mr. Anderson was identified as making the transmissions during the taxi operations at Charlotte to the point where the IFR flight plan information was given to the tower. All other ground and in-flight transmissions was identified as the voice of Mr. Addison.

Mr. Anderson was a certificated private pilot and was in the process of receiving multiengine instructions from Mr. Addison; Mr. Reynolds held no airman certificates.

Air Traffic Control Procedures

The ATC Procedures Manual (AT P7110.1B) prescribes procedures and accompanying phraseology to be used by personnel of all facilities providing air traffic control service. Controllers are required to be familiar with all provisions of AT P7110.1B and to exercise their best judgment if they encounter situations not covered therein.

With regard to IFR control responsibilities, it is stated that the procedures and minima outlined in the manual are to be applied, except in cases of authorized deviation (Sec. 112). This section states that, "Pilots are required to abide by applicable provisions of FAR or any other pertinent regulation, regardless of the application of any procedure or minima in this manual."

Under IFR Procedures, Part 280, USE OF ROUTES, the recommended manner in which aircraft will be cleared over various routes is prescribed to the controller as follows:

"280 USE OF ROUTES
281 Routes
281.1 Clear aircraft via one or more of the following:
A. Designated airways and routes.

Phraseology:
VIA:
VICTOR (color) (airway number)
or
J (route number)
or
SUBSTITUTE (airway or jet route) FROM (fix)
TO (fix)
CROSS/JOIN VICTOR (color) (airway number)
(number of miles) MILES (direction) OF (fix)

B. Radials, courses, or direct to or from navaids.

Phraseology:
DIRECT
VIA:
(name of navaid) (specified) RADIAL/COURSE
or
(fix) AND (fix)
or
RADIALS OF (airway or route) AND (airway or route)

C. DME arcs of VORTAC or TACAN aids.
D. Radials, courses, and headings of departure or arrival routes.
E. Vectors.
F. Fixes defined in terms of degree-distance from navaids for special military operations.
G. Courses, quadrants, or radials within a radius of a navaid.

Phraseology:
CLEARED TO FLY (specified) COURSES/RADIALS/QUADRANTS OF
(navaid name and type)
WITHIN (number of miles) MILE RADIUS."

The applicable regulation, with respect to courses required to be followed during IFR operations, is FAR 91.123. The regulation states:

"91.123 COURSE TO BE FLOWN

Unless otherwise authorized by ATC, no person may operate an aircraft within controlled airspace under IFR, except as follows:

(a) On a Federal airway, along the centerline of that airway.

(b) On any other route, along the direct course between the navigational aids or fixes defining that route.

The controller effecting separation between the Cessna and PAI 22 fied that he was utilizing lateral separation as defined in Section 223 of AT P7110.1B. This section is found under general Section 220, Separation in which 220.1 prescribes, "Separate IFR and special VFR aircraft by the minima and methods described in this section." Lateral separation under Section 223.1 is described in the Manual as follows:

"223.1 Separate aircraft by one of the following methods:

A. Clear aircraft on different airways or routes whose widths do not overlap. (N)

B. Clear aircraft below 18,000 to proceed to and report over or hold at different geographical locations determined visually or by reference to navaids.

C. Clear aircraft to hold over different fixes whose holding pattern airspace areas do not overlap each other or other airspace to be protected.

D. Clear departing aircraft to fly specified headings which diverge by at least 45 degrees.

223.1A Note--Airspace protected for airways is based on airway widths described in FAR 71.5 and airspace protected for routes will be consistent with widths described in FAR 71.5."

AT P7110.1B Section 262.7 also prescribes that Approach Control facilities notify an arriving aircraft at the time of first radio contact or as soon as possible thereafter, the type approach clearance or type of approach to be expected if two or more approaches are published and the clearance limit does not indicate which will be used.

With respect to ATC procedures concerning clearance read-backs from IFR flights, it was noted that on July 18, 1967, the FAA issued a General Notice (GENOT) to all ATC facilities which read, in part:

> ". . . it is agency policy that read-backs will not be deleted or discouraged and will be accepted by Air Traffic Control Facilities. As good operating practice, controllers may request clearance readback whenever the complexity of the clearance or any other factors indicate a need."

It is of interest to the Board that in March 1966, the FAA initiated an IFR Systems Indoctrination Program (SIP) [11/] designed to introduce the neophyte/non-professional instrument rated pilot into the IFR Air Traffic Control System. This was an experimental program limited to flights conducted solely within the FAA Southern Region. [12/] Participation was on a voluntary basis and the provisions of the program were to be explained to those qualified pilots (operating within the scope of SIP) at the time they filed a flight plan.

In general, it called for providing participating pilots with expanded and more simplified ATC services. Special accommodations to be rendered by

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11/ IFR System Indoctrination Program, FAA SO1250.1A, 3/2/66.

12/ FAA Southern Region includes North Carolina, South Carolina, Tennessee, Mississippi, Alabama, Georgia, and Florida.

ATC facilities included, inter alia, increased services and information during preflight briefings, slower and more detailed transmittal of clearances, simplified arrival and departure instructions, and advisories as to course/radial changes and facility frequency changes as necessary.

It was specified in the instructions that because of congestion on air/ground frequencies, pilots air-filing flight plans would not be encouraged to participate.

Another purpose of SIP was to test the IFR system capability to absorb the additional workload that would be generated by this program. According to the FAA, the Southern Region received 37 responses out of total of 708 flight plans filed and, because of this apparent "lack of interest," the program was discontinued in August 1967.

The Cessna requested and received its IFR clearance during taxi operations, on an air/ground (tower) frequency and was not on a SIP flight plan for this flight.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

General

The investigation disclosed no evidence of any failure or malfunction of the airframe, engines, or components of either aircraft involved in the accident. Both aircraft had been maintained in accordance with prescribed regulations. The crew of PAI 22 and the pilot-in-command of the Cessna were all properly certificated for their flights.

Operation of Cessna, N3121S

The record is clear that the Cessna failed to comply with the clearance to proceed from the Asheville VOR to the Asheville RBN. The location of the collision site, approximately 9 miles southwest of the VOR on the 243° radial, is not indicative of a flightpath which would be in compliance with any of the four published instrument approaches for Asheville.

The Board has considered three alternatives as to why the Cessna failed to proceed from the VOR to the Asheville RBN:

1. The crew of the Cessna, anticipating an ILS approach, became confused by the clearance and were unable to locate the Asheville RBN on the ILS chart prior to the aircraft arrival over the VOR. In the confusion it was decided that one of the other facilities depicted on the ILS chart (OM or MM) was, in fact, the Asheville RBN and a flight course toward one of these facilities was initiated.

2. The crew of the Cessna, anticipating an ILS approach, misinterpreted the clearance wherein they believed that the Broad River RBN and the Asheville RBN were one and the same facility. A course toward the Broad River RBN, depicted on the ILS chart, was initiated from over the VOR.

3. The crew of the Cessna, either failing to locate the Asheville RBN upon reaching the VOR, or for other undetermined reasons, decided to ignore the clearance and continue inbound by visual reference to the ground.

Prior to departure from Charlotte the flight received a weather briefing which included a forecast for Asheville for the approximate time of arrival, indicating a ceiling of 1,500 feet broken clouds, 12,000 feet broken clouds, with the visibility 5 miles in haze. It is not known what other preflight preparations were accomplished or whether the pilot

had flown into the Asheville area prior to this flight. The crew initially intended to conduct the flight in VFR conditions with no flight plan. However, during the taxi-out, a complete IFR flight plan was filed with the tower and subsequently the Cessna was cleared to the Asheville VOR, via a direct route.

The first occurrence of significance occurred at 1151:30, while the Cessna was under the control of the Atlanta Center. They were advised to "expect an ILS approach at Asheville." Their attention undoubtedly was focused on this possibility. Their radios were set accordingly, their attention was undoubtedly focused on the ILS chart, and very likely a 1964 ILS approach chart.

Normal ATC procedures call for a Center to be currently advised as to the type of approaches being conducted at the various terminals with its area. In this case, Asheville Approach Control had previously informed the Center that ILS approaches were being conducted. It is also a required procedure for the Center to advise an IFR flight of the type of approach to expect at the point of intended landing. The relay of this information is intended to provide a pilot with adequate time to review the approach procedure currently in use at the destination airport and the one which he most likely will utilize in his approach for landing. It <u>is not</u> an approach clearance nor does it necessarily mean that this is the type of an approach for which the aircraft will finally be cleared. However, under most conditions a pilot receiving an approach advisory will prepare for that type of approach.

Inasmuch as this advisory was received approximately 5 minutes prior to the clearance to the Asheville RBN, it can reasonably be assumed that during this period of time the crew oriented their thinking toward an ILS approach at Asheville, and it is most probable that an ILS chart would have been reviewed and the necessary plans for the approach formulated by the crew during this time.

One of the first considerations would have been to determine the primary fix for that approach and the transition route to that fix from over the VOR, which was the then current clearance limit. The primary approach fix for the ILS approach is the Broad River RBN and the transition route from the VOR is delineated on the approach chart as 232°, distance 12.7 miles.

Examination of the radio equipment recovered from the wreckage of the Cessna indicates that one of the VOR receivers was tuned to the Asheville ILS and that the ADF receiver was tuned to Broad River RBN.

Considering the requirements for this approach and the flight's proximity to Asheville at this time, the crew, most logically, would have set up the radio navigation receivers as follows:

No. 1 VHF NAV receiver to the Asheville ILS localizer frequency (110.5MHz)

No. 2 VHF NAV receiver to the Asheville VOR frequency (112.2MHz)

ADF receiver to the Broad River RBN (379 kHz)

In this manner, inbound course information to the VOR would be presented by the No. 2 VHF NAV receiver and outbound heading information from the VOR to the Broad River RBN would be presented by the ADF pointer, as well as a course deviation indicator (CDI) heading of 232° if this was set up on the No. 2 VHF NAV equipment on passing the VOR. Additionally, localizer course and glide slope (available only on the No. 1 VHF NAV) information would be preset on the No. 1 VHF NAV receiver and would also provide a radial cross-check for Broad River RBN as well as the outbound localizer course presentation which would facilitate the procedure turn.

At 1153:00, radar service was terminated by the Atlanta Center and control of the flight was transferred to Asheville Approach Control. At 1153:49, in response to a request from Approach Control, the flight reported passing the 340° radial of the Spartanburg VORTAC. 13/ In this, the first contact between Approach Control and the Cessna, the pilot was not advised as to the type of approach he would be given upon his arrival at Asheville. As previously indicated, Section 262.7 of AT P7110.1B provides that Approach Control facilities will notify an arriving aircraft at the time of first radio contact, or as soon as possible thereafter the type approach clearance or the type of approach to be expected when

13/ This position is not consistent with other known positions as indicated by radar observations and when plotted, shows an inconsistent ground speed between these points. Applying a more constant ground speed over the route, it appears that the aircraft was passing the 350° radial at Spartanburg at that time rather than the reported 340° radial.

two or more approaches are published and the clearance limit does not indicate which will be used. This was not done. It appears that the controller did not know at that time what type of approach would be utilized so he was unable to provide this information. While this explanation is reasonable, it also is clear that lacking such information the crew would proceed on the basis of their latest information--that given by the Center that they were to expect an ILS approach upon arrival at Asheville.

The crew's expectation of receiving ILS approach clearance to Asheville was probably further fortified a few minutes later, at 1154:29 when PAI 1022 (another Piedmont aircraft inbound to Asheville) received clearance for an ILS approach circling to land on Runway 16. At that time both aircraft were on Approach Control frequency and this clearance could have been heard by the crew of the Cessna. They would not, however, have had any knowledge of the local airport traffic situation, specifically the departure of PAI 22, since these communications were transmitted on another frequency.

The next communication with the Cessna was a clearance issued by Asheville Approach Control at 1156:28 as follows:

> "Three one two one Sugar cleared over the VOR to Broad River, correction make that the Asheville radio beacon ....over the VOR to the Asheville radio beacon, maintain seven thousand, report passing the VOR."

This clearance was acknowledged by the reply:

> "Thr - two one Sierra"

Again, there is no direct reference to the type of approach the flight was to be given. However, the controller should have been aware at this time that the Cessna would be cleared for an ADF-2 approach rather than for an ILS approach since there is no ILS procedure utilizing the Asheville radio beacon. It is evident, however, that the Cessna did not proceed toward the Asheville radio beacon (298°) after passing the VOR but rather proceeded on a southwesterly course. This clearance, and its comprehension by the pilot, is most significant. It not only established a new clearance limit and route of flight but also formed the basis for required separation between the two aircraft involved.

In considering the adequacy of the clearance, the Board reviewed the applicable portions of the Air Traffic Control Procedures Manual (AT P7 Under the general heading USE OF ROUTES, the recommended manner in which aircraft will be cleared over various routes is prescribed to the contrary To comply with this section of the manual, it is apparent that the controller, in clearing the Cessna from the Asheville VOR to the Asheville RBN should have either specified a radial or course to be flown or specified "via [...?] in his phraseology. There is no doubt that had the controller used the option of specifying the radial or course from the VOR; i.e., ". . . over the VOR to the Asheville RBN (via the 298° radial of the Asheville VOR) the possibility for misunderstanding or error would have been reduced. However, if the controller had selected the use of the phraseology "via [...?] i.e., ". . . over the VOR (via direct) to the Asheville radio beacon,"

doubtful that the clearance would have been enhanced or that any additional significance would have been added that was not already implied.

FAR Part 91.123 specifies that a direct course be flown between two navaids or fixes defining that route, which further substantiates the position that the omission of the word "direct" from the clearance should not have affected the pilot's actions in complying with the clearance or the route to be flown from the VOR to the Asheville RBN, provided, of course he knew the location of the destination to which he had been cleared.

This clearance should have been a precise indication that an ILS approach was not to be utilized since there was no ILS procedure using the Asheville RBN. However, the initial use of the Broad River RBN in the clearance, immediately changed to Asheville, could have continued a chain of misunderstanding which was initiated when the Center first advised the flight that they could expect an ILS approach. The ILS chart contained only one reference to the Asheville RBN, and that in the missed-approach procedure. It was not described by geographic location and the absence of a clear indication of its location, coupled with the corrected clearance, could very well have led the pilot to conclude that the Asheville RBN was associated with an ILS approach, either the outer marker (OM) or, in the alternative, that the designation had been changed from Broad River RBN to Asheville RBN, and it was the change in name or designator that prompted the controller's initial usage of Broad River instead of Asheville. In the absence of the designation of a radial to fly or, of more importance, the identification at this time of the type of approach to be utilized, confusion could have been compounded or a misunderstanding continued undetected.

One minute 50 seconds after receiving the clearance, the flight reported over the VOR (1158:20) as requested:

> "Two one Sierra just passed over the VOR. We're headed for the . . . (Pause) . . . ah . . . Asheville now."

Although the controller was given no indication that the clearance was not understood since the flight did not request clarification or further instructions, the transmission could indicate an uncertainty as to where or what the Asheville RBN was. The words "we're headed for the" would presume the use of a facility name such as "Asheville RBN." Instead the sentence was completed after a 4-second pause by the single word, "Asheville." There are many Asheville references in the terminal area [on?] the approach chart. It is not unreasonable to conclude that at this point too, there was confusion or misunderstanding as to the destination.

Finally, 1 minute 16 seconds prior to the collision, Approach Controller cleared the Cessna for an ADF-2 approach to Runway 16, to report the Asheville RBN inbound. This clearance was acknowledged, "roger", immediately and unhesitatingly. At this point, it should have been clear to the crew that the flight was not proceeding in accordance with its clearance and immediate action should have been initiated by the crew to either report its position or request assistance. However, if they still did not know the location of the Asheville RBN, it would not be unreasonable to assume that they would continue their course while they were attempting to locate Asheville RBN.

At this point, the crew probably attempted to locate and study the ADF-2 approach chart and/or verify the position of the Asheville RBN on the ILS approach chart. As was previously noted, the ILS chart has numerous references to "Asheville", and does not portray the geographic location of the Asheville RBN. In either case, considerable time could have been required to find the proper approach chart or evaluate the aircraft's present position relative to the location of the Asheville RBN.

Operation of PAI 22

PAI 22 was cleared for takeoff and reported "rolling" at 1158:07. The report from the Cessna was received 13 seconds later while PAI 22 was still on the runway in its takeoff roll. It must be noted that the controller's primary responsibility throughout this time was to insure that at least minimum separation would be effected between PAI 22 and the Cessna in accordance with procedures prescribed at AT P7110.1B. The controller charged with this responsibility stated that he was utilizing lateral separation as outlined in Section 223 of that manual and that no set distance or time is required in the separation criteria, as there were two aircraft over two different geographical points proceeding along nonconverging paths.

However, it is the Board's interpretation of the procedures outlined in Section 223.1 that the Cessna must be considered an en route aircraft proceeding along a transition route from the VOR to the Asheville RBN, and that as such, it is entitled to 4 miles of protected airspace either side of the centerline of a direct course between these points.

Since the airport is located on the south boundary of that airspace (see Attachment #1), any aircraft departing from Runway 16 with an immediate left turn on course to the VOR would most certainly enter the protected airspace of a direct route between the VOR and the Asheville RBN.

It can be seen that the restriction to PAI 22 to maintain runway heading until reaching 5,000 feet kept the aircraft clear of the protected airspace required for the Cessna between the VOR and the RBN and, predicated on the receipt of the position report of the Cessna over the VOR on a nonconverging flightpath with the aircraft. Had this position report from the Cessna not been received by Approach Control prior to PAI 22 reaching 5,000 feet, it would have been necessary for the controller to again amend PAI 22's clearance to insure standard separation However, this was not necessary since the Cessna reported passing the VOR while PAI 22 was still on the runway and, in fact, the departure restriction was not removed from PAI 22 unitl 1 minute 11 seconds after lift-off. With the knowledge of PAI 22's geographical position at this time (4 to 5 miles southeast of the airport) and the time at which the Cessna reported over the VOR, the controller determined that adequate lateral separation would exist between the two aircraft and the Cessna would be well clear of the VOR before PAI 22 could arrive there.

The following table shows the distance that would have existed between the two aircraft at the times and positions indicated, predicated

upon the Cessna flying a direct course from the VOR to the Asheville RBN (in accordance with the clearance) at a speed of 180 knots:

Event	Time	Position of PAI 22	Estimated [14] Position of the Cessna	Computed Separation Distance
Position report of the Cessna over the VOR	1158:20	On Runway 16	Over VOR	13.5 mi
PAI 22 cleared unrestricted to the VOR	1159:44	3.2 mi. SSE of Airport	4 mi. NW VOR	9 mi
Last tower observation of PAI 22	1200:08	4.5 mi. SSE of Airport [15]	5.5 mi. NW VOR	8.3 mi
Collision PAI 22/Cessna	1201:18	8 mi. SSE of Airport	9 mi. NW VOR	8.5 mi

Note: Projection of relative positions of both aircraft beyond the time of the accident shows increasing separation.

It is evident to the Board that had the Cessna transited a direct route from the VOR to the Asheville RBN, adequate separation in accordance with requirements set forth in AT P7110.1B would have existed.

The flight of PAI 22 was brief and involved only the takeoff and climbout to the point where the collision took place. The conduct of the flight was in accordance with its IFR clearance and within the confines of

14/ Based on the controller's estimate of the Cessna's speed, look, TAS, along a direct route from the Asheville VOR to the Asheville RBN.

15/ Controller estimated his last observation between 4 to 5 miles south-southeast of the airport, slightly to the left of the localizer course. For purposes of this calculation, a distance of 4.5 miles was used.

applicable procedures and regulations. The Board concurs in the FAA interpretation that the applicable IFR departure procedures were established for terrain/obstruction avoidance purposes and are not mandatory procedures when a departing flight can effect terrain avoidance by visual means.

It was shown in the cockpit visibility study that each aircraft could have been visible to the flightcrew of the other aircraft for approximately 35 seconds prior to the collision, providing there were no intervening clouds. Although witnesses reported that the collision occurred in an area clear of clouds, the evidence indicates that both aircraft would have been operating in and out of broken clouds just prior to the accident. Therefore, in this situation, the "see and be seen" concept can only be considered inapplicable. To observe visually and avoid another aircraft under those existing conditions of weather and the high rates of closure, from a practical standpoint, is nearly impossible. Also, neither flight was aware of the presence of the other and, therefore would not be exerting any increased outside vigilance for conflicting traffic. In fact, it is believed that attention outside of the cockpit of both aircraft would have been somewhat reduced because of the higher workloads associated with the departure and approach flight phases.

The Board is unable to identify the specific reason for the Cessna deviation from its clearance. The Board does not believe there is sufficient evidence to conclude that the Cessna pilot ignored the clearance. However, it is believed reasonable to assume that it was either by reason

of confusion or through misunderstanding of the clearance. In either event, it is concluded to be the product of two factors: (1) inadequate knowledge of the Asheville area by the pilot and poor flight planning, and (2) the failure of the ATC system to provide timely information which would have prevented the deviation or at least alerted the pilot to recognize his misunderstanding.

The Cessna pilot, prior to arriving in the Asheville area, should have reviewed and become familiar with all of the approach charts for the airport Had this been accomplished when the clearance was received, "over the VOR the Asheville Radio Beacon," the pilot would have been familiar with the location and frequency of the facility. Information as to the location of the Asheville Radio Beacon is contained in the OMNI supplement, the section chart, the en route facility chart, the airman's manual, and the approach charts published for Asheville, all of which should have been available to the Cessna pilot. If the Cessna pilot had adequately planned his flight, should not have become confused or uncertain with respect to the meaning of the clearance or the location of the Asheville Radio Beacon, nor should he have misunderstood the clearance. Furthermore, when the clearance was received for an ADF-2 approach, approximately 1 minute prior to the accident he should have known immediately that he had deviated from the clearance and either reported his position or requested assistance.

Concerning the operation of the ATC system, the Board recognizes that it is not infallible. It requires a cooperative effort on the part of both pilots and controllers to achieve the desired results. If an inadequate clearance is issued by a controller, or if an adequate clearance is not

followed precisely by a pilot, the programmed margin of safety is decreased. A successful system must provide safeguards to protect against the inherent fallibilities. The use of surveillance radar, where installed, provides a more positive means of air traffic separation, since the controller can visually observe the tracks of aircraft within its range. However, even this system adjunct becomes vulnerable when aircraft not under positive control transit control areas and vital altitude information are lacking. In nonradar environments, radio voice communication which can be ambiguous and cause misunderstanding between pilots and controllers, becomes the only means by which aircraft separation can be effected. The only safeguard in this system is complete adherence to clearances by pilots and, ideally, a method of air-to-ground communications which insures absolute comprehension of instructions by pilots and total assurance to controllers that clearances are being complied with. The scope of ATC practices and procedures in these area must be maintained at that level wherein the possibilities for misunderstanding or confusion will be reduced to the absolute minimum and which in turn, will provide the maximum amount of tolerance in the system.

There can be no doubt that had the controller advised the Cessna to plan for an ADF-2 approach at the time of first contact or at least when the clearance to the Asheville RBN was given, any confusion or misunderstanding by the pilot as to the approach to be conducted, or as to the location of the Asheville RBN, would have been eliminated prior to passing the VOR. Not only should the controller have been aware that the flight

had previously been advised to expect an ILS approach, but he also must have formulated in his mind the type of approach for which the flight would now be cleared. In view of the circumstances, the delay in the issuance of this advisory must be considered as a major factor leading up to the events which followed. In this instance, notwithstanding the obvious omissions on the part of the crew of the Cessna, the lack of additional information from ATC to offset the previously issued advisory in all likelihood set the stage for a situation that need not have developed

In addition, if the controller had specified a radial or bearing from the VOR to the Asheville RBN in giving the clearance, any possible doubt as to the course to be followed would have been removed.

Although a clearance readback is not mandatory, a request to this effect by the controller may have served to clear up any uncertainty in the mind of the pilot with regard to the instructions, and perhaps may have alerted the controller that they were not clearly understood. In this regard, it is noted that on the day before the accident (July 18, 1967) the FAA issued a GENOT to ATC facilities which read, in part:

> ". . . as good operating practice, controllers may request clearance readback whenever the complexity of the clearance or any other factors indicate a need."

Obviously the clearance was not complex; however, there could have been no doubt in the mind of the controller at that time that minimum separation of these two aircraft was dependent upon the Cessna following a direct course from the VOR to the Asheville RBN.

It appears to the Board, based on the facts in this case and others reviewed in recent years, that controllers in their communications often tend to use the same standards for the professional air carrier pilots and the nonprofessional general aviation pilots. While the Cessna pilot in this case was instrument-rated and well qualified, the controller had no way of knowing the qualifications of the pilot with whom he was communicating. The Board believes that controllers should not equate all pilots with the upper segment of the proficiency spectrum. While we are aware of the pressure of time imposed upon controllers by the near saturation of the system, we maintain that it should not be permitted to limit necessary communications. All the available information with respect to clearances should be given to pilots, particularly nonairline pilots, and the practice of readbacks of clearances should be encouraged, particularly larly, as in this case, where time was clearly available.

In the absence of radar surveillance which would assure that a proper flightpath was being maintained, it appears that more positive steps, such as those discussed above, could have been taken to insure compliance with the clearance.

It must be stressed, however, that pilots are required to abide by the applicable provisions of the FAR with respect to ATC procedures, regardless of the application of any procedure or minima outlined in AT P7110.1B. If there is any uncertainty regarding compliance with an ATC clearance, the pilot is required to notify an ATC facility.

2.2 Conclusions

(a) Findings

1. Both aircraft were properly certificated and were in an airworthy condition for the subject flights.
2. Both flight crews were properly certificated and qualified to conduct their respective flights.
3. There is no evidence of any failure or malfunction of either aircraft or aircraft components prior to the collision.
4. Both aircraft were operating on IFR flight plans at the time of the accident.
5. Atlanta Center advised the Cessna to expect an ILS approach at Asheville.
6. At 1153:49, Asheville Approach Control had its initial contact with the Cessna and no notification was given as to the type of approach to be used.
7. At 1156:28, Asheville Approach Control cleared the Cessna to proceed from over the Asheville VOR to the Asheville RBN, but did not identify the type of approach to be used.
8. The clearance to the Asheville RBN was generally adequate in terms of clarity, content, and intelligibility, but did not conform to the applicable phraseology set forth in AT P7110.1B.

9. The clearance to the Asheville RBN was acknowledged by the Cessna but was not read back. There is no requirement for readback of ATC clearances issued to en route aircraft.

10. The Cessna reported passing the VOR at 1158:20 and the crew advised ATC that they were headed for Asheville. PAI 22 was on its takeoff roll on Runway 16 at this time and had been cleared to climb to 5,000 feet m.s.l. on runway heading.

11. At 1159:44, PAI 22 was cleared to climb unrestricted to the Asheville VOR.

12. The Cessna was first advised that they were to conduct an ADF-2 approach to Runway 16 approximately 1 minute 16 seconds prior to the collision. AT P7110.1B prescribed that Approach Control issue an approach clearance, or advisory as to the type of approach to be conducted, at the time of first radio contact with a flight or as soon as possible thereafter.

13. The collision occurred at 1201:18 at an altitude of 6,132? feet m.s.l. on the 243° radial of the Asheville VOR, at proximately 9 miles southwest of that facility.

14. Terminal area Navaids were operating satisfactorily at the time of the accident.

15. Surveillance radar was not installed at Asheville.

16. The flightpath of the Cessna from over the VOR to the accident site was not in accordance with the clearance issued by ATC.

17. The departure of PAI 22 was in accordance with its IFR clearance and in conformance with applicable FAA departure procedures.

18. Adequate separation, in accordance with the provisions of AT P7110.1B, would have existed between the two aircraft if the Cessna had proceeded on a direct course from over the VOR to the Asheville RBN.

19. The crew of the Cessna did not request clarification or instructions regarding any radio transmissions from ATC.

20. The geographical location of the Asheville RBN is not depicted on the ILS approach chart for Asheville.

21. The collision occurred in a clear area; however, both aircraft were operating in and out of clouds prior to the accident.

22. The Cessna and PAI 22 were unaware of the presence of one another, as they were communicating with ATC on different radio frequencies.

23. While the Board is unable to determine the specific reason for the Cessna's deviation from its assigned IFR clearance, it may have been due to (a) the pilot's inadequate knowledge of the Asheville area and poor flight planning, and (b) the failure of the ATC system to provide timely information which would have prevented the deviation or at least alerted the pilot to recognize his misunder standing.

(b) Probable Cause

The Safety Board determines that the probable cause of this accident was the deviation of the Cessna from its IFR clearance result in a flightpath into airspace allocated to the Piedmont Boeing 727. The reason for such deviation cannot be specifically or positively identif The minimum control procedures utilized by the FAA in the handling of Cessna were a contributing factor.

3. RECOMMENDATIONS

With respect to the discussions of the landing approach charts relevant to this accident, the Board is aware of continuing programs by the FAA to review and modify aeronautical chart displays in order to facilitate current navigational requirements. Among the planned changes to the C&G landing approach charts will be the pictorial display of all navigational aid facilities or fixes, applicable to the approach, or missed approach procedure for the type of approach being displayed.

In particular, this will result in the future depiction of the Asheville RBN on the Asheville ILS approach chart inasmuch as the Asheville RBN is a facility utilized in the missed-approach procedure.

The FAA is proposing continued modification of the landing approach charts as changes become necessary or desirable and is being assisted in this endeavor by the Flight Information Advisory Committee (FIAC) whose members represent the aviation interests of both Government and industry.

It is recognized that pilot/ATC radio communications in non-radar terminal areas represent the primary means by which air traffic separation is safely effected. Conformity to established ATC procedures by both pilots and controllers is the only means by which the margin of safety and system flexibility can be increased.

In view of anticipated increases in ATC system utilization, the Board urges continued improvement in communication methods and procedures, especially with regard to IFR aircraft in non-radar environments. Specific areas for study might include the feasibility of mandatory clearance readbacks by pilots

revisions to recommended controller phraseology which will provide specific instructions with regard to clearances that affect flightpath changes, more frequent monitoring of the progress of an aircraft in a non-radar terminal area through appropriate ATC communications. The addition of surveillance radar to these areas, as it becomes available, will of course diminish the problems of control experienced in the non-radar terminals The Board recommends expeditious increases in ATC radar coverage as the economics of money and manpower allow.

Another recognized problem with respect to the safe and efficient operation of the system is the widely varied experience levels of the usual pilots. At one end of the scale is the highly trained and proficient air carrier pilot who, for the most part, is intimately familiar with the aspect of the air traffic system. At the other end is the newly instrument-rated general aviation pilot with a relatively low amount of pilot time and with limited "actual instrument" flying experience. The system cannot and is not geared to, fully exploit either end of the spectrum; however it is designed to be flexible enough to provide a safe operation for all pilots "qualified" to participate. In addition to providing a means of air traffic separation, functional requirements of the system demand that it be adaptable to an expeditious air carrier and military operation as necessary to meet the essential needs of traveling public and the Department of Defense.

In essence, the system and its procedures must be sophisticated to the degree that a rapid and efficient traffic flow is assured, yet simply

to the point where a neophyte instrument pilot can be safely controlled. From the standpoint of system modification, it is apparent that these factors work against one another. Moreover, as system traffic loads increase, the variance between the pilot proficiency levels widen, and the continuing need for system modification becomes more pronounced.

While the Board strongly favors the simplification of air traffic control procedures as both a means to improve the programmed margin of safety and to facilitate the less proficient IFR pilots, it recognizes that modification in this direction can go only so far without a deleterious effect on the efficiency of the system as it now exists. Any attempt to radically simplify the procedures in order to totally accommodate the lower proficiency pilots can only result in a dual standard of control within the ATC complex. The Board believes this would be an undesirable situation, and as the present system nears the saturation point, one wherein the overall level of safety would be considerably reduced.

Therefore, in addition to seeking methods by which ATC procedures may be improved and simplified, the Board also recommends that more stringent requirements be established for the pilots using the system.

It is suggested that the FAA review the existing minimum levels of skill required for the issuance of an instrument pilot rating and evaluate these requirements against present and anticipated system proficiency level requisites. A valid criterion for these requirements should be a minimum level of proficiency wherein a pilot receiving an initial instrument rating is truly qualified for immediate and unrestricted operation in the system.

Further, it is recommended that the FAA establish a requirement for an annual proficiency flight check for all instrument-rated pilots utilizing the system to insure a continued level of proficiency which is at least compatible with the initial requirements.

The establishment of higher requirements for instrument ratings would not be, and is not meant to be, an attempt to constrict the utilization the system or to eliminate any pilot categories from continued use. As matter of practicability, it is the only way that the disparity in the proficiency levels can be narrowed thereby improving the efficiency and safety of the overall operation. In the long run, those pilots not now required to demonstrate any proficiency level at all after receipt of a instrument rating would benefit, at the very least, by the instructional value associated with an annual proficiency flight check.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOSEPH J. O'CONNELL, Jr.
Chairman

/s/ OSCAR M. LAUREL
Member

/s/ JOHN H. REED
Member

/s/ LOUIS M. THAYER
Member

/s/ FRANCIS H. McAdams
Member

Crew Information

The Crew of Piedmont Flight 22, N68650

Captain Raymond F. Schulte, age 49, was employed by Piedmont Airlines on July 18, 1947. He possessed airline transport pilot certificate No. 96053-41 with type ratings for the B-727, Fairchild F-27, DC-3, Martin 202/404, and commercial privileges, airplane multi/single-engine land and sea. His last first-class medical certificate was dated July 1967, and was issued with no waivers.

Captain Schulte had a total of approximately 18,383 hours flying of which 151 hours were in B-727 type aircraft. He had flown the B-727 approximately 82 hours in the preceding 30 days. His rest period prior to reporting on duty for this flight was approximately 15 hours.

Captain Schulte completed his training in the B-727 on May 10, 19[?] He received an unsatisfactory grade on his initial rating check in the area of traffic control and holding. He repeated the maneuver on a recheck the following day and received a satisfactory grade. He passed his last line check in the B-727 on July 6, 1967.

First Officer Thomas C. Conrad, age 30, was employed by Piedmont on March 30, 1961. He possessed a commercial pilot certificate No. 151675 with an airplane single-engine land and instrument ratings. His last first-class medical certificate was dated March 8, 1967, and was issued with no waivers.

He had a total of approximately 3,364 flying hours of which 135 hours were in the B-727 type aircraft. He had flown a total of 52 hours in the 30-day period preceding the accident. First Officer Conrad completed his training and satisfactorily passed his proficiency check in the B-727 on April 21, 1967.

Flight Engineer Lawrence C. Wilson, age 37, was employed by Piedmont on August 23, 1965. He possessed Flight Engineer's certificate No. 1723[illegible] and airline transport pilot certificate No. 1367746. His last first-class medical certificate was dated July 13, 1967, and was issued without waivers.

Flight Engineer Wilson had a total of 281 hours in the B-727 and satisfactorily completed his last line check on March 20, 1967.

The two flight attendants were regularly employeed by Piedmont for that position and were properly trained in emergency procedures.

Occupants of the Cessna 310 - N3121S

Mr. John D. Addison, age 48, was the assigned pilot-in-command of N3121S. He was employed by Radial Air, Inc., of Springfield, Missouri, and had been hired by Lanseair, Inc., to conduct this flight. He possesses a commercial pilot certificate No. 72864-41, with airplane single and multi-engine land and instrument ratings. Mr. Addison was also a rated flight instructor, airplane and instrument and held an advanced ground instructor certificate. Mr. Addison's most recent issuance of certificate was a temporary airman certificate issued on February 14, 1967, when he was tested for and sucessfully passed a flight instructor renewal.

He passed a second-class FAA medical examination on August 1, 1966 with the limitation: Holder must wear correcting glasses and shall have available a second pair of correcting glasses while exercising the privileges of his certificate.

Mr. Addison had a total of 10,000 flying hours as pilot-in-command which approximately 11 hours were in the Cessna 310. He had flown a total of 118.5 hours while employed by Rapid Air during the period June 6, 19 to July 13, 1967.

Mr. Robert E. Anderson, age 36, was an employee of Lanseair, Inc. He held private pilot certificate No. 1597858 with airplane single-engine land rating. He passed an FAA second-class medical examination on April 1966, with no limitations. Mr. Anderson had a total of approximately 5 flying hours. Of this total, approximately 43 hours were dual instruct and approximately 10 hours were flown on instruments.

Mr. Ralph E. Reynolds, the third occupant of the Cessna was also a employee of Lanseair, Inc. No records were found that he held or had ever possessed an FAA pilot certificate of any kind.

Aircraft Information

The Boeing 727-22, N68650, S/N 18295, was leased by Piedmont Aviation, Inc., from the Boeing Company. The aircraft was manufactured in 1963 and had a total aircraft time of 6,445 hours. The time since overhaul was 889 hours.

N68650 was equipped with two Pratt and Whitney JT8D-1 engines, and one JT8D-1 engine.

The aircraft records indicate that N68650 had been maintained in accordance with all company procedures and FAA directives. There were no aircraft discrepancies reported prior to departure from Asheville.

The Cessna 310, N3121S, S/N 35069, was manufactured in 1955 and had a total aircraft time of 2,723 hours. It was equipped with two continental O-470 engines each of which had a time since overhaul of 40 hours.

A review of all available aircraft records indicates that the aircraft was maintained in accordance with approved procedures and directives.

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