

# AIRCRAFT ACCIDENT REPORT

Adopted: August 21, 1969

PIEDMONT AIRLINES  
FAIRCHILD-HILLER 2276, N712U  
CHARLESTON, WEST VIRGINIA  
AUGUST 10, 1968

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

NATIONAL TRANSPORTATION SAFETY BOARD  
DEPARTMENT OF TRANSPORTATION

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SYNOPSIS

Piedmont Airlines, Flight 230, Fairchild Hiller 227B, N712U, a regularly scheduled passenger flight, crashed and burned while on an approach to the Kanawha County Airport, Charleston, West Virginia, at approximately 0857 e.d.t., on August ~~10, 1968~~ <sup>11, 1970</sup>. The three crewmembers and 32 of the 34 passengers were fatally injured in the accident. The aircraft was "destroyed by impact and subsequent fire."

The flight was conducting an Instrument Landing System (ILS) localizer (~~no glide slope~~) approach to Runway 23 when it crashed into a steep hillside approximately 250 feet short of the runway threshold and 33 feet below the threshold elevation. ~~Visual flight conditions existed at this time~~

~~At the time of the accident, a layer of dense fog estimated to be 150 feet thick, was obscuring the threshold and approximately one-half of the approach light system for the runway. Outside of the fog area, visual flight conditions existed.~~

The Safety Board determines that the probable cause of this accident was an unrecognized loss of altitude orientation during the (final) portion of ~~an~~ <sup>the</sup> approach into shallow, dense fog. The disorientation was caused by a ~~rapid reduction in the ground guidance segment available to the pilot at a point beyond which a go-around could not be successfully effected.~~ ~~insufficient supply of oxygen to the pilots mask causing him to become hypoxic.~~

1. INVESTIGATION

1.1 History of the Flight'

Piedmont Airlines (PI) Flight 230, a Fairchild Hiller 227B, N712U, was a regularly scheduled passenger flight from Louisville Kentucky, to Roanoke, Virginia, with en route stops at Cincinnati Ohio, and Charleston, West Virginia. The flight departed Louisville Kentucky, at 0720<sup>1/</sup> on August 10, 1968, and proceeded routinely to its first intermediate stop, Cincinnati, Ohio.

At 0805, PI 230 departed Cincinnati on an Instrument Flight Rules (IFR) clearance to Charleston (Kanawha County Airport) via Victor Airways 128 south to York, thence Victor 128 to Charleston, to maintain 9,000 feet. The flight proceeded en route under the control of the Indianapolis Air Route Traffic Control Center and at 0835:20 was cleared to the Milton Intersection (10 miles west-northwest of the Charleston VORTAC on Victor 128) and to descend to and maintain 5,000 feet. Just prior to this clearance, at 0835, PI 230 had called the Charleston Tower, requesting the latest weather. This was provided as: sky partially obscured, visibility 1/2 mile fog and smoke, Runway 23 visibility less than 1/8 mile. The flight responded, ". . . we'll see you in about 10 --- 15 minutes", to which the tower replied, "Okay, looks by the time you get . . . down this way possibly the runway visibility will have improved to a half mile."

b

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

At approximately 0841, PI 230 contacted Charleston Approach Control and reported leaving 6,000 for 5,000 feet. The controller advised PI 230 that radar contact had been established and instructed the flight to depart their present position on a 070° heading for a vector to the holding pattern at the ILS outer marker. The latest weather was also given at this time as: *sky* partially obscured, visibility 1/2 mile, fog and smoke, runway visibility Runway 23 zero, altimeter setting 29.94 inches.

The flight was then provided with holding instructions to be followed upon arrival over the outer marker compass locator (LOM) and was given an expected approach time of 0915, subject to weather conditions.

At 0850, prior to reaching the LOM, PI 230 was instructed to turn right to a heading of 140° and was cleared to descend to 2,400 feet. The flight was further advised that the runway visibility (RW) for Runway 23 was now seven-eighths of a mile.

At 0851, Approach Control advised PI 230, "you are seven miles northeast of the outer locator, turn right heading two zero zero, cleared for an ILS approach." The flight acknowledged the clearance and was advised by the controller shortly thereafter that "our glidepath is out of service." PI 230 responded "OK, thank you."

At 0852, Approach Control advised the flight that its position was 5 miles from the LOM and instructed it to contact Charleston Tower on 120.3 MHz.

At 0852:53, prior to the flight's call, the Tower local controller

cleared PI 230 to land. At 0854:40, PI 230 requested a wind check and reported passing the outer marker inbound. The wind was reported as 230° at 4 knots. At 0855:55, PI 230 asked, "Have you got the lights turned all the way up?" The controller replied, "Sure do, a little fog right off the end there and it's wide open after you get by that, it's more than a mile and a half now on the runway." This was the last known radio communication with PI 230.

Shortly after the foregoing transmission, the controller observed a column of smoke rising near the approach end of the runway and immediately activated the crash siren and called for the dispatch of airport emergency equipment. He then instructed American Airlines Flight 701, a Lockheed Electra also on an ILS approach behind PI 230, to execute a missed-approach procedure.

One witness, who was located in the valley approximately 1/2 mile from the approach end of the runway, stated that at the time of the accident a fog bank was obscuring the hilltop on which the airport is located. Although he did not see the aircraft at **any** time during the approach, he stated that as the aircraft approached his position the engines sounded normal and that his first indication of the accident was when he heard the sound of an explosion.

The pilot and a passenger of an aircraft awaiting takeoff clearance on a taxiway adjacent to the approach end of Runway 23 stated that the visibility in the fog at the end of the runway was "close to zero" and that although they were looking in the direction of the incoming aircraft, they could not see the airport approach lights or the approach

light structure because of the fog obscuration. They stated that their first observation of PI 230 was when it suddenly appeared out of the fog, approximately 50 feet in the air over the end of the runway. At this time the aircraft was on fire and falling rapidly toward the ground.

The wreckage came to rest on the opposite side of the runway about 300 feet from their position.

It was determined that the aircraft struck the steep hillside about 250 feet short of the runway threshold at an elevation of 865 feet m.s.l. (approximately 33 feet below the elevation of the threshold). The aircraft then careened up and over the side of the hill and onto the airport, coming to rest off the right side of Runway 23.

The accident occurred at 0856:53 during daylight conditions.

## 1.2 Injuries to Persons

<u>Injuries</u>	<u>Crew</u>	<u>Passengers</u>	<u>Others</u>
Fatal	3	32	0
Nonfatal	0	2	0
None	0	0	

Post-mortem examinations of the flight crewmembers revealed no evidence to indicate any preexisting disease that would have affected the performance of their duties.

## 1.3 Damage to Aircraft

The aircraft was destroyed by ground impact and subsequent fire.

## 1.4 Other Damage

None

1.5 Crew Information

All crewmembers were properly certificated and qualified to conduct this flight. (For detailed information see Appendix A.)

1.6 Aircraft Information

The aircraft was properly certificated and maintained in accordance with existing requirements.

The weight and center of gravity (c.g.) of the aircraft were determined to have been within prescribed limits at the time of the accident. (For detailed information see Appendix B.)

1.7 Meteorological Information

Official surface weather observations from Kanawha County Airport before and after the time of the accident were as follows:

0825, special, partial obscuration, surface and tower visibility 1/4 mile, fog, smoke, wind 210° at 4 knots, altimeter setting 29.94 inches, RW Runway 23 zero, fog obscuring 7/10 sky.

0842, special, partial obscuration, high scattered clouds, surface and tower visibility 1/2 mile, ground fog, smoke, wind 220° at 4 knots, altimeter setting 29.94 inches, RW Runway 23 zero, fog obscuring 4/10 sky. (Observation filed but not transmitted.)

record special, partial obscuration, high scattered clouds, surface and tower visibility 1 mile, ground fog, smoke, temperature 73°F., dew point 70°F., wind 220° at 4 knots, altimeter setting 29.95 inns, RW Runway 23 1-1/2 miles. fog obscuring 4/10 sky.



0906, local observation, partial obscuration, high scattered clouds, surface and tower visibility 1 mile, ground fog, smoke, temperature 74°F., dew point 70°F., wind 230° at 5 knots, altimeter setting 29.95 inches, RW Runway 23 1-1/2 / miles, aircraft mishap, visibility 2 miles southeast, fog obscuring 4/10 sky.

The terminal forecast for Charleston issued by the Weather Bureau at 0045, valid for a 12 hour period beginning at 0100, was in part as follows :

0500 - 1000, Partial obscuration, visibility 1/2 mile, ground fog, smoke, variable to ceiling 200 feet, sky obscured, visibility 1/4 mile, fog, smoke.

The next routine issuance of the Charleston terminal forecast was at 0645, valid for a 12 hour period beginning at 0700. That forecast was in part as follows:

0700 - 1000, Partial obscuration, ceiling 10,000 feet overcast, visibility 1/2 mile, fog, smoke, variable to partial obscuration, ceiling 200 feet, sky obscured, visibility 1/4 mile, fog.

At 0425, ~~AIRMET~~ Alfa 2 (valid 0425 to 0900) was issued as follows :

Over West Virginia and mountains of western Maryland and western Virginia, frequent visibility less than 2 miles in ground fog and occasional ceilings below 1,000. Continue beyond 0700.

The 0700 aviation weather sequence reports and terminal forecasts for Charleston, West Virginia, were provided to the crew of Flight 230 at the Piedmont operations office at Louisville prior to the flight's departure on this trip.

The pilot of a light aircraft which had taken off from Runway 23 shortly before the accident testified that a fairly solid fog bank was situated over the approach end of the runway. He stated that the fog appeared to cover the first 300 feet of the runway and was approximately 150 feet thick.

The first officer of American Airlines (AA) Flight 701 which had commenced an ILS approach to Runway 23 behind PI 230 testified that the weather conditions in the area were mostly VFR but that a fog bank was clearly visible over the approach end of the runway. He stated that as they approached the airport, he could see the first half of the approach lights extending out of the fog but that the remainder of the approach lights and the approach end of the runway were obscured by the fog. He further testified that the captain observed the far end of Runway 23 and that after passing the OM, they both could see smoke rising through the fog in the vicinity of the airport. The flight was then advised by the tower to conduct a missed approach. He stated that the wreckage of PI 230 first became visible through the fog as the flight was passing overhead at an altitude of 600 feet (above the airport) at which time the rest of the airport also came into view.

Climatological data compiled for the Kanawha County Airport show that over a 20-year period, the month of August had the maximum occurrence of fog days, with the average number being 19 days. The fog condition was described as occurring usually before midnight and persisting at the field until approximately midmorning.

## 1.8 Aids to Navigation

The ILS installed for approaches to Runway 23 utilizes the LOM as the primary approach fix. This facility is located 4.3 miles from the runway. The middle marker (MM) associated with the system is located .6 mile from the runway. The published procedure for this approach (see Attachment 1) is to cross the LOM inbound at 2,300 feet m.s.l. on a heading of 230° (the localizer and runway heading are the same). At this point, descent to the authorized minimum altitude is commenced. The minimum descent altitude <sup>2/</sup>(MDA) with the glide slope inoperative is 1,582 feet m.s.l. (600 feet above airport elevation). With the glide slope feature operative the decision height <sup>3/</sup>(DH) is 1,382 feet m.s.l. (400 feet above airport elevation). Compliance with

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<sup>2/</sup>Minimum descent altitude is the lowest altitude expressed in feet above mean sea level, to which descent is authorized on final approach, where no electronic glide slope is provided, or during circle-to-land maneuvering in execution of a standard instrument approach procedure.

<sup>3/</sup>Decision height is the height expressed in feet above mean sea level at which a decision must be made, during an ILS or a PAR instrument approach, to either continue the approach or to execute a missed approach.

Federal Aviation Regulation (FAR) 91.117 <sup>4/</sup> is required for continuation of the instrument approach and descent below the authorized MDA or DH.

Following the accident, a flight check of the ILS was conducted by the FAA. The report of that check revealed that all components <sup>5/</sup> of the system, except for the glide slope feature, were operating in a satisfactory manner. The glide slope had been shut down since

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<sup>4/</sup> 91.117 Limitations on use of instrument approach procedures (other than Category **11**).

(a) General. Unless otherwise authorized by the Administrator, each person operating an aircraft using an instrument approach procedure prescribed in Part **97** of this chapter shall comply with the requirements of this section. This section does not apply to the use of Category **II** approach procedures.

(b) Descent below MDA or DH. No person may operate *an* aircraft below the prescribed minimum descent altitude or continue an approach below the decision height unless --

- (1) The aircraft is in a position from which a normal approach to the runway of intended landing can be made; and
- (2) The approach threshold of that runway, **or** approach lights **or** other markings identifiable with the approach end of that runway, are clearly visible to the pilot.

If, upon arrival at the missed approach point or decision height, **or** at **any** time thereafter, any of the above requirements are not met, the pilot **shall** immediately execute the appropriate missed approach procedure.

<sup>5/</sup> ILS components include: Localizer and glide slope transmitters, LOM and MM.

June 18, 1968, and was not in operation at the time of the accident. 6/  
It was reported by the FAA that the reason for the glide slope  
outage was that the monitoring system for this component was  
unsatisfactory in the event of an out of tolerance glidepath width.

Appropriate notices to airmen (**NOTAMS**) concerning the status  
of the glide slope were issued by the FAA and were in effect on the day  
of the accident.

The radar utilized by Charleston Approach Control is model  
ASR-1 equipment. It **was** being operated on 30-mile radius, centered,  
while PI 230 was under Approach Control **jurisdiction**. **No** difficulties  
or irregularities were reported concerning the operation of **this**  
radar system. The approach controller stated that he observed the  
progress of the aircraft's radar target following changeover to the  
tower, until the target was about 2 **miles** northeast of the airport.  
The stated purpose of this continued observation was to ensure that  
adequate separation was maintained between PI 230 and AA 701. He  
stated that he did not note any deviations either left or right  
of the extended runway centerline throughout this period of  
observation.

#### 1.9 Communications

There were no reported difficulties in communication with or  
from **PI** 230 throughout the flight from Cincinnati to the point of  
impact.

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6/ The glide slope feature was subsequently returned to operation  
on August 28, 1968.

### 1.10 Aerodrome and Ground Facilities

Kanawha County Airport is located at latitude  $38^{\circ} 22'N$  and longitude  $81^{\circ} 36'W$ , at a published elevation of 982 feet m.s.l. There are ~~two~~ intersecting runways: 14/32 and 5/23. Runway 23 is hard-surfaced, bituminous construction, 5,600 feet long and 150 feet wide. The elevation at the threshold of Runway 23 is 898 feet m.s.l. and at the departure end, it is 956 feet m.s.l., an upslope of 1.03 percent. The threshold of Runway 23 has a sod overrun extending 200 feet to the rim of a valley. The valley descends steeply to a depth of nearly 300 feet, rising again to approximately the runway elevation near the **MM**. The terrain continues to rise northeast of the MM to an elevation of approximately 1,000 feet m.s.l., or 120 feet above the runway elevation. The approach light system begins 3,000 feet from the threshold, is supported on stanchions which bridge the valley, and terminates at the edge of the overrun, 200 feet from the runway threshold (see Attachment 2).

A high-intensity runway lighting system (**HIRL**) is employed for Runway 23. The approach lighting system installed is the high-intensity approach lighting system (**ALS**), U. S. Standard (A) with sequenced flashing (strobe) lights. A terminating bar, containing 11 red lights, marks the end of the approach lights and is situated perpendicular to the runway centerline. Two sets of red wingbar lights are located 100 feet from the runway threshold and two sets of green threshold lights are located 50 feet from the runway. The threshold is marked by 33 flush-mounted green lights plus 8 green lights extending

out from each side of the runway. Additionally, a white lighted roll guidance bar (decision bar) extending 50 feet on either side of the approach light centerline is located approximately 1,000 feet from the runway threshold.

The approach and runway light intensity is controlled from the tower and ranges from Step 1 (lowest) through Step 5 (maximum). When the lighting intensity is on positions 1, 2 or 3, the strobe lights flash inbound from the end to the decision bar. When the intensity is on positions 4 and 5, the strobe lights proceed the entire length of the system, ending in the terminating bar at the rim of the hill 200 feet from the threshold.

At the time of the accident all lights were at their highest intensity setting (step 5) and were operating satisfactorily.

#### 1.11 Flight Recorders

PI 230 was equipped with a flight data recorder and a cockpit voice recorder, both of which were recovered from the wreckage in satisfactory condition.

The flight data recorder installed was a Fairchild Model 5424-500, S/N 5471. The recording medium containing the pertinent flight record was readable, with all parameters functioning throughout the readout time period of 10 minutes prior to impact.

The readout shows that the flight had proceeded in accordance with its ATC clearances and that at approximately 4 minutes 8 seconds prior to impact, a descent from 3,400 feet m.s.l. was commenced. A fairly constant rate of descent of approximately 620 feet per minute

was maintained for 3 minutes 24 seconds, at which time the aircraft was leveled off at an altitude of approximately 1,250 feet m.s.l. During this time an average heading of approximately 235° was maintained and the airspeed was reduced from 140 knots to 110 knots. An altitude of 1,250 feet m.s.l. was maintained for about 32 seconds (12 seconds before impact), at which time the final descent was commenced. An airspeed of between 120 and 123 knots was maintained until impact. (See Attachment 2 for details of flightpath and altitude during last 30 seconds as based on flight recorder readout.)

The cockpit voice recorder installed in the aircraft was a Fairchild Model A-100, S/N 2185. The recording tape of the unit was recovered from the wreckage undamaged and a transcript of pertinent cockpit conversation was prepared commencing with the approach into Charleston. The time covered by the transcript is 5 minutes 23 seconds.

The transcript starts at time 0851:30.6, at which time the captain called for "gear down." Following this, the landing checklist was completed, approach flaps were reported set, and, at 0854:40 the first officer advised the tower that the flight was passing the outer marker inbound and requested a wind check.

The following is a transcription of all conversation recorded in the cockpit for approximately the last 2 minutes of flight:

0855 :00

Captain Well, looks like our altimeters were within reason

First Officer Yeah

Captain Yeah, I like that altimeter

First Officer Boy, you know it -- reads right about the middle marker there.



Captain **Yeah**

First Officer **I** always watch that radio altimeter  
 (Sound of person whistling)

*From the  
Two altimeters*

0855:35.3

Captain **I** go by this one on a field like this close one ,

First Officer **Yeah**  
 (Sound of power increase)

*... the power*

captain **There's** too *many* **valleys** here

*... the valley*

captain **Ask** him -- **John**, ask him if he's got his lights  
 turned all the **way** up.

*... the lights*

0855:55

Radio **Trans-**mission air to ground  
 Have **you** got the lights turned all the **way** up?

*... the lights*

(Sound of parer increase)

Tower **Sure** **db**, uh, a little fog right off the end there and  
 it's wide open after **you** get by that, it's more than  
 a mile and **a** half on the runway.

0856:05.2

Captain Fuel trim

0856:09.1 **Im** going to hold this altitude

0856:24.6

First Officer **I** got the lights in sight **down** low. Got it?

0856:26 (Sound of power reduction)

Captain In sight, thank you

First Officer **Everythings** good

0856:32.3

Captain Landing flaps

0856:37.1

First Officer I got to get to the chart right here we're liable to lose it

0856:42

First Officer Got the lights there?

Captain Yeah, boy

0856:49 (Sound of power reduction)

0856:51 (Sound of power increase)

0856 :51.9

First Officer Watch it!

0856 :53.2 (Sound of impact and end of recording)

1.12 Wreckage

The aircraft first contacted trees at a distance of approximately 360 feet from the threshold of Runway 23 and at an elevation of approximately 885 feet m.s.l. Initial ground contact was made against the sloping terrain approximately 250 feet short of the threshold and approximately 33 feet below the runway elevation. It was determined that the aircraft attitude at impact was approximately 4° to 5° nose down and slightly left wing **down**. The measured terrain upslope angle at this point was 30°. The aircraft continued up the hill and onto the airport coming to rest approximately 6 feet beyond the threshold and 50 feet from the right edge of Runway 23. The swath path from the point of initial tree contact to the wreckage area was oriented on an approximate 236° heading.

The major airframe structure and all flight control surfaces were found in the wreckage area. There was no evidence of any in-flight separation of the aircraft structure or components.

All flight control surfaces were recovered and examination of the flight control system revealed no evidence of failure or malfunction prior to impact. The elevator trim tab was found at a setting of approximately 5" tab up. The nose gear and both main landing gears were found in the extended and locked position. Both wing flaps, as determined by jackscrew measurements, were in the full down or "landing flap" position.

The hydraulic and electrical systems were examined and no evidence was found that would indicate any pre-impact failure or malfunction.

The pitot and static pressure systems were completely disrupted by aircraft breakup and groundfire. Both pitot heads and the right-hand staticport panel were free of internal blockage. The left-hand static port panel was not recovered.

The captain's and first officer's barometric altimeters were recovered and were found with barometric settings of 29.93 and 29.94 inches Hg, respectively (reported field barometric setting was 29.94 inches Hg.) Impact damage precluded functional testing of the units. The radio altimeters received considerable impact damage; however, all monitor circuits were tested functionally utilizing a new indicator and the units were found to be operating within specifications.

Examination of the captain's and first officer's pictorial deviation indicators (PDI) showed indicated headings of 232° and 234° with both course selectors positioned at 231°.

The Nos. 1 and 2 radio magnetic direction indicators (RMDI) were found at heading indications of 235° and 232°, respectively.

Examination of the directional **and** vertical gyros revealed evidence of rotation at impact.

Both powerplants separated from the aircraft at ground impact and were recovered in the main wreckage area. The left engine **was** damaged extensively by ground fire. **The** right engine ground fire exposure **was** localized in the vicinity of the flow control unit area. Disassembly and examination of both engines and propellers revealed no evidence of *any* failure or operational distress prior to impact. Rotational impact damage was observed on the compressor impeller, rotating guide vanes, and the turbine assemblies of both engines. Both reduction gear **quill** shafts were broken in a torsional type mode. Mud ingestion was noted throughout the visible portion of the compressor, combustion chambers, **and** turbines of each engine.

The blade angles at impact for the left and right propellers were computed to be approximately **16.0"** and **17.8,"** respectively, as based on measurements between the feathered stop adjustment ring and the rear **wall of** the propeller cylinders. These angular blade values were consistent with values obtained by determining, geometrically, the elongation of each blade centrifugal race dowel pin hole, **and** relating this value as a function of blade angle.

All propeller blades exhibited varying degrees of rearward bending with reference to the plane **of** rotation.

### 1.13 Fire

Following impact, an intense ground fire erupted which destroyed sections of the fuselage and wing areas. Firefighting personnel and

Equipment from the Air National Guard Unit located at the airport arrived at the wreckage approximately 2 minutes after the crash and had the aircraft fire suppressed within 10 minutes.

#### 1.14 Survival Aspects

The three crewmembers and 29 passengers were fatally injured at impact. These fatalities were attributable to severe trauma. Five survivors were removed from the wreckage area and taken to hospitals in Charleston. Three of the five survivors succumbed the following day. All five of the initial survivors had been thrown clear of the aircraft cabin during the impact sequence.

#### 1.15 Tests and Research

Subsequent to the accident, the Safety Board conducted a flight test in a Piedmont Airlines FH-227, N706U, for the purpose of producing a cockpit voice recorder (CVR) tape with annotated shaft r.p.m. values. Two tapes were made, each with a different CVR. The test regime was limited to establishing both engines at identical shaft r.p.m. values starting at 15,000 and decreasing in increments of 500 to and including 11,000 r.p.m.

At each level, the r.p.m. values were stabilized, insofar as could be determined through the use of standard cockpit instrumentation. Then, following tape annotations, a 10 to 15 second "quiet period" ensued, wherein only the ambient cockpit noise was present. At the 11,000 r.p.m. level, two tests were run, one with 120 pounds of torque pressure and the other at 40 pounds.

Upon completion of the tests, the tape was removed from both CVR's. A sound spectrographic analysis of the cockpit area microphone channel was performed to determine the predominant resonance(s) associated with each shaft r.p.m. level. As a result of this analysis, it was determined that the following frequency values approximated the shaft r.p.m. values indicated:

<u>Shaft r.p.m.</u>	<u>Frequency (Hz)</u>
15,000	4740
14,500	4540
14,000	4380
13,500	4215
13,000	4080
12,500	3960
12,000	3785
11,500	3730
11,000	3500

The two tests performed at 11,000 r.p.m. with the normal vs. minimum torque pressure settings produced predominant resonances (engine-related) at the same level. There was a minor variation in the lower frequency resonances, associated with the lower airspeed involved during the low-torque test.

The results of this activity were then compared with a series of spectrograms made from the cockpit area microphone channel of the CVR removed from N712U in order to determine the engine r.p.m. configuration of that airplane during its final approach to Kanawha County Airport on August 10, 1968. The results of this comparison are as follows:

(1) Just prior to the sentence, "I'm going to hold this altitude," the predominant resonance is at 4740 Hz equivalent to 15,000 shaft r.p.m.

(2) Immediately following the call for landing flaps, the resonance is at 3780 Hz corresponding to 12,000 r.p.m. This value remains

relatively constant through "I gotta get to the chart, we're liable to lose it here."

(3) At a point 2.5 seconds prior to "WATCH IT!" there commences a slight reduction in the resonance from one of the engines, to a level of approximately 3600 Hz, or about 11,215 r.p.m.

(4) At 0.7 seconds after the first utterance of "WATCH IT!", the resonances begin a marked upslope to a value of 3920 Hz (**12,400** r.p.m.) for one engine and 4480 Hz (**14,300** r.p.m.) for the other up to initial impact. Throughout the last impact sounds, there remains evidence of the lower cited value, but the higher value increases over a 0.7 second period to 4740 Hz (**15,000** r.p.m.) before dying out 0.4 seconds prior to cessation of recorder operation.

#### 1.16 Pertinent Information

##### Piedmont Airlines Approach Procedures

The PI Operations Manual, Part 3000, specifies that all IFR approaches shall be conducted in strict compliance with the approach operations specifications for that particular airport as set forth in the appropriate approach pages of the Jeppesen Manual, except where ATC approves a different procedure, and such approach can be safely executed. Included with the approach chart in the Jeppesen Manual are the approach "sliding scale" minima operating specifications for the Charleston Airport. (See Attachment 1.)

The specifications state that under local conditions of smoke, haze, ground fog, dust, etc., a landing can be made with visibility reduced to 1/2 mile if the ceiling is at least 1,000 feet provided

that the pilot can lineup with the runway before entering the visibility restrictions and can stay lined up throughout the approach and landing.

The PI Operations Manual, Part 2000, Section I, also references sliding scale and landing minima as follows:

"25. Sliding Scale - Regular, Refueling, and Provisional Airports

a. Propeller Aircraft. Unless otherwise prohibited, a pilot may initiate a straight-in instrument approach procedure when the visibility is reported to be less than the visibility minimum prescribed in such instrument approach procedure in accordance with the following:

(1) For each increase of 100 feet in reported ceiling above the MDA or DH prescribed in the applicable instrument approach procedure and these operations specifications, a decrease of 1/2 mile in visibility is authorized until visibility of 1/2 mile is reached.

(2) Descent to the DH or MDA prescribed in the applicable instrument approach procedure and these operations specifications may be made, provided visual reference has been established at the higher MDA or DH required by application of the sliding scale.

b. Turbojet Aircraft. Sliding scale not authorized.

26. Landing Minima. Local Conditions - Regular, Refuel — and Provisional Airports - IFR

Unless prohibited in the applicable instrument approach procedure, a landing may be made at an airport when the local visibility is reduced to not less than 1/2 mile or RVR 2400



by purely surface weather conditions such as smoke, haze, dust, ground fog, blowing snow or sand, etc., provided the ceiling is not less than 1,000 feet, the aircraft is aligned with the runway of intended landing before entering the local surface visibility conditions, and the runway of intended landing is plainly visible allowing the pilot to have adequate visual reference to the line of forward motion at all times during final approach and landing."

*after reading the NTSB report*

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

*69-6 and some outside info*

Evaluation of all of the evidence obtained during the investigation of this accident indicates that the flight was operationally routine until the final phase of the approach to the Charleston

Airport. At this point in the approach, approximately 6 seconds from impact, the aircraft commenced a rapid descent which resulted in contact with the terrain short of the runway threshold.

*Examination of the aircraft structure, components, and systems revealed no indication of any in-flight failure, malfunction, or other abnormality that would have caused or contributed to an unwanted descent.*

Evidence of an engine power application as well as the type of damage exhibited on the aircraft structure, indicates that the crew attempted to "pull up" just prior to impact.

In view of these findings, it is obvious that the causal area of this accident concerns the operational factors involved in the conduct of the approach and the particular circumstances that would influence a qualified pilot to initiate a steep descent when only 200 feet above

*So they were*

the airport level, and to continue it to a point above the ground where recovery could not be attained.

One of the most significant factors bearing on the conduct of the approach was the weather conditions which existed at the airport during this period.

Essentially, the early morning weather was characterized by a ground fog condition which severely restricted visibility on the airport and in the approach zone for Runway 23. Aside from the fog obscuration, the ceiling was unrestricted with only high clouds reported. During the time that PI 230 was making its approach, however, the visibility conditions over most of the airport were improving rapidly. From 0842 to 0856 (just prior to the accident) the Tower visibility had improved from 1/2 mile to 1 mile and the RWY had increased from zero to 1-1/2 miles. However, despite the general improvements in both the prevailing visibility and the RWY, the visibility in the threshold area and in the approach zone for Runway 23 remained restricted due to the fog concentration.

One apparent reason for this dissimilarity was the fact that in addition to "burn off" or lifting effect due to solar radiation, a light southwesterly wind was also moving the airport fog to the northeast toward the approach end of the runway. In conjunction with this movement, a fog condition that existed in the Coonskin Park Valley (between the threshold of Runway 23 and the MM) was also in the process of solar lifting.. The combined result was the formation of a dense blanket of fog over part of the approach light structure and in the runway approach zone.

Pilot witnesses estimated the area of fog to have existed from over the middle of the approach light structure to approximately 300 feet beyond the runway threshold. Because the fog was lifting, it is not likely that a precise flat top to the fog bank was discernible, however, through witness observations, the fog was determined to have been between 100 and 200 feet thick.

Based on these findings, it is most probable that the subject flight would have been conducted in visual conditions during most of the approach or at least to a point just beyond the **MM**. In this area the crew would have encountered rapidly deteriorating visibility conditions as the aircraft descended into a wispy layer of smoke and haze and then into the tops of the fog bank. Dense fog and extremely poor visibility conditions would have been encountered thereafter.

Conversations on the CVR substantiate that the crew had sighted the approach lights prior to reaching the **MM** and still had them in sight as they passed over the beginning of the approach light structure. That, to this point, the crew was conducting the approach in part by visual reference, rather than on instruments alone, is further indicated by the computed flightpath over the ground which shows a displacement of over 200 feet to the left of the ILS localizer course until the aircraft was beyond the **MM** and abeam the beginning of the approach light structure.

As evidenced by the plot of the flightpath constructed from flight recorder data, the aircraft descended to an altitude of

1,225 feet m.s.l. after passing the OM 8/ and this altitude was maintained until after the flight had passed Coonskin Ridge (NY location). A descent was then (18 seconds prior to impact) reinitiated at a rate of approximately 625 feet per minute and maintained until approximately 6 seconds prior to impact. It is noteworthy that the descent rate of the aircraft during this period very closely approximates that of a normal glide slope descent and that the flightpath, as indicated on the flight recorder profile plot, remained slightly above that of the projected glide slope (although the ILS glide slope feature was not in operation).

At this point, 6 seconds before impact and at an altitude of approximately 1,075 feet m.s.l. (175 feet above the approach lights), the descent steepens to over 2,000 feet per minute and is continued until impact. It is significant that the position of the aircraft at this time, approximately over the middle of the approach lights, corresponds closely to the area where the dense fog would have been encountered and where ground visibility from the cockpit would have been sharply reduced.

Thus, until 6 seconds before the accident, the approach can be considered a routine and acceptable operation. The only logical

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8/Descent below the authorized MDA (1,582 feet m.s.l.) was permissible in accordance with the prescribed procedures and regulations (FAR 91.117) wherein the pilot may elect to continue the approach and descent on the basis of identifiable terrain and/or approach lights.

conclusion, in the absence of any evidence to the contrary, is that ~~some~~ phenomenon associated with the reduced visibility upon entering ~~the~~ fog affected the pilot in such a manner that he steepened the descent ~~to~~ the point where recovery could not be effected.

The data relating to problems associated with approaches conducted into low visibility conditions are relatively sparse considering that it is, indeed, one area in which research material has been continually in demand by all segments of the aviation community. From the data that are available, it is easily recognizable that pilot judgments and reactions with respect to a low visibility confrontation will vary depending on the specifics of a particular situation. To this, the variables of atmospheric transmission (of light), aircraft position, and the amount of ground guidance available must be applied and considered. In a visual approach in low visibility, the pilot, the aircraft, and the ground guidance available comprise what is known as the "visual control loop." In essence, approaches into reduced visibility result in a reduction of the total quantity of visual cues available to the pilot on which his judgment and reactions are based. It follows that this can result in operational decisions, i.e., control inputs which the pilot believes to be correct based on what he sees (or what he thinks he sees) but which are totally inappropriate to the real situation. This can be defined as an "open visual loop," wherein the pilot makes an input to the control of an aircraft in any

of the three axes of pitch, roll, or yaw, and his outside visual cues do not show him that he **was** correct. In a "closed visual loop" the outside cues will show the pilot that the control input was correct. It has generally been accepted that accidents involving visual misjudgments represent failures in the visual control loop. 3

The amount of the visual ground guidance pattern (guidance segment) that a pilot can obtain in fog penetration is a function of the visual range, 9/ cockpit cutoff angle<sup>10/</sup> and the position of the aircraft. (See Attachment 3.)

Also to be considered with respect to the ground guidance a pilot will receive, is the type of fog condition that is encountered. In a "thick" fog (where the descent to MDA or ~~DA~~ is conducted within the fog condition), the visual guidance segment will normally increase as the altitude decreases. However, in "shallow" fog (where visual contact has been established with recognizable terrain' features or ground aids before the descent is made ~~into~~ a lower fog layer

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9/ Visual range is the distance that can be seen by a pilot through the atmospheric condition. It is affected by the transmissivity of the atmosphere and by the ratio of the photometry brightness (brightness of the background) to the brightness of the sky in the direction of observation. It should be noted that variations in fog density and uniformity differ from point to point or with time, and are frequent sources of differences between the reported visibility and the guidance received by the pilot. The reported visibility in a particular fog condition will not necessarily, if ever, correspond to the visual range available to the pilot at a given point in his approach.

10/ Maximum angle of view downward from the pilot's position to the ground as measured from the horizontal. It measures the restrictions to the pilot's downward field of view imposed through the aircraft structure.

the guidance segment will decrease as the aircraft descends toward the fog and will be at a minimum at the moment the aircraft enters the fog layer. As the descent is continued the guidance segment will then increase, the same as in a "thick" fog penetration.

For example, if an aircraft is 300 feet from the fog and there is a visual range of 500 feet within the fog, the pilot will have unrestricted visibility up to the fog and will be able to see 500 feet through the fog, or a total distance of 800 feet. As the pilot approaches the fog, the guidance segment obviously decreases, reaching the minimum at the moment the fog is entered.

As is apparent, the height of the aircraft plays an important part relative to the amount of guidance segment that will be seen. With a visual range of 500 feet in the fog, and a fog depth of 500 feet, the guidance segment will be zero if the aircraft is 500 feet or higher above the approach lights. Considering the cockpit cutoff angle, the guidance segment could still be zero at altitudes less than 500 feet. However, as the altitude is decreased, the guidance segment increases, reaching its maximum at or near the level of the approach lights, where the 500 feet visual range can be observed at its most forward point.

What little information does exist with relation to the minimum acceptable visual range has been obtained through controlled testing and relates only to ideal conditions of a stabilized approach on an ILS facility and to aircraft with approach speeds not in excess of 125 m.p.h. From this empirically derived data, it is generally

considered that an experienced pilot requires a guidance segment of at least 500 feet in order to perceive a sufficient portion of the approach lights and/or runway ground pattern to continue an approach by visual reference alone. For turbine aircraft with approach speeds higher than 125 m.p.h., the minimum visual range requirements will increase.

Although it **was** not possible to determine positively the actual visual range through the fog with regard to the approach of **PI 230**, it can reasonably be assumed, based on the evaluation of **all** reports, that it would have been no more than 500 feet, and probably less.

In order to establish a reasonable assessment of the segment of approach lights visible to the pilot during the approach, the following tabulation was compiled assuming a visual range of 500 feet, and an arbitrary 45" slope to the face of the fog beginning 1,500 feet from the runway threshold:

Time from Impact (Seconds)	Pitch* Angle	Cutoff** Angle	Height above Approach Lights	Segment of Approach Lights Visible
6.6	11°	7"	190 feet	220 feet
6.0	"	"	170 feet	167 feet
5.0**	"	"	150 feet	37 feet
4.0	"	"	125 feet	122 feet
3.0	"	"	95 feet	212 feet
2.0	"	"	60 feet	323 feet
1.0	"	"	10 feet	473 feet
0.0	"	"	-35 feet	-

\*The pitch angle **was** determined by a test flight with a **FH-227** with the same weight and center of gravity **as** **PI 230**. The cutoff angle was determined by use of a specially designed camera for this purpose and a pilot's seat height determined by persons who had flown with Captain **Sugg**, as well as the position of the seat **as** found in the wreckage.

\*\*At 5 seconds the aircraft had just entered the fog. (See Attachment 4 for a graphic depiction of the above computed values.)



If these were, in fact, the conditions encountered by PI 230, it can be seen that as the aircraft approached the fog, the guidance segment (segment of approach lights visible) decreased rapidly, reducing from 220 feet to 37 feet in 1.6 seconds. It is also apparent that, although the guidance segment would have increased as the aircraft descended through the fog, a "minimum" 500-foot segment would not have been attained.

Shallow fog presents a particularly hazardous situation in that the rapid reduction in visual range results in a sudden shortening of the guidance segment which may then be insufficient for proper guidance, especially in the vertical plane. It is quite probable in "shallow" fog penetration to have an adequate segment for azimuth guidance, but to be in the "open visual loop" for vertical assessment. Also, it has been shown that the sudden reduction in visual range on entering the fog may be misinterpreted for a pitch change in the noseup direction. Pilots unfamiliar with this phenomenon will, therefore, tend to steepen their angle of descent when they encounter this situation.

From studies conducted by the Royal Aircraft Establishment (Great Britain) in connection with approaches in low visibilities, it was indicated that lateral displacement from a ground pattern can easily be recognized as soon as one crossbar comes into view. Reductions in visual range, therefore, would have little effect on the azimuth guidance at low altitudes'. Displacement in the vertical plane, however,

results mainly in extension or compression of the guidance segment and is not indicated by any change in symmetry of the ground guidance pattern. Changes in the vertical direction must be assessed by the pilot through mental comparisons of an "ideal" pattern image representing zero displacement against the "actual" pattern image he observes. Because the differences between the "ideal" image and an image representing even a large vertical displacement are small, the pilot must from time to time concentrate all of his attention on making this mental comparison.

It was stated that, "In the vertical plane there is no comparable simple connection between the heading in the vertical plane (instantaneous angle of descent) and the movement of any of the elements of the perspective image. The result of these two differences may be summed up by saying that a pilot can detect a small lateral error, and see in a few seconds whether it is increasing or decreasing, whereas he can only detect a height error if it is large, and will not know for many seconds whether it is increasing or decreasing." In fact, it was indicated in the tests that in low visibility approaches, the height at which visual guidance in the vertical plane from the approach lights becomes adequate may be as low as 100 feet.

It was further noted that because the vertical situation is so difficult to assess, the pilot will (consciously or subconsciously) attempt to check his judgment by various other means. At low altitudes it is possible to estimate height from a knowledge of the appearance of the terrain features such as trees, buildings, roads, to a lesser extent the size and spacing of approach lights, and from

past experience compare this height against the estimated range from touchdown. In approaches over sloping or mountainous terrain which present a false impression of the real horizon, these additional cues cannot be obtained and the statistics show the accident rates to be higher in these areas. (5)

It should also be noted that the problem of vertical assessment is further compounded by any turns (movements in the roll axis) to correct for azimuth displacement.

As was previously stated, somewhere in the vicinity of 6 seconds prior to impact, Flight 230 entered the fog condition and as far as can be determined, experienced a sudden and severe reduction in the previously established guidance segment. Here, the rate of descent also increased and approximately 2 seconds later, there was evidence of a slight engine power reduction. A power reduction at this time, without a change in the angle of descent, strongly indicates that the pilot desired to lose altitude. This would mean that he had to see a situation, evaluate it, and then retard the power levers. At this point in the approach, when the aircraft was only 175 feet above the approach lights, the only reason that the pilot would want to lose altitude at the rates indicated on the flight recorder (in excess of 2,000 feet per minute) would be that he thought he was higher than he actually was. The one plausible explanation would be that in some manner the shortening of the guidance segment upon entering the fog provided the illusion of being too high. (6)

(2) It is noteworthy that the approach path runs directly over a valley with the runway threshold area situated at the edge of a (4)

steep hillside. Therefore, if the pilot **was** attempting to obtain additional visual cues from the terrain directly below the aircraft, the illusion of being high may have been even more pronounced.

Assuming a visual range of 500 feet and that the captain **was** maintaining a fixed eye position, the ground would have come into view somewhere between 3 and 4 seconds before impact. This would have caused him immediately to apply power and pull up if he thought he **was** too low. However, the reaction time required to decide to add power and then to move the throttles, plus the time required for the engine to react, would easily take an additional 1 to 1.5 seconds. Therefore, the evidence of an engine power application slightly more than 2 seconds prior to impact is consistent with the assumed visual range and operational circumstances of this accident.

It is also apparent that the aircraft crossed from left to right, over the light line, in the vicinity of the decision bar 3.5 seconds prior to impact. The aircraft **was** approximately 90 feet above the lights at this point and descended below the light line at .8 seconds from impact. To this point in the analysis, a visual range of 500 feet has been assumed in assessing the visual segment that would have been available to the pilot. However, in view of the circumstances, and the close proximity at which the aircraft passed over the lights, it is very possible that the visual range **was** much less than 500 feet. **If** this were the case, the lack of vertical guidance would have been even more drastic than described and could account for the obviously complete lack of the pilot's awareness of their precarious position until it **was** too late to accomplish a recovery.

Considering powerplant and aircraft response times, the 2-plus seconds remaining to impact when the sound of the power increase occurs, is insufficient time to arrest the high rate of descent and gain sufficient altitude to avoid the crash. An additional consideration is the fact that the aircraft does have a tendency to pitch down when throttles are retarded at the lower approach speeds. However, it is noted that the airspeed during the final 26 seconds of flight was never below 120 knots, which is well above the critical speeds in which a pitch problem could have been a factor. It is believed that normal aircraft rotation could have been accomplished at the speed involved, at any point in the approach had this action been so desired.

It is also of interest to the Board that Section 91.117 of the FAR provides that when an instrument approach is used, the pilot may not operate the aircraft below MDA or DH unless the approach lights or other markings identifiable with the approach end of that runway are clearly visible to him. This section further provides that, if upon arrival at the missed approach point or at anytime thereafter any of these requirements are not met, the pilot shall immediately execute the published missed-approach procedure.

The purposes of safety are presumably satisfied by these regulatory provisions under the theory that if the pilot can clearly see the approach lights or other markings identifiable with the approach end of the runway, he will be able to descend properly and land safely. Conversely, if at anytime he loses sight of the ground or approach

lights, he can safely execute a go-around. The Board believes that deficiencies exist in this reasoning, however, in that "clearly visible" is not defined, and the minimum amount of ground reference or guidance segment, necessary for nonprecision approaches in low visibility conditions has never been established. What little information does exist is based on empirically derived data and relates only to ideal conditions of a stabilized approach on the ILS facility. This minimum amount of guidance segment has been considered to be 500 feet at 120 m.p.h., or a distance equal to the number of feet traveled in 3 seconds of time for aircraft with approach speeds greater than 120 m.p.h. **Even** this limited amount of information has not been widely distributed, nor is it contained in air carrier or other pilot training manuals. **As** a consequence, the pilot is forced to make a purely subjective determination of the adequacy of the visual guidance segment available in each instance where visibility in the approach zone is less than the reported prevailing visibility, RVV, or RVR (runway visual range). Under the present regulation, the pilot may elect to continue an approach if he **has** only one or two light bars of the approach light system in sight at the **MDA** or **DH**.

In most such instances, the guidance segment first observed will continue to improve as the descent continues as in a "break out" beneath an overcast or "thick" fog. **Thus**, by **usual** experience, the pilot is conditioned to expect an increasing ground guidance segment once visual contact has been established. However, the reverse of this is true when the aircraft proceeds from visual conditions at the **MDA** or **DH** into a fog layer that is both "shallow" and dense.

In this circumstance, the visual guidance segment that at first appeared adequate will decrease as the fog top is approached, and will reach its minimum value at the moment of penetration. Thus, the pilot's appraisal of the adequacy of the ground guidance segment can be made accurately only at, or just immediately before, entering the fog. The pilot's decision, then, whether to continue or abandon the approach must be instantaneous and precise and, unfortunately, based on a split-second judgment. Continuation of the descent into "shallow" fog with even marginal ground guidance can be deceptive and hazardous for the reasons previously outlined in this report. Therefore, from a safety standpoint, the deficiencies in the regulations are apparent, since under the conditions mentioned above, the pilot can legally place his aircraft in a position where a recovery may not safely be accomplished.

## 2.2 Conclusions

### (a) Findings

1. There was no failure or malfunction of the aircraft, powerplants, propellers, or other systems.
2. The crew was properly certificated and qualified for the flight.
3. The aircraft was being operated in visual meteorological conditions until approximately 6 seconds before the crash, when it entered a shallow fog overlying the approach lights and the approach end of Runway 23.
4. Visual range in the final portion of the approach zone and over the Runway 23 threshold was 500 feet or less in the fog.

5. Because of the visual guidance segment available in the initial part of the approach, the pilot would have no way **of judging** the visual range in fog until the moment **of** penetration.
6. Descent below **MDA** into the restricted visibility **was** permissible under present regulations.

(b) Probable Cause

The Safety Board determines that the probable cause of this accident was an unrecognized **loss of** altitude orientation during the final portion of an approach into shallow, dense fog. The disorientation was caused by a rapid reduction in the ground guidance segment available to the Pilot, at a **point beyond which** a go-around could not be successfully effected.



3. RECOMMENDATIONS

Subsequent to this accident the following recommendations were forwarded by the Safety Board to the Administrator of the Federal Aviation Administration:

- (1) That section 91.117 and section 121.649 of the Federal Aviation Regulations be amended to prohibit any approach below 200 feet above field level unless the pilot has the runway threshold in sight and require that he continue to have same in sight during the remainder of the approach.
- (2) That the Federal Aviation Administration bring to the attention of all instrument pilots the hazards associated with shallow fog penetration. This might be accomplished in the form of an Advisory Circular and/or by publication in the Airman's Information ~~Manual~~ Reference to training films, such as the ICAO production of "Fog and Runway Lighting," and the sources from which such films could be obtained, should be included.
- (3) That information on shallow fog penetration, the effect upon the guidance segment, and the potential illusions that can be created be included as mandatory items in air carrier training programs and in the curriculum of FAA approved Instrument Flight Schools.
- (4) That the Federal Aviation Administration pursue as expeditiously as possible their research project to determine the instrumentation necessary to provide slant visual range information.

- (5) That the Federal Aviation Administration establish standards and specifications for, and encourage the development of, synthetic trainers capable of providing realistic low visibility approach simulation.
- (6) That improved approach zone lighting in at least the last 1,000 feet of the approach preceding the runway threshold be programmed for installation on a priority basis at airports having a climatological history of frequent heavy fog conditions when and if financial conditions permit.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOHN H. REED  
Chairman

/s/ OSCAR M. LAUREL  
Member

/s/ FRANCIS H. McADAMS  
Member

/s/ LOUIS M. THAYER  
Member

Flight Crew InformationThe Crew of Piedmont Flight 230, N712U

Captain Gene A. Sugg, aged 40, was employed by Piedmont Airlines on August 1, 1955, and was upgraded to captain on the F-27 in May 1965. He possessed airline transport pilot certificate No. 1282517 with type ratings for the Martin 202/404, Fairchild F-27/FH227, YS-11. He also held a flight instructor certificate, airplane and instruments. His last first-class medical certificate was dated April 30, 1968, and was issued with no waivers.

Captain Sugg had a total of approximately 6,884 first-pilot hours with a total flight time in F-27/227 aircraft of 2,809 hours. He had a total of 289 flight hours in the FH-227 and 79 flying hours within the last 30 days preceding the accident. He satisfactorily completed his last line check on May 20, 1968, and passed his last proficiency check in the Martin 404 on July 17, 1968.

Captain Sugg had a rest period of 10 hours 25 minutes within the 24-hour period preceding the flight. The records indicate that he had flown into the Kanawha County Airport as a flight crewmember 35 times in the previous 6-month period.

First Officer **John F.** Messick, aged 34, was employed by Piedmont Airlines on September 19, 1966. He possessed commercial pilot certificate **No.** 1373035 with airplane multi/single engine land and instrument ratings. His last first-class medical certificate was dated February 8, 1968, and was issued with no waivers. First Officer Messick had a total of 3,722 flying hours of which 403 hours were in **F-27/227** type aircraft. He had flown approximately 70 hours within the 30-day period preceding the accident. **His** last proficiency check was satisfactorily completed on May 12, 1968.

First Officer Messick received 10 hours 15 minutes off-duty time prior to this flight.

AIRCRAFT INFORMATION

The aircraft, a Fairchild-Hiller 227B, N712U, S/N 557, had a date of manufacture of August 2, 1967, and was placed in service by Piedmont on November 3, 1967. At the time of the accident the aircraft had accumulated a total time of 2,197:03 hours.

N712U was powered by two Rolls-Royce Rda7-MK-532-7 engines which were equipped with Dowty Roto1 R-193/4-30-4/50 propellers.

The aircraft records indicate that N712U had been maintained in accordance with all company procedures and FAA directives. There were no aircraft discrepancies reported prior to departure from the flight's origination point at Louisville, Kentucky.

## 1. Investigation

The Board received notification of the accident at approximately 9:30 a.m. e.d.t., on August 10, 1968, from the Federal Aviation Administration. An investigating team was immediately dispatched to the scene of the accident. Working groups were established for Operations, Air Traffic Control, Witnesses, Weather, Human Factors, Structures, Power-Plants, Systems, Maintenance Records, and Flight Recorders. Parties to the Investigation included: Piedmont Airlines, the Federal Aviation Administration, Air Line Pilots Association, Fairchild-Hiller, and the Weather Bureau. The on-scene investigation was completed on August 16, 1968.

## 2. Hearing

A public hearing was held at Charleston, West Virginia, on October 22, 1968.

### ACKNOWLEDGMENT

The Safety Board wishes to acknowledge the contributions of E. S. Calvert of the Royal Aircraft Establishment (Farnborough), Charles A. Douglas, National Bureau of Standards, U. S. Department of Commerce, Robert F. Gates, Federal Aviation Administration, and Captain R. E. Beck, Air Line Pilots Association, for their contributions to aviation safety through research into the problems of low visibility approaches and landing. Their studies in this area provided considerable assistance to the Board in evaluating the circumstances of this unfortunate accident.

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**CHARLESTON, WEST VIRGINIA**

(FH-227, YS-11, M-404)

**LOCAL CONDITIONS** 0 SMOKE, HAZE, GROUND FOG, DUST, etc. M-404.

- A. **TAKE-OFF:** - Minimum visibility  $\frac{1}{2}$  mile with ceiling 10,000 feet, OR sun, moon, stars visible and ceiling not less than 300 feet. Pilot must have adequate reference to forward motion during take-off. Alternate within 1 Hour at Single Engine speed required when weather conditions are below Approved Landing Minimums.
- B. **LANDING:** - can be made with visibility reduced to  $\frac{1}{2}$  mile if ceiling is at least 1000 feet **PROVIDED** Pilot can line up with runway before entering visibility restriction and can stay lined up throughout Approach and Landing.
- C. **TAKE-OFF AND LANDING:** - require IFR or controlled VFR clearance from Tower when operating within control zone with ceiling and visibility less than 1000 feet and 3 miles.

**II. OTHER THAN LOCAL CONDITIONS:**

- A. **TAKE-OFF IFR:** can be made with visibility 1 mile. Take-off alternate 1 hour required when weather conditions are below Approved Landing Min. **TAKE-OFF IFR:** (FH-227, YS-11) - can also be made with  $\frac{1}{2}$  Rwy. 23 **PROVIDED** runway used has Operative Hi-intensity runway lights OR take-off run, and Huntington or Parkersburg has alternate landing minimums.  $\frac{1}{2}$  mile required for Rwy 5 with HTS or PKB as alternate. **TAKE-OFF IFR:** - Straight-in landing limits shown below can be used for take-off **PROVIDED** conditions are such that Approach and landing can be made on Applicable Rwy.. No take-off alternate required.
- B. **LANDING: IFR:** (FH-227, YS-11, M-404)

		RVR	DH	VISUAL	MDA	
1. ILS (ICRW) Rwy. 23	S-dn	1	1582			
		$\frac{1}{2}$	1582	1482		
		$\frac{3}{4}$	1582	1582	1582	
	a. OM or MM out	S-dn	1	1582		1582
			$\frac{1}{2}$	1582	1482	
			$\frac{3}{4}$	1582	1582	1582
	b. Glide Slope out	S-dn	1	1582		1582
			$\frac{1}{2}$	1582	1682	1582
			$\frac{3}{4}$	1782	1782	1582
	c. ALS out	S-dn	1	1582		1582
			$\frac{1}{2}$	1582	1482	
			$\frac{3}{4}$	1582	1582	1582
d. with LOC and OM	S-dn	1	1582		1582	
		$\frac{1}{2}$	1682	1582	1582	
		$\frac{3}{4}$	1782	1582	1582	
2. ADP (CR) Rwy. 23	S-dn	1	1582		1582	
		$\frac{1}{2}$	1682	1582	1582	
		$\frac{3}{4}$	1782	1582	1582	
3. VOR-1 (CRW)	C-dn	1			1582	
		$\frac{1}{2}$			1582	
		$\frac{3}{4}$			1582	
4. VOR DME-1 (CRW)	D-dn	1		1582	1582	
		$\frac{1}{2}$		1682	1582	
		$\frac{3}{4}$		1782	1582	
5. ASR (Rwy. 5, 14, 23)	S-dn	1			1582	
		$\frac{1}{2}$			1582	
		$\frac{3}{4}$			1582	
	C-dn	1			1582	

ISSUED: September 25, 1956  
 REV. NO: ELEVEN  
 EFFECTIVE: April 2, 1968

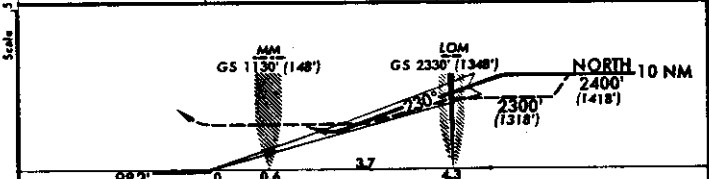
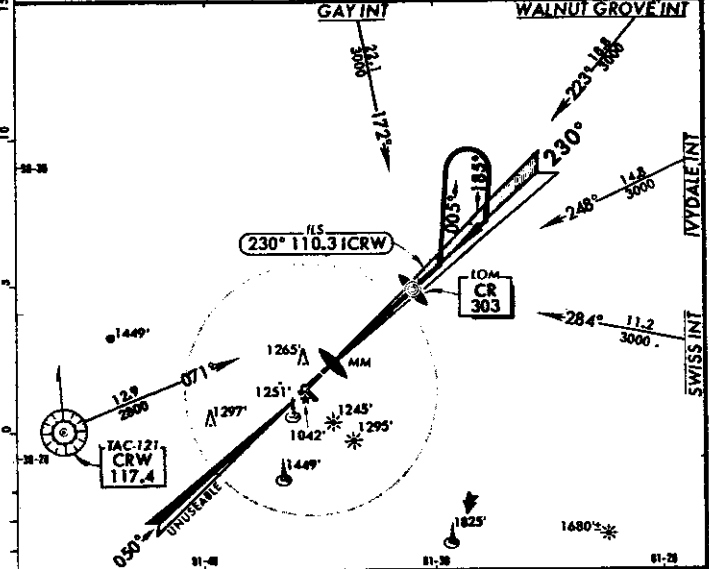
**Jeppesen Approach Chart**

MAR 22-68

(11-1)

**CHARLESTON, W. VA.**

CHARLESTON Tower 120.3 122.4G 126.2 257.8	Apt. Elev. 982' Var. 03° W GS 335.0	KANAWHA ILS Rwy 23 NDB (ADF) Rwy 23 LOC 110.3 ICRW
Approach(R) 119.2	Departure(R) 124.1	Ground 121.9 348.6



PULL UP STRAIGHT AHEAD TO 3000 feet, then direct to CRW VOR and hold WEST on R-261, RIGHT turns.

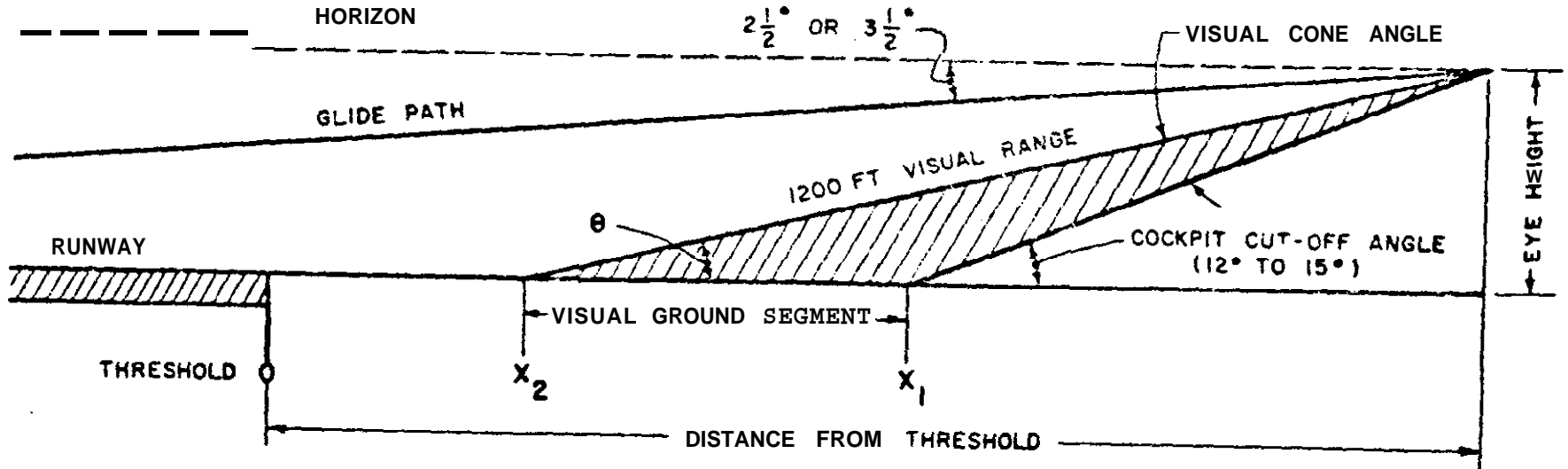
A	STRAIGHT-IN LANDING RWY 23			CIRCLE-TO-LAND
	MDA 1382'(400')	MDA 1582'(600')	MDA 1582'(600')	
B	1	1	1	1582'(600')-1
C	1	1	1	1582'(600')-1 1/2
D	1	1	1	1582'(600')-2
MDA	1382'(400')	1382'(400')	1582'(600')	1582'(600')-2
End	1	1	1	1682'(600')-2

Ground speed - Kts	60	80	100	120	140	160
G.S.	2:57	3:13	4:17	5:22	6:26	7:30
LOM to MAP 4.3	4:18	3:14	2:35	2:09	1:51	1:37

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# VISUAL GROUND SEGMENT



Attachment No. 3

# GUIDANCE SEGMENT STUDY

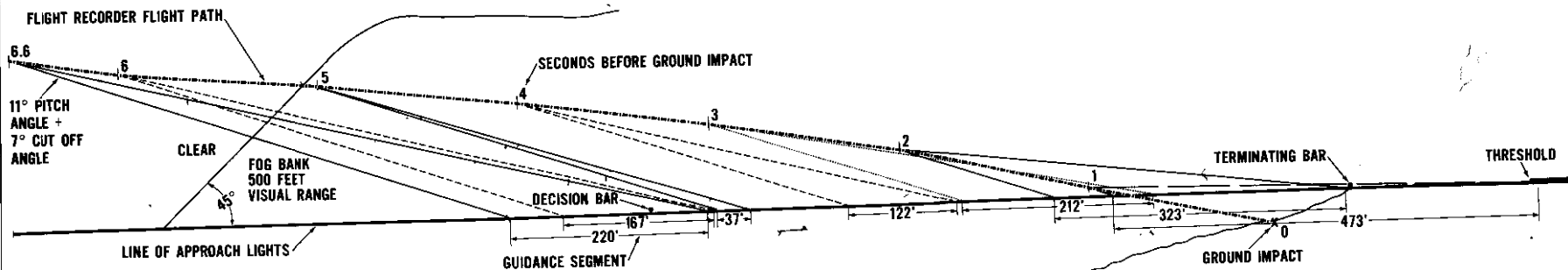
NATIONAL TRANSPORTATION SAFETY BOARD  
Department of Transportation  
BUREAU OF AVIATION SAFETY

PIEDMONT AIRLINES, FH-227 N712U  
CHARLESTON, W.VA.  
August 10, 1968

DOCKET NO. SA-406

ATTACHMENT NO. 4

SCALE 0 50 100  
FEET



*1200 ft*

*700*