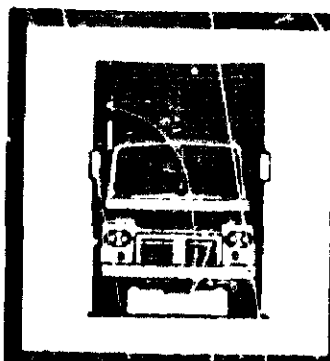
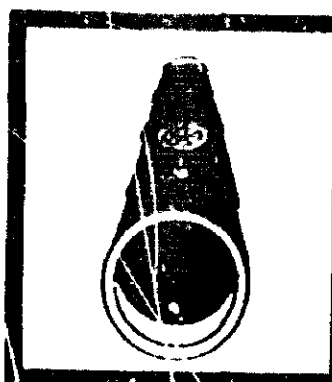
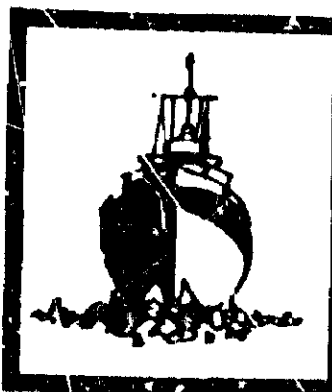
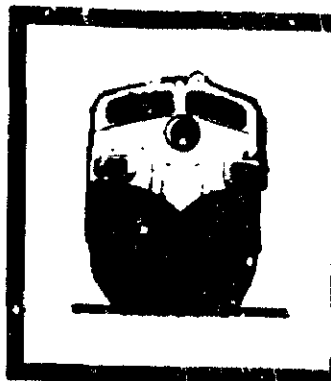
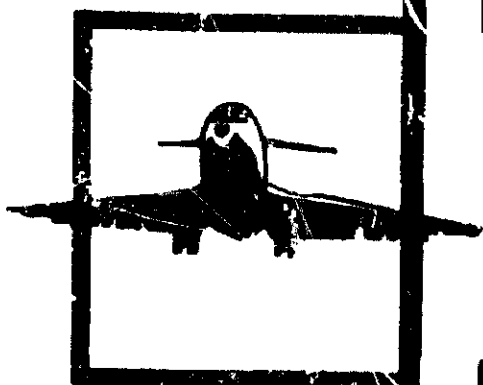


PB82-910413



NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

**SUN WEST AIRLINES FLIGHT 104,
PIPER PA-31-350 (T-1020), N41070
DURANGO-LaPLATA COUNTY AIRPORT,
DURANGO, COLORADO
DECEMBER 31, 1981**

NTSB-AAR-82-13

UNITED STATES GOVERNMENT

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16. Abstract Sun West Airlines Flight 104, a scheduled passenger-service commuter air carrier flight departed Albuquerque, New Mexico, at 1855 mountain standard time on December 31, 1981, with five passengers and one pilot aboard for a flight to Durango, Colorado. The en route portion of the flight, conducted under instrument flight rules, was normal. Flight 104 was cleared by Denver Air Route Traffic Control Center at 1951:37 for a VOR approach to Durango-La Plata County Airport. Radar service was terminated at 1953:30, when the flight was about 3 miles northeast of the Aztec Intersection on the VOR approach. About 2000, ground witnesses observed Flight 104 fly over the airport in a northerly direction about over the VOR transmitter (missed approach point) adjacent to the runway midpoint. The airplane descended and crashed about 1,350 feet east of the departure end of runway 2, about 3,250 feet from the VOR. The airplane was destroyed by impact and postimpact fire. The pilot and three passengers were killed and two passengers were seriously injured in the accident. Weather at the time of the accident was reported as "indefinite ceiling 400 feet sky obscured, 1 mile visibility in light snow and fog, with calm winds." The National Transportation Safety Board was unable to determine the probable cause of this accident, which occurred during an attempted missed approach. A low ceiling and poor visibility were factors which contributed to the accident.					
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WASHINGTON, D.C. 20594**

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Adopted: November 4, 1982

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SYNOPSIS

Sun West Airlines Flight 104, a scheduled passenger-service commuter air carrier flight departed Albuquerque, New Mexico, at 1855 mountain standard time on December 31, 1981, with five passengers and one pilot aboard for a flight to Durango, Colorado. The en route portion of the flight, conducted under instrument flight rules, was normal. Flight 104 was cleared by Denver Air Route Traffic Control Center at 1951:37 for a VOR approach to Durango-La Plata County Airport. Radar service was terminated at 1953:30, when the flight was about 3 miles northeast of the Aztec Intersection on the VOR approach.

About 2000, ground witnesses observed Flight 104 fly over the airport in a northerly direction about over the VOR transmitter (missed approach point) adjacent to the runway midpoint. The airplane descended and crashed about 1,350 feet east of the departure end of runway 2, about 3,250 feet from the VOR. The airplane was destroyed by impact and postimpact fire. The pilot and three passengers were killed and two passengers were seriously injured in the accident. Weather at the time of the accident was reported as "indefinite ceiling 400 feet sky obscured, 1 mile visibility in light snow and fog, with calm winds."

The National Transportation Safety Board was unable to determine the probable cause of this accident, which occurred during an attempted missed approach. A low ceiling and poor visibility were factors which contributed to the accident.

1. FACTUAL INFORMATION

1.1 History of the Flight

At 1855 mountain standard time, 1/ on December 31, 1981, Sun West Airlines Flight 104, N41070, a Piper PA-31-350(T-1020)—a scheduled passenger-service commuter air carrier flight from Albuquerque, New Mexico, to Durango, Colorado—departed Albuquerque with five passengers and one pilot aboard. The flight was operating on a "canned" 2/ company instrument flight rules (IFR) flight plan. The departure and en route portions of the flight at 13,000 feet 3/ were routine. At 1928:08, Denver Air Route

1/ All times contained herein are mountain standard time based on the 24-hour clock.

2/ A "canned" flight plan is a prefiled flight plan that is stored by Air Route Traffic Control Center computers and is activated by Air Traffic Control when the pilot calls for clearance to depart.

3/ All altitudes contained herein are in feet above mean sea level, unless otherwise specified.

Traffic Control Center (ARTCC) approved a descent to 11,000 feet for Flight 104. At 1933:35, the flight reported, "Denver Center, Sun West 104, we're level at eleven, we didn't pick up much [ice] on the descent, we're just below the bases at this time. I wonder if you could get us the latest Durango weather." Denver ARTCC replied that the Durango weather report was "almost 1 hour old" and that it was indefinite ceiling at 400 feet obscured, 1 mile visibility, light snow and fog. . . ." The controller also gave the pilot the latest Farmington, New Mexico, weather. At 1934:37, Flight 104 said, "All right, thank you very much, we'll uh shoot the approach at Durango with uh Farmington as our alternate then."

At 1941:29, Denver ARTCC requested more current Durango weather from Frontier Airlines Flight 815, which was approaching Durango and was in radio communication with company personnel at the airport. The Frontier pilot complied and radioed the weather to Sun West Flight 104. The current weather was reported as "indefinite ceiling 400 obscured, visibility 1 mile, light snow and fog, wind calm, altimeter 29.81." Flight 104 acknowledged receipt of this weather at 1945:46. Flight 104 was cleared for a VOR DME 4/ approach to runway 2 at Durango Airport at 1951:37. Radar service was terminated by Denver ARTCC at 1953:30 when the airplane was about 3 miles northeast of Aztec Intersection. (See figure 1.)

At 2000:19, Frontier Flight 815, which was parked on the ramp at Durango Airport, called Denver ARTCC and inquired if they were still talking to Sun West Flight 104. The first officer of Frontier Flight 815 stated that he had seen Sun West Flight 104 miss the approach and now they were receiving an emergency locator transmitter (ELT) signal. The Frontier first officer radioed at 2002:05, "One of the company personnel here says they think that he may have hit the ground on the missed approach out there, but anyway, we been waiting to [hear] locator beacon, and we visually seen him take off in that direction but it sure didn't look like he was very high." At 2002:55, the Frontier pilot radioed that he was no longer receiving the ELT signal.

Several witnesses at the airport either observed or heard Flight 104 fly past the airport. Many of them were busy with activities associated with the arrival/departure of Frontier Flight 815.

One witness said that his attention was drawn to Flight 104 because of the engine noise and the fact that it was "very low." He said he saw the airplane fly parallel to the runway (020°) until it disappeared in the snowfall. He said the airplane's wings were level and it was neither climbing nor descending during the time he observed it. Shortly thereafter, he heard a thud and a sound similar to trees snapping.

Another witness saw Flight 104 fly along the runway, make a right turn to about 060°, and then suddenly descend behind a hill which was covered with trees. He estimated the airplane's altitude as it passed to have been about 400 feet above the runway. He estimated visibility to have been about 1/2 mile.

A third witness said the airplane was about 200 feet above and 200 feet to the left (west) of the runway as it flew by. He observed the right turn to about 060° and said visibility was about 1 mile.

A fourth witness, a deputy sheriff on security duty at the airport, said the airplane flew over the runway at an altitude of about 100 feet above the runway. He said he last saw the airplane in level flight, lower than he believed was normal for the approach. He said heavy wet snow was falling with visibility of about 1 mile.

4/ Visual Omni Range - Distance Measuring Equipment navigational aid.



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A fifth witness did not see the airplane but he did hear "a large amount of power" being applied to the engines.

The sixth witness, the first officer of Frontier Flight 315, was sitting in the right cockpit seat of the airplane parked on the ramp. He said he heard Flight 104 approach the airport and observed it make a missed approach. He said that shortly after he observed the right turn, the airplane attitude abruptly changed from level flight to a sharp descent instead of a climb, which he expected. He tuned his radio to 121.5 MHz and heard the ELT signal, and he immediately notified Denver ARTCC and other persons at the airport.

The seventh witness, the Sun West station agent, said he observed Flight 104's lights as it flew by, but did not see the wings. He said Flight 104 flew over the ramp area between the runway and terminal building. He thought the airplane was at the same altitude as other airplanes he had seen executing a missed approach. He last saw the airplane in a right turn and lost sight of it in the snowfall.

None of the witnesses interviewed could recall having seen the position of the landing gear or flaps on Flight 104.

A 9-year-old girl and her 5-year-old brother were the only survivors of the accident. The young boy did not remember anything about the accident. The young girl was sitting on the right side of the cabin in the third seat behind the copilot's seat. She said she could see the pilot and part of the instrument panel from her location. She said she slept from Albuquerque, and heard "no funny sounds" during the flight until the landing approach. She said she knew they were going in for landing at Durango, and the first indication that there was a problem was during the approach when a woman in the left, second-row seat screamed "[we can't land], 5/ there is another plane on the runway." She said that after the woman screamed, "the pilot was pushing buttons" and "then a red light came on." She said the light was on the left of the instrument panel center, to the right of the pilot. She said the pilot "kept pushing buttons" and then she felt they "were falling." She said no one else screamed or said anything, then she heard someone yell "fire" after they crashed.

The girl had flown in propeller-type airplanes about seven times, but never into Durango. She said she did not recall engine sounds changing at any time. She said the "engines were running regular." She said she could not see outside because of darkness. She never saw the wings or anything on the ground during the approach. The girl said she thought the pilot put the landing gear down because she "could hear it."

She also said she thought she heard a bell ("an alarm") or a "ringing sound" when the red light came on during the last portion of the flight. Her recollection about the alarm was not as clear or positive as her other statements. The girl said she did not recall getting "light in her seat like a roller coaster," but she did compare the falling sensation she sensed to going over a bump in the road. She said, "I just felt it, I remember falling." She recalled that the falling sensation continued until impact. She never felt the airplane buffet or "shudder."

The airplane first contacted sagebrush and then a fence on a level snow-covered pasture about 1,350 feet east of the departure end of runway 2 at 6,592 feet elevation. The airplane came to rest about 1,600 feet farther, along a crash path oriented

5/ The witness was not positive about these words.

060° magnetic, at coordinates 37°09'01" N latitude and 107°45'02" W longitude. The initial impact area was about 3,600 feet from the terminal ramp area. The accident occurred during the hours of darkness.

1.2 Injuries to Persons

<u>Injuries</u>	<u>Crew</u>	<u>Passengers</u>	<u>Other</u>	<u>Total</u>
Fatal	1	3	0	4
Serious	0	2	0	2
Minor/None	0	0	0	0
Total	1	5	0	6

1.3 Damage to Aircraft

The airplane was destroyed by impact forces and postcrash fire.

1.4 Other Damage

None

1.5 Personnel Information

The pilot held the proper ratings and certificates to conduct the flight. He had received the training required by regulations and was qualified for the flight. (See appendix B.) He had flown 3 hours 8 minutes on the day of the accident and had been on duty for 7 hours. He had 14 hours rest before reporting for duty. The day before the accident, the pilot had flown 5 hours 9 minutes and was on duty for 11 hours. Prior to that day he had been off duty for 5 days.

According to Sun West personnel, the pilot had flown the PA-31 into Durango over 100 times in the past year, of which almost 50 flights were in instrument meteorological conditions. He had flown into Durango the day before the accident and successfully completed a missed approach during poor weather. Company personnel stated that the pilot had flown about 10 instrument approaches into Durango in the past month. He had logged about 204 total hours of actual instrument time.

1.6 Aircraft Information

N41070, a Piper PA-31-350, was the model T-1020 commuter version of the Piper Chieftain. It was certificated, equipped, and maintained in accordance with applicable Federal Aviation Regulations issued by the Federal Aviation Administration (FAA). The airplane was equipped with two Avco-Lycoming TIO-540-52B engines.

The airplane was within its weight and balance limitations for the flight. There were about 616 pounds of 100-octane, low-lead aviation gasoline aboard at the time of the accident.

The airplane was newly manufactured and was delivered to Sun West Airlines on December 23, 1981. The pilot involved in the accident flew N41070 from the factory in Florida to Phoenix, Arizona, on December 24, 1981. The airplane had accumulated 58.7 hours since new. There were no open maintenance writeups at the time of the accident.

The airplane was fitted with an Edo Avionics Corporation Century 41 flight control system (autopilot). The autopilot provided the pilot with the capability to fly and to control the airplane, including during instrument approaches, by means of inputs to the autopilot control head. The autopilot did not include an automatic go around mode. The PA-31 pilot operating handbook and FAA-approved Sun West Airlines operations specifications did not restrict the use of the autopilot for instrument approaches. Sun West Airlines unwritten procedures and training instructions recommended that the pilot not use the autopilot for instrument approaches.

The Century 41 autopilot provides the pilot with heading capture and hold, navigational course (VOR or localizer beam) capture and tracking, altitude hold, and climb and descent control through the autopilot trim switch. An autopilot disconnect alert system displays a white light on the autopilot annunciator panel which flashes at least four times and gives an aural tone for 2 seconds when the autopilot is disconnected. The aural tone is an electronically generated sound.

The Safety Board examined the Piper Aircraft Corporation manufacturing, production, certification, and flight test records for N41070 regarding the autopilot installation. The records showed that the autopilot system checkout (ground) was signed off on December 8, 1981. There was no written documentation as to how the ground checkout was accomplished, although Piper personnel stated that the appropriate Edo Avionics Corporation written procedures and test equipment would have been used by the Avionics department technicians. The records also showed that six test flights were flown before the airplane was delivered. There were three production test flights (December 18, 19, and 20, 1981) and three precertification test flights (December 20, 21, and 22, 1981). On the first precertification test flight the pilot wrote up the autopilot as, "flies glide slope one dot low." After the second precertification test flight, the pilot wrote "same on flight No. 2, now full scale." The corrective action entries showed that a temporary flight control system computer was installed and then another replacement computer was installed, and the pitch trim capstan (servo) was adjusted. These actions were dated December 21, 1981. The last precertification test flight (December 22, 1981) was flown and the autopilot system was signed off by the test pilot. There were no records available pertaining to the actual maintenance trouble-shooting procedures used to clear the discrepancy. The airplane was delivered to Sun West Airlines with 8.8 hours flight time.

The airplane was equipped and certified for flight in known icing conditions.

1.7 Meteorological Information

Weather observations were taken at Durango-La Plata County Airport by a National Weather Service (NWS) certified observer employed by Frontier Airlines. He stated that he determined cloud ceiling measurements by using information obtained from balloons, a ceiling light, and pilot reports. Visibility was established by reference to the distance of known objects from the point of observation. He had been a weather observer for over 15 years with 9 of those years at Durango.

Surface observations taken by the NWS-certified observer were, in part, as follows:

- 1940 -- indefinite ceiling at 400 feet, sky obscured, visibility 1 mile, light snow, fog, temperature 32° F, dew point 32° F, winds calm, altimeter setting 29.81 inches Hg.
- 2000 -- indefinite ceiling 400 feet, sky obscured, visibility 1 mile, moderate snow, fog, temperature 32° F, dew point 32° F, winds calm, altimeter setting 29.81 inches Hg, remarks—possible airplane accident.
- 2015 -- indefinite ceiling 200 feet, sky obscured, visibility 1/2 mile, moderate snow, fog, winds calm, altimeter setting 29.81 inches Hg.

The terminal forecast for Durango, prepared by the NWS in Denver, Colorado, called for occasional indefinite ceilings at 600 feet, sky obscured with visibility of 1/2 mile in light snow and fog. Severe turbulence and moderate icing were forecast for the area that included the accident site.

At 1822:55, Sun West Flight 104 radioed the Albuquerque Flight Service Station (FSS) while inbound to Albuquerque, about 35 miles out, stating that the flight would be landing at Albuquerque and departing shortly for Durango. The pilot asked for the Durango weather and was given the latest observation of "indefinite ceiling 600 feet, sky obscured, visibility 1 mile, light snow and fog. . . ." The FSS specialist also gave the pilot the latest Farmington observation and the current forecast, both of which were for visual flight rules (VFR) conditions. The pilot replied that Farmington would be a good alternate; he asked if Farmington weather was forecast to deteriorate and was advised that it was forecast to remain good. Farmington is located 34 miles southwest of Durango.

There was no record that the pilot obtained a formal preflight weather briefing prior to departing Albuquerque. Even if the pilot had requested and received a preflight weather briefing before departing Albuquerque, the briefing would not have included the contents of the terminal forecast for Durango. According to NWS personnel, the terminal forecast for Durango is a "nonscheduled" aviation terminal forecast prepared and amended as necessary by meteorologists at the Denver NWS office to support the operational needs of Frontier Airlines only. The nonscheduled forecast, and amendments, are transmitted by the NWS locally (Denver Tower and Approach Control, Arapahoe Tower, and Frontier Airlines) via electrowriter. According to NWS directives, the forecast is not transmitted to the FAA Weather Message Switching Center in Kansas City, Missouri, for distribution to Service A circuits. The Service A circuits provide meteorological data to a large segment of government and nongovernment users, including the Albuquerque FSS.

The first officer of Frontier Flight 815, which landed at Durango at 1951, stated that tops of clouds in the area were about 10,000 feet, with bases near 7,000 feet. He stated that during the descent out of 9,700 feet (near Aztec Intersection), the airplane picked up a trace of light, to at worst moderate, icing in clouds and snow. He said there were no significant windshears, gusts, or turbulence during the approach to Durango. He said that, once on the ground at Durango, he estimated visibility to be 1 to 2 miles.

A Texas International Airlines DC-9 landed at Durango at 2100. The captain, who was flying, said he saw the approach lights at the 2 DME fix (about 1 mile from the runway threshold) at about 600 feet above ground level (A.G.L.) He said light to moderate snow was falling during the approach and he encountered no turbulence or windshear.

1.8 Aids to Navigation

The airport was served by a VOR DME and a VOR-A approach procedure for runway 2. The navigational equipment located on the airport was functioning properly at the time of the accident. The landing minimums for the approach procedure flown by Flight 104 were 6,980 feet (333 feet A.G.L. minimum descent altitude (MDA) and 1 mile visibility, with the missed approach point at the VOR, which is located about 500 feet to the east of the runway and about 5,900 feet from the approach end of runway 2.

The airport is also equipped with a VASI, 6/ pilot-actuated approach lights, 7/ high-intensity runway lights, and a wind direction indicator. All lighting systems were working properly at the time of the accident.

1.9 Communications

There were no reported communications difficulties.

1.10 Aerodrome Information

The Durango-La Plata County airport is located about 15 miles southeast of the city of Durango at an elevation of 6,685 feet. The terrain in the immediate vicinity of the airport is rolling hills covered with sagebrush and trees. The airport is served by one runway (02/20) which is 9,200 feet long and 150 feet wide. The asphalt surface was covered with wet snow at the time of the accident.

There is a UNICOM radio (122.8 Mhz) at the airport which is monitored by Sun West Airlines station personnel.

The airport is certificated under the provisions of 14 CFR Part 139.

1.11 Flight Recorders

No flight data recorder or cockpit voice recorders were installed aboard N41070, nor were they required.

1.12 Wreckage and Impact Information

The wreckage and ground impact scars were confined to an area about 1,600 feet long and about 100 feet wide along a path oriented 060° magnetic. (See appendix C.) The first evidence of ground impact was about 1,350 feet from the north end of runway 2 in level terrain covered with snow and sagebrush. The first marks noted were propeller slashes in the sagebrush. These marks continued for about 100 feet, where the airplane struck a barbed wire fence. The elevation at the initial impact area was about 6,600 feet. The right-engine propeller dome and a piece of right-engine cowling were found near the fence and two broken fence posts were nearby. There were no definite indications of ground impact at this point or for the next 400 feet. About 425 feet beyond the initial ground contact point, the left and right propeller assemblies were found. There were

6/ Visual Approach Slope Indicator lights to provide pilots with visual glide slope guidance to the touchdown zone.

7/ The approach lights are turned on by the pilot during the approach by means of keying the microphone on 122.8 Mhz five times.

gouges in the ground adjacent to (between) the propellers. The terrain remained level for about 950 feet from the initial ground contact area to the edge of a ridge line. The ridge line (6,592 feet elevation) sloped downward at about 35° for about 350 feet. The hillside was covered with scrub pine trees about 15 to 20 feet high. At the bottom of the 35° slope the terrain sloped upward about 5° to where the airplane came to rest, about 320 feet from the bottom of the hill and at an elevation of 6,430 feet.

Numerous pieces of airplane structure were found in the broken trees on the hillside. These pieces included the emergency exit door, the nose baggage door, both wingtip fairings and position lights, and engine cowling material.

Snow obscured most ground scars along the wreckage path except at the bottom of the 35° slope where considerable dirt and sand was disturbed. Numerous pieces of left wing structure were found in this area which was also sooted by ground fire. Gouges were evident from that point to where the main wreckage came to rest oriented on a 170° magnetic heading.

The airplane was severely damaged by ground fire. The instrument panel, control wheels, and other cockpit accessories were destroyed by fire. The cabin area was burned away with only portions of the seat frames remaining. The empennage was intact and unburned from a point where it joined the aft fuselage. The top of the rudder was separated and was found along the scatter path in the trees. The horizontal stabilizer and elevator were in place. The outer 15 inches of the left stabilizer and elevator were bent upward about 30°.

The left wing was separated at the fuselage and had sustained severe impact and fire damage. The right wing had separated from the fuselage and was relatively intact except for some twisting and distortion. The right fuel tank was intact and contained fuel.

Continuity of all flight control cables was established except for overload impact damage and fractures. The elevator trim tabs were found in the neutral position. The validity of the elevator trim position could not be established because of broken and disrupted control cables and connections.

The landing gear were found in the retracted and locked position. The flaps were in the retracted position.

The engines and propellers had received severe impact damage. The left engine was severely damaged by fire. All blades of the propellers were badly twisted and bent. The leading edges of the propeller blades had nicks and gouges and the blade faces had chordwise scoring. Examination of the engines revealed no preimpact failures. The left vacuum pump was examined and there was no evidence of preimpact failures. The right vacuum pump was destroyed by fire.

1.13 Medical and Pathological Information

An autopsy showed that the pilot died from severe multiple impact injuries and that the extreme thermal injuries were postmortem. Toxicological analyses of tissue, urine, and blood revealed no evidence of drugs or alcohol and a 4-percent saturation of carbon monoxide. Traces of nicotine were found in the urine.

Two passengers' bodies (one male and one female) were also severely burned. Full body X-rays revealed multiple fractures for both bodies. Toxicological analyses of blood samples revealed carbon monoxide levels of 12.8 percent for the male, and 5 percent for the female.

The third fatally injured passenger (female) was not burned. External examination and full body X-rays revealed fractured cervical vertebra (C-7) and lumbar vertebra (L-1) with compression of the body, fractured left tibia and fibula, and multiple abrasions and contusions. The body had been embalmed prior to the opportunity to obtain tissue and blood samples for toxicological analysis.

The two surviving passengers received multiple abrasions and contusions. The boy sustained a third-degree burn on his left thumb and hand. He had received a second-degree burn of the scalp possibly from oil or fuel splashing on him. The girl received a deep cut on her forehead.

1.14 Fire

The ignition source of the fire was not determined. There were numerous potential sources from the hot engine components, friction, and broken electrical connections during the airplane breakup. Spilled fuel from the left wing tank and broken fuel system lines provided a source of fuel for ignition. Fuel in the right wing tank did not ignite, and the fuel remained in the tank.

1.15 Survival Aspects

The accident was partially survivable, only because the two children did not receive fatal impact-type injuries during the deceleration. The boy said that he woke up, saw fire, and crawled away from the fuselage. He said that he did not remember unfastening his seatbelt. The girl apparently was thrown clear of the airplane during the last impact. The fatally injured occupants died from multiple impact-type injuries when their restraint systems failed.

Search and rescue efforts were hampered by darkness, weather, and terrain. Medical services were called about 2030 and arrived about 2100, but local residents were at the scene administering first aid to the survivors within about 30 minutes of the accident.

1.16 Tests and Research

None.

1.17 Additional Information

1.17.1 Instrument Approach Procedures

According to the chief pilot of Sun West Airlines, once the airplane reached the MDA, the pilot of Flight 104 would have been flying the airplane at 120 KIAS, with the landing gear extended and flaps set at the approach setting of 15°. Once the runway was in sight and the landing was assured, the pilot would have fully extended the flaps to 40°. The chief pilot stated that company pilots were trained and directed not to use the autopilot for the approach. He said that he would not expect the pilot of Flight 104 to have been using the autopilot during the approach.

The operational procedure for executing a missed approach would have been: add power (probably climb power), raise the nose, establish and verify a positive rate of climb, and raise the landing gear and flaps. In this case, the pilot also would have turned right to the missed approach course of 060°.

1.17.2 Elevator Trim Service History

The FAA Service Difficulty Reports (SDR) for all PA-31 airplanes were searched for past elevator runaway trim malfunctions. Only one report was found for the PA-31 (Navajo) model airplane, dated January 11, 1978. No SDR's were found for the PA-31-350 (Chieftain) model airplane.

A search of National Transportation Safety Board aviation accident/incident records revealed no occurrence of runaway trim as a factor or cause in PA-31 type airplanes.

1.17.3 Excerpts Regarding Sensory Illusions, Vertigo, and Spatial Disorientation

The following excerpts were extracted from the undated FAA booklet titled "Physiological Training":

Sensory Illusion -- A false or misinterpreted sensory impression; a false interpretation of a real sensory image.

Vertigo -- A hallucination of movement. A sensation of rotary motion of the external world or of the individual himself.

Disorientation -- Loss of proper bearings, state of mental confusion as to position, location or movement.

Sensory apparatus in various parts of your body provides your brain with information about your position in relation to your environment. The eyes, inner ears, and muscle sense, in other words, literally tell you which end is up. In flying, many conditions you encounter can cause conflicts or illusions in these sensory functions. Cockpit confusion might be another term for disorientation since the information from your senses and from your flight instruments may be contradictory.

* * *

All these illusions are mistakes in interpretation caused by inadequate information on which to establish a reference. Your eyes are reporting correctly to your brain, but they don't give it enough information to work on.

This situation is worse at night than during the day, for your eyes are furnishing less information. Under such conditions your eyes can send false messages to the brain.

* * *

Letting your senses take over and putting your trust in them may or may not cause an illusion. You may have absolutely no idea what the attitude of the airplane is or its position in reference to the ground.

Trust your Instruments.

* * *

Other sensing mechanisms located in the inner ear are called otolith organs. They are affected by straight line or linear accelerations. They register various "G" forces as they are applied to the body but are not able to give accurate body orientation information to the brain.

FLIGHT FACTORS CONTRIBUTING TO SENSORY ILLUSIONS

1. Changes in acceleration and deceleration.
2. Cloud layers.
3. Low level flight over water.
4. Frequent transfer from instruments to visual flight conditions. One must use either VFR or IFR, not oscillate from one type to the other.
5. Unperceived changes in flight altitude.

* * *

First of all, you probably appreciate the fact that sensory illusions or vertigo are problems that usually show up under conditions of poor visibility. Whenever the visibility is poor enough to prevent you from checking your equilibrium senses with your eyes, your equilibrium system is undependable.

* * *

Tests show that you interpret the actual horizon about one-fifth of a second faster than you interpret your instruments. Furthermore, you make a recovery from a dive about one and a half seconds faster under visual conditions than when you are on instruments. You are also more susceptible than usual to the stresses of flight such as fatigue, oxygen lack, and anxiety. These stresses reduce your ability to think straight, so you are in danger of forgetting to use your instruments the minute things get tough. Anything that produces an emotional upset is likely to disrupt your conscious mental processes and make you much more susceptible to the illusions of false sensations.

The second point to remember is that the illusions that have been described in this section are relatively rare. Believe it or not, this can actually be a disadvantage. You learn to adjust to the sensations of normal flight as you gain flying experience, but the possibility remains that you will suddenly encounter a vivid illusion that you have never experienced before. If you do not know what the illusion is or how you can handle it, you are likely to get

panicky and let your emotions take over. When this happens, you are putting your life in the hands of your senses, and under such conditions they may prove inadequate.

Last, but not least, remember that many accidents occur as a result of indecision about going on instruments. With poor visibility you may begin to go on instruments and then sensory illusions can make you believe your instruments are wrong.

There is just one way to beat false interpretation of motion. Put your faith in your instruments and not in your senses. Know what kind of tricks your senses can play on you, keep calm, and have confidence in your instrument panel.

2. ANALYSIS

2.1 General

The airplane was properly certificated and had been maintained in accordance with applicable regulations and procedures. The pilot was properly trained, certificated, and qualified to conduct the flight. He had the proper medical certification, adequate rest, and there was no evidence of preexisting or incapacitating disease or pathology which would have affected his ability to conduct the flight.

Examination of the engines and propellers revealed that the engines were developing high power at impact. There was no evidence that power loss or malfunction were causal factors in this accident.

There was no evidence found to indicate preimpact failure or malfunction of the airplane structure, systems, or flight controls; however, severe impact and postimpact fire damage destroyed many components which therefore could not be examined.

There was no indication that the pilot encountered difficulties during the approach until the airplane passed the immediate vicinity of the VOR station (missed approach point). Therefore, there is no reason to suspect that airplane or ground navigational equipment malfunctions were causal factors, nor is there reason to suspect pilot-static malfunctions were factors. The fact that the eyewitnesses observed the airplane fly over the airport at or near the proper course and altitude further discounts such possibilities.

The witness observations and the fact that the landing gear and flaps were up suggest that the pilot was executing a missed approach procedure when the airplane crashed. Because the company procedure for a nonprecision approach specified gear extended, flaps at the approach setting (15°), and airspeed 120 KIAS, the Safety Board concludes from the flap and gear positions that the pilot was unable to land from the approach and that he raised the gear and flaps at or near the VOR and initiated the missed approach procedure. From the location of the red light described by the surviving passenger, the Safety Board concludes that she saw the landing gear in-transit light which is on when the gear doors are open during landing gear retraction.

The Safety Board concludes that the weather conditions at the time of the accident probably were below the landing minimums specified for the approach being conducted. Eyewitness accounts and official observations indicated deteriorating ceiling

and visibility about the time of the accident. The cloud ceiling decreased from 400 feet obscured at 2000 to 200 feet obscured at 2015. Also, the visibility decreased from 1 mile to 1/2 mile in moderate snow and fog during the same period. If the pilot had flown a precise ground track and altitude (MDA) to the missed approach point, and if the ceiling was 400 feet and the visibility was 1 mile, the pilot should have acquired the necessary visual cues to complete or attempt a normal landing. The fact that he initiated a missed approach when over the airport suggests strongly that the ceiling and/or visibility was less than minimums when the airplane approached the runway, and the pilot was not able to obtain adequate visual references to continue the approach to a successful landing.

The pilot most likely did obtain a glimpse of airport features as the airplane passed near the VOR, adjacent to the terminal area, as evidenced by the one passenger's exclamation (scream) that there was an airplane on the runway. Since there was no airplane on the runway at that time, the comment by that passenger most probably referred to an observation of the terminal area to the left of the runway where Frontier Flight 815 and other aircraft were parked under bright lights. That probably was the only occasion the pilot may have had to observe airport features because the surrounding terrain was in darkness. He either did not see the approach lights or runway lights in sufficient time to descend from the MDA and land, or he lost sight of the runway once he left MDA and had to stop the descent. In either case, the airplane was not in position to land and the airport was overflown in preparation for a missed approach procedure.

The ground witness observations of the flightpath of Flight 104 vary somewhat regarding its height and ground track as the airplane passed the terminal. Height estimates varied from 100 feet to 400 feet above the airport, and the airplane's location varied from over the VOR to almost over the terminal. The weather conditions at the time must be considered when evaluating the witness observations. As indicated by the post-accident weather observation, the vertical visibility was probably less than 400 feet when the airplane passed. Further, some witnesses stated that they lost sight of the airplane after it flew away from them, and before it struck the ground. Since the airplane struck the ground about 3,600 feet from the witnesses, this would indicate that horizontal visibility was less than 1 mile. None of the witnesses observed the landing gear or other features of the airplane distinctly. Some only saw lights but others definitely saw the airplane fuselage and wings. Based on the assessment of horizontal and vertical visibility at the airport, on the fact that the pilot began the missed approach procedure, and on the observation of the witnesses that they did not see the airplane for more than a glimpse, the airplane must have been quite low. Also, based on a consensus of the witness observations, and on the weather conditions, it appears that Flight 104 probably passed over the runway, in the vicinity of the VOR, between 200 and 300 feet.

The probability that the airplane was below the MDA for the approach when observed by the witnesses could be accounted for by the possibility that the pilot saw the runway lights, descended below the MDA for the landing, and then either lost sight of the runway or realized that he could not land, because he was not aligned or was too far down the runway. Regardless of the reason for the low altitude when passing the terminal, the pilot should have been able to complete a successful missed approach and the airplane should have gained considerable altitude before it arrived at the point where it crashed.

In order to analyze the possible explanations for the loss of altitude, the Safety Board calculated the rate of descent required to descend from the altitudes observed by the witnesses, when the airplane passed over the airport to the point of initial ground contact. The straight-line distance from the VOR (missed approach point) to

Initial ground contact was about 3,250 feet. The airspeed assumed for the calculations was 120 KIAS, which was about 150 miles per hour true airspeed, or 220 feet per second (fps). Using these distances and speeds, the elapsed time from abeam the VOR to ground contact would have been about 14.3 seconds. Since the airplane turned right from about 030° to about 060° during the missed approach, and assuming a standard rate turn (3° per second), it would have required 10 seconds to complete the turn. Therefore, the actual ground track would have been an arc and the actual distance from the VOR to ground contact would have been greater than 3,250 feet. Consequently, the elapsed time from VOR passage to impact would have been slightly over 15 seconds for the assumed 120 KIAS.

Using the conservative time of 15 seconds, the rate of descent from 300 feet above the airport to impact would have been 1,200 feet per minute (fpm), or 20 fps; from 200 feet it would have been 800 fpm or 13.3 fps; and from 100 feet it would have been 400 fpm, or 6.6 fps. Since it cannot be determined what the actual descent profile was, these are average rates of descent over the entire distance from the VOR to impact.

2.2 Possible Reasons for the Descent

The Safety Board was not able to determine why the airplane lost altitude and crashed during the missed approach attempt. Several of the more likely possibilities were considered, but none of them could be confirmed based on the available evidence.

Mechanical failure.--Flight control or trim malfunctions or flight instrument failures could account for the unwanted descent; however, the damage to and destruction of the flight control components and flight instruments precluded a positive conclusion that they were functioning properly. However, the Safety Board believes that such system malfunctions are improbable because the airplane was controllable until a few seconds before impact, the components examined revealed no preimpact failures, and there was no previous record of malfunctions. The evidence indicates that the pilot probably recognized the unwanted descent at the last moment and that he attempted to return the airplane to climbing flight. The initial ground contact involved primarily the propellers cutting sagebrush until the airplane passed through the fence a few seconds later. The airplane could not have had a high rate of descent at that time or there should have been extensive ground scars and gouges, and separation of airframe parts. The airplane remained in the air for about 450 feet after striking the fence, until the first principal ground contact was made. The only airplane parts in the initial contact area were the right-engine propeller dome and a piece of right-engine cowling. These pieces separated when the right engine hit the fence post. Therefore, the Safety Board concludes that the airplane's descent was virtually nil, and the pilot had nearly recovered from the descent when the propellers touched the sagebrush and when the right engine struck the fence. The Safety Board believes that the reason for the unwanted descent was not a problem that prevented ascent; rather, it apparently involved a problem that was not recognized in sufficient time to prevent the initial descent and to recover completely. Consequently, the Safety Board concludes that uncontrollable mechanical failures probably were not the reason for the loss of altitude.

Runaway trim.--Airplane design criteria specify that the pilot be able to overcome the forces involved with runaway nosedown elevator trim. However, the possibility exists that runaway trim could have occurred concurrently with the airplane configuration changes associated with the execution of the missed approach, and during a phase of flight in which the demands on a single pilot are very high. Consequently, a

runaway trim condition could have gone undetected for a sufficient length of time to place the airplane in a descending attitude that was not detected by the pilot in time to overpower the mistrim condition and to effect recovery from the descent. Impact and fire damage precluded positively eliminating the airplane trim system as a causal factor, and runaway trim could explain the reason for the accident although there is no history of this problem with PA-31 type airplanes.

Autopilot use.--If the pilot was using the autopilot to fly the approach and to execute the missed approach, a malfunction or improper action by the pilot also could have initiated the descent and gone undetected for a short time. Although the company unwritten procedures and guidance specify that a pilot not use the autopilot for instrument approaches, the possibility exists that the pilot of N41070 did. The capability of the Century 41 autopilot to track the inbound course and to hold a desired altitude during the approach would have reduced pilot workload. Similarly, the pilot could have readily executed the missed approach by means of inputs to the autopilot. Therefore, the Safety Board could not rule out the possibility that the pilot used the autopilot during the approach to reduce workload, or merely to see how well it performed. Moreover, the audio warning described by the survivor could have been the autopilot disconnect alert. Although the survivor recalled hearing a "bell," there were no bell-type aural warnings installed in N41070. The sound of the autopilot disconnect aural warning is a bong-type sound which might have been the sound the survivor recalled hearing. If it was, it could mean that the pilot was using the autopilot during the approach and it was disconnected during the missed approach. The autopilot could have been disconnected when the pilot pushed the disconnect button, or when he overrode it by pulling back on the control yoke. If the autopilot malfunctioned and initiated the descent, or the pilot made an improper input once he recognized the deviation, he would have disconnected the autopilot either by overriding it or pushing the disconnect. Again, the evidence is inconclusive and therefore, the role of the autopilot in the events of this accident cannot be reasonably assessed.

Airframe icing.--The Safety Board also considered the possibility that airframe ice was the reason for the unwanted descent. The meteorological conditions were conducive to ice accumulations and the pilots of Frontier Flight 815 reported that they encountered icing during their approach a few minutes before Sun West Flight 104's approach. However, N41070 was certificated and equipped for flight into known icing conditions and the existing conditions were not so severe that they should have caused serious problems. The pilot of Flight 104 should have been able to cope easily with the existing conditions. Therefore, although it is possible that the pilot failed to remove ice buildups during the approach, and the resultant adverse aerodynamic effects resulted in the unwanted descent, the Safety Board believes such factors are not likely in this case.

Intentional maneuver.--Another possibility considered by the Safety Board, which could account for the observations of the survivor and the ground observers, involves the possibility that the pilot intentionally pushed the nose over to "duck under" and remain visual in an attempt to fly a circling approach to runway 20. A circling approach would involve a turn away from the runway followed by a reverse turn back to the runway. Since the winds were calm, the pilot could have landed on the runway in either direction. The possibility that the pilot saw the terminal area as he passed by supports speculation that the pilot may have contemplated or even attempted such a maneuver; however, he was well aware of the surrounding terrain features and therefore would not be expected to attempt such a maneuver by losing altitude.

Attitude Indicator.--Another explanation for the unwanted descent could be mechanical failure of the attitude indicator or failure of the pilot to maintain a positive climb indication by use of the attitude gyro. Attitude indicator gyros can exhibit precession as a result of acceleration forces. The typical precession error during longitudinal (forward) acceleration will produce a false nose-high indication momentarily. However, the allowable tolerance for a properly functioning gyro of the type installed in N41070 is so small that precession error should not have been sufficient to have caused noticeable effects unless there was a malfunction. There was no evidence to suggest such a malfunction, although the gyro could not be tested because of impact and fire damage. However, since the pilot maneuvered accurately to the VOR, the attitude indicator was probably operating properly. A mechanical failure precisely at the time of the missed approach is highly improbable. Therefore, the Safety Board believes mechanical failure of the attitude indicator probably was not a factor in the accident.

Pilot workload.--Several other problems could have occurred and several conditions could have affected adversely the pilot's ability to maintain a climb attitude, and conversely could have allowed an unwanted descent to occur. The pilot's instrument cross-check and visual scan would have included at least the following: attitude indicator, heading indicator, vertical speed indicator, altimeter, engine instruments (setting climb power), flap handle, gear handle, and possibly outside cues such as airport lights or other objects. All of these items would have had to be scanned during the few seconds immediately after the missed approach was initiated. The workload on the pilot would have been extremely high during this short period and would have required precise and timely perception, decisionmaking, and actions to effect a proper missed approach. Any distraction, such as the passenger's scream about an airplane on the runway, any misperception of cues, or any delayed action under these circumstances could have caused an unwanted descent that was not detected in time to avoid ground contact. The rate of descent required to cause the accident is rather high and should have been readily apparent to the pilot; however, it could have gone undetected for a few seconds, which would have been sufficient to cause the accident.

Physiological factors.--Sensory illusions, vertigo, or spatial disorientation can cause a pilot to not detect a deviation, to interpret cues incorrectly, to take inappropriate action, or to take no action when action is required. Any of these conditions can occur during instrument flight; however, the possibility of them occurring is greater at night, during aircraft configuration changes, and when accelerations (aircraft maneuvering) occur, i.e. turns, climbs, and power changes. Also, the transition from instrument references to visual references and back to instrument references can induce illusions or disorientation. Moreover, if the pilot looked out the left window in reaction to the passenger's scream about an airplane on the runway or because of his own sighting of the ground or other features, the head and eye movements associated with this action could induce disorientation.

The only way for a pilot to overcome sensory illusions is to monitor continuously and to rely on the attitude indicator, and to cross-check the other flight instruments, including the altimeter and vertical speed indicator, to verify that the aircraft is performing as desired. Unfortunately, when a pilot is experiencing illusory events, the pilot may not detect an improper instrument indication because the pilot's sensory organs are sending false messages to the brain. A pilot might react to these false messages and take inappropriate actions until the pilot determines from the airplane instruments the need for correct actions. These actions require time, so any distraction or other reason for a breakdown of a pilot's instrument scan could allow a deviation to occur and to go uncorrected for a sufficient length of time to cause an accident. All of

the known conditions to induce illusions, vertigo, or spatial disorientation existed during Flight 104's attempted missed approach. However, the absence of conclusive evidence precludes the Safety Board from assigning physiological factors as causal.

Although the preceding analysis does not include all of the possibilities for the cause of this accident, the Safety Board believes that the possibilities discussed are the more likely and plausible explanations for the accident. To assign any one of them as causal would be purely speculative and would not be supported by the evidence. Although the Safety Board could not determine the cause of this accident, it does believe that the low ceiling and reduced visibility were factors in whatever the cause was.

2.3 Single-Pilot Operation

A prior study ^{8/} conducted by the Safety Board and the evidence developed during this investigation have given the Safety Board concern about the adequacy of the regulations that allowed single-pilot IFR operation of Flight 104. Single-pilot operation in environmental conditions such as those existing at the time of the accident, coupled with the workload in conducting a nonprecision approach and missed approach in a twin-engine airplane, is very demanding. While numerous successful single-pilot operations occur daily in poor weather and high workload situations, the margin for error is much less during such operations because of the lack of redundancy provided by a second pilot.

The issue of single-pilot IFR operations in commuter service was examined by the Safety Board as part of its special study of commuter airlines in 1980. Seventy percent of the operators surveyed as part of that study stated that their companies were authorized to conduct single-pilot IFR flights; however, many commented that the practice was "marginally safe" for many reasons. Among the reasons cited were the high workload factors associated with high-density ATC areas and airport environments, and the demands of the cockpit which can overburden a single pilot.

As a result of the commuter special study, the Safety Board made several safety recommendations to the FAA, some of which addressed the need to upgrade pilot experience and training requirements in general for commuter operations. Specifically, the Safety Board recommended that the FAA, "Evaluate and revise as appropriate the criteria for the authorization of single-pilot IFR operations for commuter airlines. (A-80-72)." The FAA responded that it concurred with the recommendation and that effective March 1, 1980, 14 CFR Part 135 was amended to require that the pilot-in-command for single-pilot IFR operations must have logged 100 hours as pilot-in-command in the make and model aircraft to be flown. The amendment to 14 CFR Part 135 also required more stringent ground and flight training for commuter airplane pilots. As a result of those actions, the Safety Board classified the recommendation as "Closed--Acceptable Action."

The Safety Board believes that the amendments to 14 CFR Part 135 pertaining to upgraded pilot experience and training for certification to fly single-pilot IFR are positive steps toward improving commuter safety; however, the Safety Board remains concerned about the basis for certification of single-pilot IFR air taxi and commuter operations as it pertains to the airplane and its equipment and the interface of the pilot with the airplane, i.e. human engineering.

^{8/} Special Study, "Commuter Airline Safety," NTSB-AAS-80-1, issued July 22, 1980.

In general, 14 CFR Part 135 allows operators to fly single-pilot IFR provided the airplane is equipped with an operational three-axis autopilot, and if the airplane has a passenger seating configuration of 10 seats or less. The autopilot requirement obviously is to provide the pilot assistance to reduce fatigue and workload. However, the passenger seating standard has no relevant bearing on pilot workload.

The Safety Board is aware that the original type certification of a particular airplane includes crew-size evaluations that include workload data and instrument/control placement to facilitate single-pilot operation; however, these evaluations are performed by pilots and engineers, without the assistance of persons trained in human engineering. Nor do the evaluations take into account the operating environment. The regulations pertaining to single-pilot IFR operations contain no human engineering criteria to alleviate workload, such as requirements for standardized location of displays and controls, control yoke-actuated microphone button with a boom-microphone, or criteria to minimize design-induced errors.

The Safety Board believes that the circumstances of this accident, and many others, and the existing environment in which single-pilot certificated air taxi and commuter airplanes operate dictate the need for a closer examination of single-pilot IFR operations under 14 CFR Part 135. A safe nonprecision instrument approach to an uncontrolled airport in snow, fog, and icing conditions, at night, in a twin-engine, propeller-driven airplane, possibly followed by a missed approach procedure, involves human engineering considerations and equipment beyond the availability of an autopilot. In fact, most autopilots cannot be used at low approach altitudes or for a missed approach. Certainly, the number of seats forms no basis for measuring the complexity of the airplane operations. Therefore, the Safety Board believes that the FAA should reevaluate its basis for certifying single-pilot IFR operations for passenger-service air taxi and commuter operators of multiengine airplanes.

The Safety Board believes that 14 CFR Part 135 certification to fly single-pilot IFR should include more than the increased pilot experience and training requirements. The certification rules also should require a thorough evaluation of the airplane, including its controls and displays, the operating environment, and the interface of these aspects with the pilot. Human engineering evaluations should be accomplished concurrently by persons trained in aviation human engineering, as well as pilots and hardware engineers. Thorough evaluations of this type will help identify and reduce the potential for pilot/airplane interface problems which can result in degraded pilot performance and, thereby, result in an accident.

2.4 Survival Aspects

The fatally injured occupants were killed when their restraint systems failed during the multidirectional impacts. The decelerative forces and disruption of the airplane occupiable space was only moderate until the airplane struck the ground at the bottom of the hill. The ground scars at the final major impact area and the airplane damage revealed that the airplane struck the ground in a left wing low condition with considerable right yaw. The sideward (cartwheel) forces overloaded the occupants' restraint systems and broke open the cabin area, allowing one of the survivors to be thrown free. The other survivor was able to crawl free before the fire could spread and overcome him. The survival of the two children was the result of fortuitous circumstances in that they did not strike, or were not struck by, surrounding structures during the accident. Their relatively small size, as compared to the adults, may have afforded them more protection through their restraint systems during the decelerative forces.

The operation of the ELT, although for only 3 or 4 minutes, along with the observations of several eyewitnesses who suspected an accident, initiated the search activities. The ELT probably failed to continue operating when fire destroyed it or its antenna. The search and rescue efforts were hampered by poor weather, terrain, and darkness.

3. CONCLUSIONS

3.1 Findings

1. The airplane was certificated and was maintained in accordance with applicable regulations and procedures.
2. The pilot was properly certificated, trained, and qualified to conduct the flight.
3. Although there was no evidence of preimpact failures or malfunctions of the airplane structure, systems, flight controls or powerplants, failures or malfunctions in the airplane's systems or flight controls cannot be conclusively ruled out due to severe damage to these components.
4. The engines were developing high power at impact.
5. There was no evidence that the pilot encountered difficulties during the approach until reaching the missed approach point.
6. The pilot initiated a missed approach procedure near the VOR.
7. The airplane passed the VOR adjacent to the airport terminal at 200 to 300 feet above the runway.
8. The airplane struck the ground, the elevation of which was about the same as the airport, about 15 seconds after passing the VOR.
9. The first indication of ground contact was in sagebrush that had been cut by the propeller blades.
10. The landing gear and flaps were retracted at ground contact.
11. Weather conditions (ceiling and visibility) at the airport were deteriorating at the time of the accident with moderate snow and fog.
12. The pilot was attempting to arrest the airplane's descent when it struck the ground.
13. The reason for the unwanted descent could not be determined.
14. The pilot's instrument scan may have been disrupted, and he may have failed to recognize an unwanted descent for a sufficient period of time to preclude complete arrestment of the descent.

15. The pilot's workload during the approach and missed approach was heavy.
16. The fatally injured occupants died from impact injuries when their restraint systems failed; three of the occupants suffered extreme burns post-mortem.
17. The two survivors' restraint systems failed; however, one survivor was thrown clear and the other survivor was able to crawl clear before the fire reached him.

3.2 Probable Cause

The National Transportation Safety Board was unable to determine the probable cause of this accident, which occurred during an attempted missed approach. A low ceiling and poor visibility were factors which contributed to the accident.

4. RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board recommended, on May 14, 1982, that the National Weather Service:

Establish a policy of transmitting all nonscheduled airport terminal forecasts and amendments to the Federal Aviation Administration Weather Message Switching Center in Kansas City, Missouri, for distribution on Service A circuits. (Class II, Priority Action) (A-82-45).

Also, as a result of this investigation, the National Transportation Safety Board recommended that the Federal Aviation Administration:

Amend 14 CFR Part 135 to require human engineering evaluations of the airplane, including the operating environment as well as its controls and displays, as a basis for certification of single-pilot, multiengine IFR operations. (Class II, Priority Action) (A-82-145)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ G. H. PATRICK BURSLEY
Member

/s/ DONALD D. ENGEN
Member

FRANCIS H. McADAMS, Member, did not participate.

November 4, 1982

5. APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The Safety Board was notified of the accident about 1145 e.s.t. on December 31, 1981. One investigator was dispatched to the scene from the Board's Denver Field Office. An investigator-in-charge and three specialists were dispatched from Washington, D.C., headquarters and arrived in Durango about 2300 on January 1, 1982. Working groups were established for operations/air traffic control/witnesses, weather, structures, powerplants, and human factors.

Parties to the investigation were the Federal Aviation Administration, Piper Aircraft Company, Avco Lycoming, and Sun West Airlines.

2. Public Hearing

A public hearing was not held. Depositions were not taken.

APPENDIX B

PERSONNEL INFORMATION

The pilot, Captain Kelly E. Glendinning, age 33, held Airline Transport Pilot Certificate No. 44464354, issued June 24, 1979, with single-engine and multiengine land ratings. He also held an instructor certificate for both single-engine and multiengine land aircraft. He had received a biennial flight review on November 14, 1981, in a Piper PA-34-200 airplane. Captain Glendinning had accrued about 4,900 total flying hours, of which about 1,381 were in the Piper PA-31 type airplanes. He had flown about 234 hours in the previous 90 days and about 56 hours in the previous 30 days, all in PA-31 airplanes. His First Class Medical Certificate, issued July 28, 1981, contained no limitations or waivers.

Legend:

- ① Initial Impact - Propeller Slash Marks in Sage Brush From Both Propellers (15' Apart)
- ② Right Top Engine Cowling
- ③ Right Engine Spinner Tip
- ④ Left Propeller Assembly
- ⑤ Right Propeller Assembly
- ⑥ Top Half of Right Engine Cowl
- ⑦ Emergency Exit Door
- ⑧ Nose Cone Baggage Door
- ⑨ Nose Cone
- ⑩ 15' Trees With Tops Slashed-Off
- ⑪ Right Wing Tip Position Light Socket
- ⑫ Left Wing Tip Fairing and Position Light Socket
- ⑬ Right Wing Tip Fairing
- ⑭ Top of Rudder
- ⑮ Numerous Pieces of Left Wing
- ⑯ Left Top Engine Cowling
- ⑰ Scattered Aircraft Debris
- ⑱ Main Wreckage Site

Elevation
6,430' MSL

⑱ Main
Wreckage
170° M.H.

Elevation
6,592'
MSL

35° Down Slope

5° Down Slope

Ridge Line

MN

Latitude: 37°09'01"N
Longitude: 107°45'02"W

-25-

APPENDIX C

Wreckage Distribution Chart

Feet 0 25 75 200
50 100

Field Elevation
6,685' MSL

Cut Fence

② ③

Rwy

20'

1350'

①

2'

3,250'

VOR

Fence line