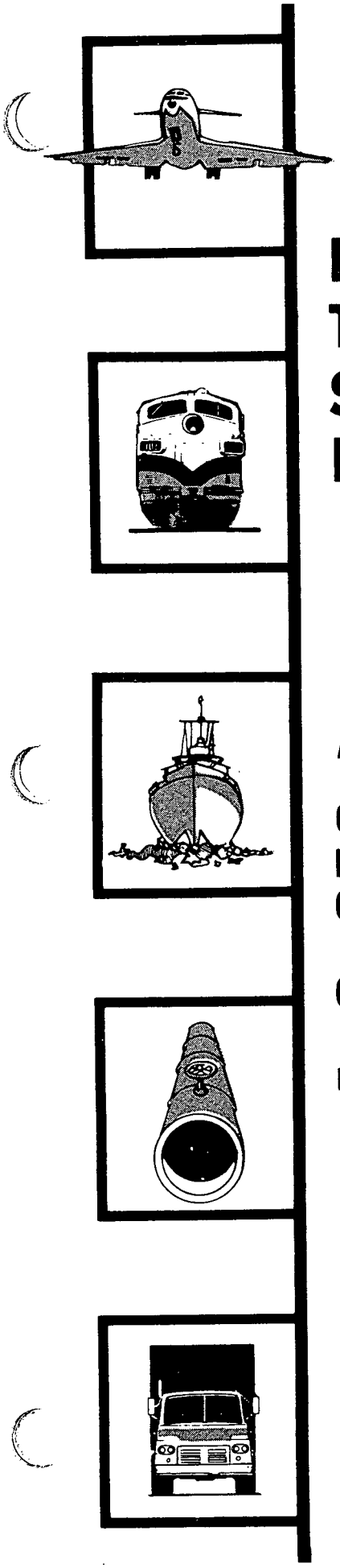

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

COMAIR, INC.
PIPER PA-31, N6642L
COVINGTON, KENTUCKY

OCTOBER 8, 1979

NTSB-AAR-80-8

UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

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16. Abstract

On October 8, 1979, at 1008:26, COMAIR, Inc., Flight 444, a Piper PA31-310, with a pilot and seven passengers on board, crashed on takeoff from runway 18 at the Greater Cincinnati Airport, Covington, Kentucky. The pilot and the seven passengers on board were killed, and the aircraft was destroyed.

After 1,500 to 2,000 ft of takeoff roll, the aircraft lifted off abruptly and climbed slowly to about 150 ft above the runway. Following liftoff, the pilot reported a loss of power from an engine, and the tower controller cleared the pilot to return and land. Seconds later, the aircraft rolled to the right to an inverted position and dove, nose first, to the ground.

The National Transportation Safety Board determines that the probable cause of the accident was the loss of control following a partial loss of power immediately after liftoff. The accident could have been avoided if either the pilot had rejected the takeoff or had raised the landing gear and flaps. His failure to take decisive action may have been due to preoccupation with correcting the malfunction, and a lack of familiarity with the aircraft and with its emergency procedures.

Contributing to the accident was the pilot's inexperience in multiengine aircraft, a hurried departure, inadequate training, inexperienced company management, and ineffective FAA certification and surveillance of the operator.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

Adopted: May 28, 1980

COMAIR, INC.
PIPER NAVAJO, PA-31-310, N6642L
GREATER CINCINNATI AIRPORT
COVINGTON, KENTUCKY
OCTOBER 8, 1979

SYNOPSIS

On October 8, 1979, at 1008:26, COMAIR, Inc., Flight 444, a Piper PA31-310, with a pilot and seven passengers on board, crashed on takeoff from runway 18 at the Greater Cincinnati Airport, Covington, Kentucky. The pilot and the seven passengers on board were killed, and the aircraft was destroyed.

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Contributing to the accident was the pilot's inexperience in multiengine aircraft, a hurried departure, inadequate training, inexperienced company management, and ineffective FAA certification and surveillance of the operator.

1. FACTUAL INFORMATION

1.1 History of the Flight

On October 8, 1979, COMAIR, Flight 444 was a commuter flight from Covington, Kentucky, to Nashville, Tennessee, and was scheduled to depart the Greater Cincinnati Airport at Covington at 0945. 1/ It was operating behind schedule because of delays in the first flights of the day flown by the captain in the aircraft.

The captain computed Flight 444's weight and balance with the aid of a Piper PA31-310 weight and balance visual plotter and the passenger manifest form. Federal Aviation Administration (FAA) approved standard weights, 170 lbs for each adult passenger, 80 lbs for each child under 12 years of age, and 23.5 lbs per bag, were used in the computations.

According to COMAIR's baggage handler, the captain checked the baggage in the nose compartment and secured the door. The aircraft was not refueled, since it had been fueled with 39 gals of 100/130 octane fuel in Toledo prior to the flight to Cincinnati. The captain commented to the baggage handler that refueling was unnecessary because the main tanks were three-quarters full. The captain started the right engine, while the baggage handler boarded the passengers and secured the cabin door.

At 1004:25 the captain told the tower controller that Flight 444 was ready to taxi. The controller cleared the flight to runway 18 and reported, "wind 190° at 8, altimeter 29.95." At 1006:19, the captain reported ready for takeoff, and the flight was cleared at 1006:26.

Flight 444 began its takeoff roll from the beginning of runway 18. The captain of Delta Airlines Flight 263, a flight behind Flight 444, stated that he saw the aircraft turn left onto the runway and immediately begin the takeoff roll. He said the takeoff appeared normal up until the instant of liftoff, which occurred before taxiway F -- 1,500-2,000 ft from the start of the takeoff roll. The wing flaps appeared to be extended 15° to 20°. He stated that the pilot "jerked his aircraft into the air" and that it began to yaw to the right and then leveled off 6 to 10 ft above the runway for 2 to 4 seconds before beginning a slow climb. The aircraft yawed right and left 10° to 20°, and the wings rocked from side to side during the slow climb. The landing gear and wing flaps remained extended. He believed that the pilot reported engine difficulty slightly after liftoff. He said, ". . . the left engine appeared normal, but . . . I could see intermittent flashes of the right prop as if it were slowed to near idle rpm."

When the aircraft was about 150 ft above runway 18, the following exchange took place between Flight 444 and the control tower. The pilot was using a headset and a boom mike to make the transmission:

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

1007:48	Tower	COMAIR triple four, contact departure so long
1007:52	Flight 444	Four forty-four has just lost an engine, like to come back around
1007:55	Tower	O.K. anything you like you, wanta make a left turn out and go in on two seven or whatever you like. You're cleared to land wind check one niner at eight.
1008:10	Tower	And COMAIR you want the equipment standing by
1008:14	Flight 444	Stand by

The captain of Delta Flight 263 stated that the aircraft never appeared to accelerate and remained in a relatively flat attitude 5° to 10° noseup. He last observed the aircraft rolling and yawing about 150 ft above and aligned with the runway, 3,800 ft to 5,000 ft from the takeoff end. The landing gear and flaps were still extended.

COMAIR's director of maintenance, who was located on a parking ramp east of runway 18, stated that abnormal engine sounds drew his attention to the aircraft when it was about 150 ft above the runway and climbing. He said, ". . . it was pulsating, it sounded like one engine. . . . it sounded at times to be at high rpm (power) and then cut out. It sounded like the aircraft wasn't developing full power on the good engine." He also said the aircraft then began to descend slightly while in slow flight, with landing gear and flaps extended and the wings rocking back and forth. It then made a shallow turn to the right. He did not see a feathered propeller.

Another witness stated that as the aircraft commenced a slight right bank turn, the nose came up slightly, and the aircraft rolled into an inverted, nosedown attitude. (See figure 1.)

The aircraft crashed in an open field, 8,695 ft from the departure end of runway 18 and 1,188 ft to the right of the centerline. The emergency locator transmitter (ELT) installed aboard the aircraft activated at 1008:26. The coordinates of the crash site were 39°03' N latitude and 84° 40' W longitude. (See figure 2.)

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other
Fatal	1	7	0
Serious	0	0	0
Minor/None	0	0	0

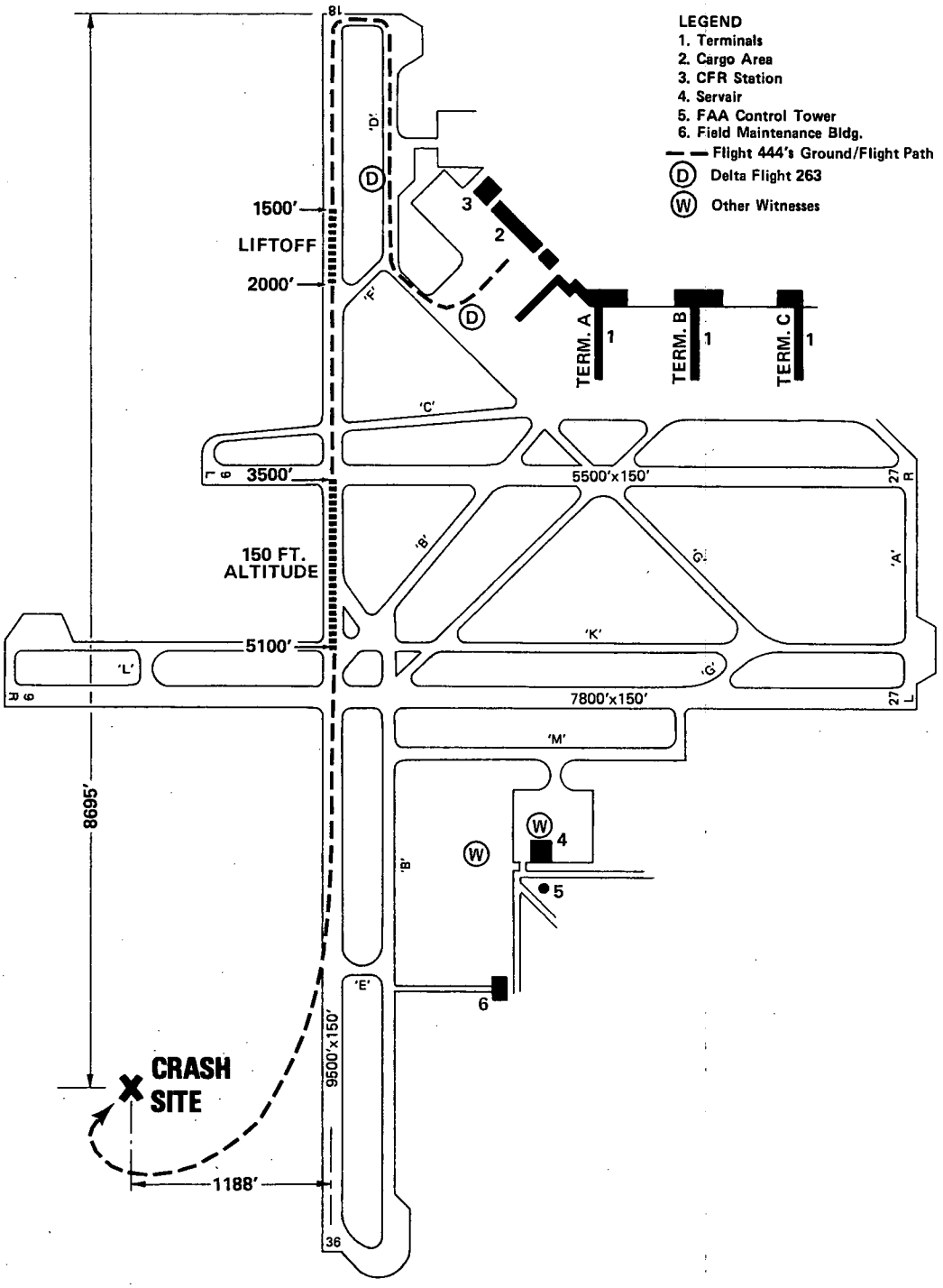

Figure 1.--Diagram of Great Cincinnati Airport.

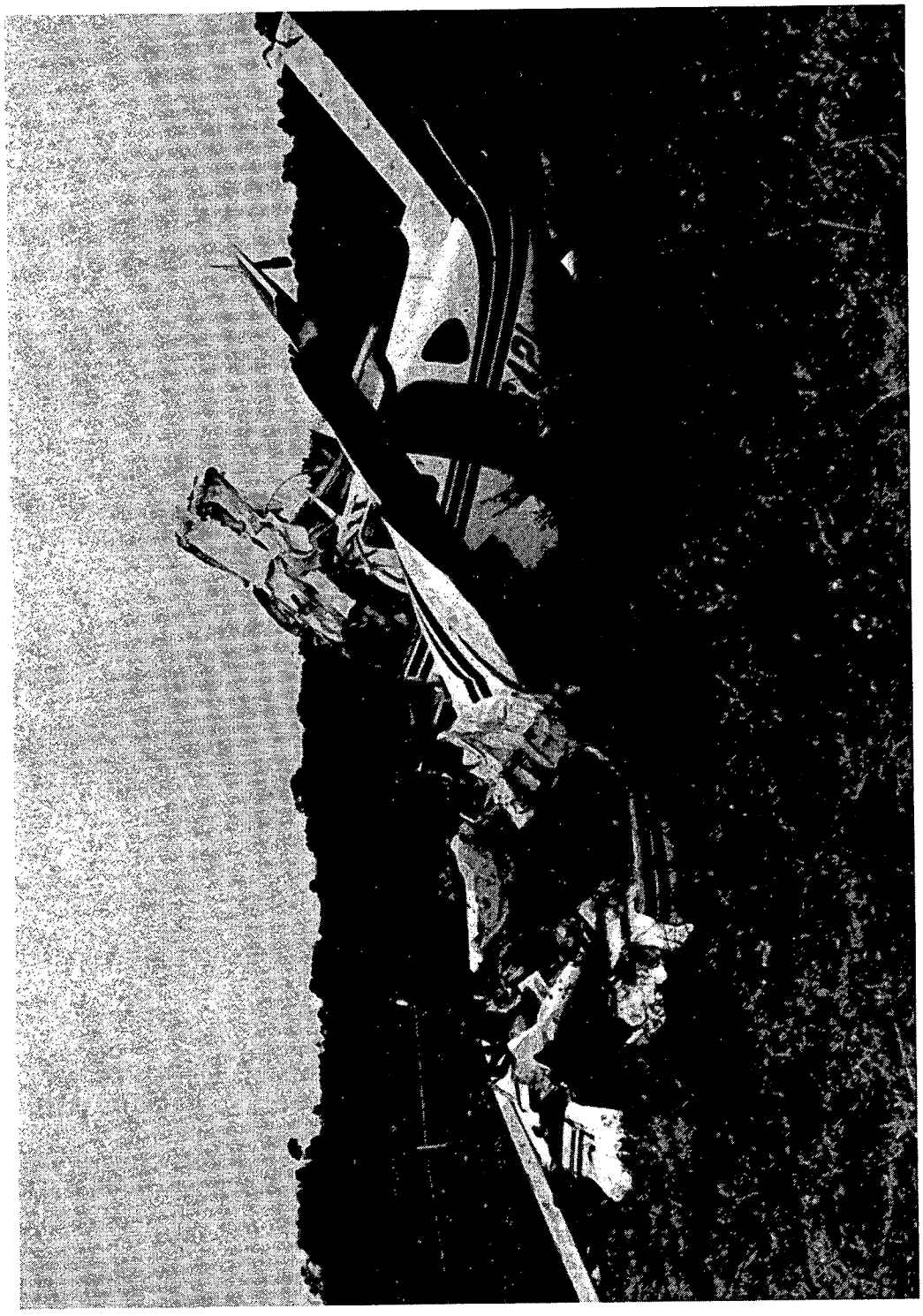

Figure 2.--Left side view of wreckage.

1.3 Damage to Aircraft

The aircraft was destroyed; there was no fire.

1.4 Other Damage

Not applicable.

1.5 Personnel Information

The captain was currently certificated and qualified for the flight in accordance with Federal Aviation Regulations. (See appendix B.) He was employed by COMAIR, Inc. September 30, 1979. During the 24 hrs before the accident, he had been on duty 7 hrs, 3.5 hours of which was in flight. His rest period was 13.5 hrs.

1.6 Aircraft Information

The Piper PA31-310 Navajo, N6642L, was issued a standard airworthiness certificate November 7, 1969. A certificate of registration for N6642L was issued to COMAIR, Inc., on January 12, 1978. The seven-passenger aircraft was powered by two AVCO Lycoming turbocharged engines (T10-540-A2B), each rated at 310 hp at takeoff.

According to the weight and balance/passenger manifest form, the captain computed Flight 444's weight and balance as follows:

Basic aircraft weight (obtained from visual plotter)	4,382 lbs
Pilot	175
7 passengers at 170 lbs each	1,190
11 bags at 23.5 lbs each	258.5
Zero fuel weight	6,005.5 lbs
Fuel on board (75 gals. of 100/130 octane)	444.5
	6,450.0 lbs
Center of Gravity	136 in.

Review of the aircraft logs disclosed that the aircraft's basic weight entered on the visual plotter was in error by 18 lbs. Also, the basic weight did not include 45 lbs of usable engine oil.

The fuel figure did not include fuel in the outboard tanks. Six gallons of fuel were drained from the right outboard tank after the accident.

The following is an accurate weight and balance calculation made by Safety Board investigators using actual weights and current information from the aircraft logs:

Basic aircraft weight	4,319.1 lbs
Oil (6 gallons)	45
Pilot	153
7 passengers	1,458
Forward compartment baggage	159
Rearward compartment baggage	48
Miscellaneous station 187	9
Zero fuel weight	6,191.1 lbs
Fuel - inboard tanks	432
Fuel - outboard tanks*	72
	6,695.1 lbs
Center of gravity	138.7 in.

* Note - It was assumed that the left outboard tank also contained 6 gals.

The Piper Navajo Flight Manual Handbook, p. 4, Report No. 1362, 1-12-67, illustrates that PA31 model aircraft have a maximum authorized takeoff gross weight of 6,500 pounds and a maximum authorized landing weight of 6,200 pounds. At the maximum authorized takeoff gross weight, the forward and rearward center of gravity limits are 134.0 inches and 138 inches.

The aircraft's flight log for October 8 disclosed that it was released for flight with no significant mechanical discrepancies.

The aircraft fuel tanks did not contain baffles to prevent fuel unporting during certain aircraft maneuvers, nor were they required. However, a placard was placed on the instrument panel in front of the pilot to warn him of the potential for unporting as recommended by Piper Aircraft Service Bulletin No. 456A, issued May 28, 1975. The placard read as follows:

> WARNING--Uncoordinated maneuvers, including side slips of 30 seconds or more--for any reason--and fast taxi turns just prior to takeoff, can cause loss of power if fuel tanks in use are less than three-fourth full.

The total unusable fuel in the aircraft is about 2 gals.

1.6.1 Aircraft Performance

Flight 444's takeoff performance was based on the aircraft flight manual and the existing conditions: takeoff weight--6,500 lbs; density altitude--900 ft msl; headwind--8 kns; temperature--12° C; and flaps--15°. Calculations show that 1,720 ft would be required to takeoff and climb over a 50-ft obstacle. The ground roll distance to liftoff is not required to be published in the aircraft flight manual. However, the Safety Board calculated the roll to be 1,100 ft, 400 ft to 900 ft less than Flight 444's ground roll.

The aircraft flight manual takeoff rotation speed and minimum control speed (V_{mc}) is 85 mph indicated airspeed (IAS). The distance required to

accelerate to 85 mph IAS and then come to a complete stop is 1,600 ft, 17 percent of the available 9,500-ft runway.

Based on information from the aircraft manufacturer, the time to consume the fuel in the line from the right main tank to the engine would be 12 to 13 seconds at 100 percent and 92 percent power levels, respectively. Assuming uniform acceleration from starting speeds of 0, 10, and 20 mph, the elapsed time to reach a liftoff speed of 85 mph would require 13 to 22 seconds and would occur between 1,500 ft and 2,000 ft from the starting point.

The two-engine climb capability with landing gear up, flaps at 15°, a gross weight of 6,500 lbs, and an airspeed of 120 mph IAS is 1,100 fpm. This performance generates a flightpath angle of 5.2°, or a 275-ft altitude gain from liftoff to the point where Flight 444 reached only 150 ft above the ground--about 3,000 to 3,500 from the departure end of runway 18.

At 110 mph IAS, which is the best single-engine rate of climb speed (Vyse), with the landing gear and flaps up, with the critical engine's propeller feathered, and with full throttle on the operating engine, the single-engine climb performance is reduced to 240 fpm, a loss of 78 percent of the two-engine climb performance. This degraded climb performance produces a flightpath angle of 1.2°, or an altitude gain of 60 ft in 3,000 ft. The angle from the point where Flight 444 lifted off to 150 ft a.g.l. at 3,000 ft was computed to be 2.9°.

The landing distance from 50 ft with 40° of flaps was 1,900 ft, as indicated by the aircraft flight manual. The additional 100 ft of altitude gained during the aircraft's takeoff would require an additional 1,900 ft of landing distance, based on a 3° flightpath angle; the total landing distance required after a climb to 150 ft is 3,800 ft. Adding this distance to the estimated 5,000 ft from liftoff to the maximum altitude reached by Flight 444 shows a 700-ft stopping margin on the 9,500-ft runway.

The aircraft flight manual indicates that the Vmc at 15° flaps is 85 mph IAS, 25 mph below Vyse. According to 14 CFR 23.149, Vmc is predicated on takeoff flaps, retracted landing gear, maximum available horsepower on the operating engine, propeller of the inoperative engine windmilling at takeoff power, and a bank angle of zero to 5° into the operating engine. The manual does not specify if Vmc is based on a wings-level attitude or a 5° bank; however, the manufacturer reported that Vmc was based on the 5° bank.

The stall speeds specified in the manual apply to a power-off, full-flap, and landing-gear extended condition at 6,500 lbs. Under these conditions, the stall speed is 71 mph IAS. Power-on stall speed data are not required to be published. Power-on, however, would reduce the stall speed. According to the manual, a 20° bank would increase the stall speed by about 4 mph.

The aircraft manufacturer's certification performance data show that with the right engine propeller windmilling and the landing gear and flaps extended,

the aircraft required 100 ft of altitude at 6,000 ft msl to recover from a stall. Up to 400 ft of altitude at 12,500 ft msl was required with both engines operating to recover from a stall. In both cases, the aircraft rolled 10 to 20° and yawed 10 to 15° during the stall. Also in both cases, 12° of nosedown pitch was required to recover. Because the altitude loss exceeded 100 ft, FAA required the manual to contain the following statement:

> "Note--At rearward c.g., gross weight, power off, gear and flaps retracted the maximum altitude lost during a stall is 400 ft."

1.7 Meteorological Information

The surface weather observation at the airport, taken by the National Weather Service at 1017 was: measured ceiling--7,500 ft broken; visibility--15 mi; temperature--53° F; dewpoint--42° F; wind--190° at 8 kns; altimeter setting--29.96 inHg.

1.8 Aids to Navigation

Not applicable.

1.9 Communication

There was no evidence of communications difficulties.

1.10 Aerodrome Information

The Greater Cincinnati Airport, elevation of 890 ft msl, is equipped with one north-south runway and two parallel east-west runways. (See figure 2.) Runway 18 is asphalt covered and is 150 ft wide and 9,500 ft long. There are no obstructions to runway 18.

1.11 Flight Recorders

Flight recorders were not installed nor were they required by regulation.

1.12 Wreckage and Impact Information

The aircraft hit on slightly downsloping ground, in open terrain, and in a near vertical nosedown altitude, 1,188 ft west of runway 18. It came to rest on a heading of 076° magnetic after bouncing rearward about 10 ft. The fuselage was demolished from the nose to an area behind the main spar of the wings, where the fuselage buckled downward. The wings remained attached to the fuselage, and the right wing was relatively undamaged. The leading edge of the left wing, from the engine nacelle to the wingtip, was crushed against the main spar. Both ailerons and flaps remained attached to the wings. The vertical stabilizer, rudder, and left horizontal stabilizer remained attached to the fuselage and were intact. The right horizontal stabilizer remained attached, but was bent and curled upward.

The landing gear was extended and locked, and the wing flaps were extended 26°. The aileron and elevator trim were set in the neutral position. The rudder trim jackscrew was positioned to nearly full left rudder trim. Examination of the flight control system disclosed no evidence of a preimpact failure or malfunction.

The throttle quadrant was damaged, and engine controls were loose and in various positions. The mixture and throttle control linkages for the right engine were in the closed position at the fuel injector servo unit. The throttle and mixture control linkages for the left engine were found in intermediate positions at the fuel injector servo unit. The operating arms on the right and left engine propeller governors were in the feathered position. The left engine fuel boost pump switch was ON, and the right engine boost pump switch was OFF. The left engine's left magneto switch was broken and its right magneto switch was ON. The right engine's left magneto switch was ON, and the right magneto switch was broken.

The fuel selector handles were positioned in the main tank detents. The fuel crossfeed valve was closed, and the emergency shutoff valves were open. Inspection of the nonbaffled, bladder-type fuel tanks disclosed that all, except for the right auxiliary tank, were ruptured as a result of the crash. However, 2.5 gals of trapped fuel were drained from the right main tank, and about 6 gals were drained from the right auxillary tank. The fuel lines and the vent lines were not obstructed. The fuel filters were free of contamination. There was fuel in the filter bowls and some fuel in the lines; both fuel boost pumps contained fuel.

1.13 Medical and Pathological Information

Postmortem and toxicological examinations of the pilot disclosed no evidence of factors which would have detracted from his physical ability to operate the aircraft. The cause of his death was impact trauma.

Examinations of the passengers disclosed that all died as a result of impact trauma. The right front seat passenger was not a pilot. X-ray examination of his hands and feet disclosed no evidence that they were on the powerplant or flight controls at the time of the accident.

1.14 Fire

There was no fire.

1.15 Survival Aspects

The accident was not survivable because of the high impact angle and high deceleration forces. Control tower personnel alerted the fire station immediately after Flight 444 reported difficulty. The first rescue vehicle arrived on the scene 1 1/2 minutes after the accident. All of the occupants remained inside the aircraft. Rescue personnel removed two occupants who were alive but they died shortly thereafter.

Shoulder harnesses were not installed in the aircraft nor were they required to be installed. Seatbelts were installed and were used. The aft cabin seats' floor attachments failed.

1.16 Tests and Research

1.16.1 Powerplants

The engines from the accident aircraft were shipped to the AVCO Lycoming's facility at Williamsport, Pennsylvania, where the Safety Board's powerplants group examined them. Because of impact damage, the ignition harnesses, the Nos. 5 and 6 pushrods, and portions of the intake and exhaust pipes were replaced on both engines. The fuel injector servo, air induction housing, and waste gate valve and actuator assembly were replaced on the left engine. When operated in a test cell, both engines developed 36 inHg manifold pressure. With slight adjustments of the density controllers, both engines produced full-rated takeoff power of 38.5 inHg.

Examination of the propellers disclosed that the right propeller was in the feathered position and the pitch change fork and knobs were not damaged. The left propeller blades were about 56°, which is above the normal operating range. The pitch change fork and knobs were not damaged. Both propellers could be cycled through their full range, and the low-pitch latches engaged properly. Both propeller governors functioned satisfactorily during tests.

1.16.2 Wing Flap System

The wing flaps in the Piper Navajo are extended electrically with the aid of a three-position switch labeled, "UP, OFF, ON." The flap indicator, located in the lower right-hand portion of the instrument panel, is not graduated numerically. Instead, it is labelled UP, TAKEOFF RANGE (white arc), and DOWN. The white arc represents flap travel of 0° to 15°. Fifteen degrees is the required setting for takeoff. Maximum flap extension for landing is 40°.

Damage to the electrical wiring and to the area of the flap actuator shaft precluded a check of the rigging of the flaps. However, the flap position transmitter and the connecting linkages between the transmitter and the flap were not damaged.

The flap switch, located below the indicator, was broken. The switch does not contain detents for flap selection. The flap indicator front bezel was dented and the glass was displaced. This probably refers to the lack of response to input signals. The indicator swung freely and deflected full scale when the instrument was handled.

1.16.3 Fuel Samples

Samples of fuel drained from the aircraft's wing tanks and fuel lines, and from a truck used to fuel the aircraft, were tested at a U.S. Air Force fuel testing laboratory. These tests showed that the fuel met specifications and was not significantly contaminated.

1.16.4 Metallurgical Examination

Since a fractured exhaust pipe could cause a loss of power, fractures found on the exhaust pipes from the right engine were examined in the Safety Board's laboratory with a scanning electron microscope. The examination disclosed only typical overload failures.

1.17 Additional Information

1.17.1 Company Development and FAA Actions

COMAIR, Inc., headquartered at the Greater Cincinnati Airport, registered with the CAB under Part 298 on February 12, 1977, and was issued its air taxi certificate by the FAA General Aviation District Office (GADO) at Louisville, Kentucky, on March 21, 1977. COMAIR proposed to operate a single-pilot, scheduled passenger and on-demand passenger and cargo service with three aircraft in day and night VFR/IFR conditions.

From May 1977 to October 1979, COMAIR grew rapidly and underwent significant changes in management. Initially, the management structure consisted of a president/director of marketing; vice president; and director of flight operations/director of maintenance/treasurer. Because of the overburdening responsibilities of the director of operations and maintenance, those responsibilities were turned over to the vice president and the treasurer concerned himself solely with accounting and administrative tasks. After the first year of operation, the treasurer and the president resigned because of their concern that needed unscheduled maintenance was not being performed. The new president, who was an inactive commercial pilot with multiengine and instrument ratings and 2,000 hrs of pilot time, had no previous commuter airline or air taxi experience. He also owned and managed a nonaviation company. Since May 1977, there had been three different chief pilots, four different check airmen, and three directors of maintenance, and the director of flight operations and training had changed. The company developed its progressive aircraft inspection program in January 1978 which was approved by the GADO.

As a result of reduced service by two major air carriers to cities within COMAIR's area of operations, the company's schedule gradually increased from six nonstop daily flights to about 100 flights per day, 5 days a week. During this period, the number of pilots increased from 3 to 21 and the number of aircraft increased from 3 to 9. At the time of the accident, the company was operating only seven of its nine aircraft because two had been grounded for maintenance.

On January 4, 1979, COMAIR informed the GADO of its intent to operate under the new 14 CFR 135 regulations. The company applied for approval for its pilot training and maintenance programs and deviations from the new regulations regarding pilot experience requirements, and was granted extensions of its compliance dates. Because of a heavy workload at the GADO in recertificating 40 air taxi and two commuter operators within its jurisdiction, COMAIR was not issued its new certificate until August 1979.

COMAIR disagreed with the GADO over the interpretation of 14 CFR 135.179(a), inoperable instruments and equipment for multiengine aircraft. As a result, it requested clarification from FAA's Southern Region at Atlanta, Georgia. The company had previously requested approval of a minimum equipment list (MEL) for its aircraft and was concerned about dispatching aircraft with inoperable equipment. At the time of the accident, a response to its request had not yet been received. In the interim, the company was required to insure that all equipment installed in the aircraft when it was certificated was in operation on every flight.

On August 28, 1979, the company informed the GADO that its chief pilot would be assuming the duties of director of flight operations and training. It also requested that the chief pilot be authorized to act as a check airman, because the company anticipated having 18 captains and 18 first officers by January 1980. According to the director of flight operations, when the captain of the accident aircraft was hired on September 30, the company had more routes to fly than pilots to fly them. He stated that the company was losing one captain every 5 or 6 weeks; they were seeking employment with corporations or with major airlines.

FAA surveillance of COMAIR's operation disclosed that pilot records were incomplete, that at least one pilot did not have in his possession the required airman certificates, and that another pilot had exceeded his flight and duty time limitations. For these reasons and others, on September 13, 1979, the GADO chief requested that the Southern Region's situation monitor team investigate COMAIR's "system worthiness."

On October 10, 1979, as a result of the GADO's prior request, the Southern Region's situation monitor team began a 9-day special evaluation to determine COMAIR's compliance with applicable Federal regulations and to determine the effectiveness of its approved procedures and programs under the new 14 CFR 135. In the area of operations, COMAIR was found to be in violation of regulations governing flight duty time, recordkeeping, weight and balance computations, check airman qualifications, and flight training. In an interview with the six pilots hired before the captain of the accident aircraft but after recertification under the new 14 CFR 135, the monitor team found that these pilots had not received the training outlined in the company's approved training curriculum. None of the pilots had been trained in a simulated engine failure on takeoff or at altitude, and some were not trained to recognize approaches to stalls, as required. Also, the company's training records for these pilots showed that each was credited with more training than was recorded in his personal logbook. The evaluation showed that the company's check airman, though still only licensed as a commercial pilot, was giving check rides to airline transport pilots (ATP) following recertification. The check airman did not check for proficiency in single-engine emergencies on takeoff during check rides. FAA found that the consolidation of the director of flight operations, director of training, and chief pilot duties ". . . resulted in poor recordkeeping and lack of proper supervision. This caused airmen to exceed flight duty time and rest periods, and allowed manifests to be filled out improperly."

Although in the GADO's previous inspections, COMAIR's maintenance procedures had been found satisfactory, the situation monitor team found that the company was not in compliance with its operations manual and material covering

weight and balance, status of and compliance with airworthiness directives, designation of responsibility for airworthiness, maintenance record entries, reporting mechanical irregularities, and approved aircraft inspection program.

As a result of the team's investigation, FAA developed a letter of agreement delineating corrective action to be taken by COMAIR to insure an adequate level of safety; the FAA also instituted enforcement investigative reports.

1.17.2 Pilot Training and Experience

The captain flew for two other operators before his employment with COMAIR. One operator reported that the captain was primarily a single-engine flight instructor who had flown no more than 20 hrs of charter flying in a Cessna 337 (centerline thrust, twin engine). The other operator, a commuter airline using Piper Aztecs, had employed the captain from July 16, 1979, to September 1, 1979. On his resume, the captain listed 62 hrs of total multiengine time. He listed about 24 hrs of flight training in the Piper Aztec, during which he demonstrated his proficiency in single-engine emergency procedures on five flights; his performance was satisfactory. He also had flown about 10 hrs of crosscountry training flights in the Piper Navajo, which involved primarily IFR en route and approach procedures. No single-engine emergency procedures were practiced in the Navajo. All flight training was conducted with the captain flying from the left seat; none of the training was conducted at or near the maximum certificated gross weight of either the Aztec or the Navajo.

From August 14 to August 31, 1979, the captain accumulated about 29 hrs as pilot-in-command of a Piper Aztec in single-pilot commuter flying. On August 21, he obtained a 14 CFR 135 6-month instrument check and an ATP rating from another GADO during a 2-hr flight in an Aztec.

At the time of the captain's employment with COMAIR, he reported on his resume a total of 205 hrs of multiengine time. However, only a total of 93 hrs of multiengine time could be substantiated by FAA and previous employment records. This flight-time consisted of 63 hrs of pilot-in-command experience in conventional multiengine aircraft, 34 hrs of which were obtained either during training or flight checks. According to the pilot's second logbook, up until the day of the accident he had recorded a total flight-time of about 2,820 hrs, 214 hrs of which were in multiengine aircraft. COMAIR personnel did not perform a thorough reference check to verify his previous flight-time and experience.

The captain's certificate of ground training was signed on September 30, 1979, by COMAIR's director of flight operations/training. The document certified that the captain had received 20 hrs of instruction on such subjects as the company's operations manual and the aircraft systems; ground training was required by regulations before he could serve as pilot-in-command. The reverse side of the certification form showed that the training was conducted from October 1 to October 3. Although there were spaces for the captain's initials and signature attesting to the training he received, these spaces were blank. Additionally, other company records showed that the captain received 1.5 hrs of flight training from the director of flight operations/training on September 30 and was

assigned as a pilot-in-command in the Navajo the following day. No record of this training was recorded in the captain's logbook. The first flight recorded in his logbook for COMAIR was flown on October 2.

The director of flight operations stated that during the 1.5-hr training flight, steep turns, stalls, and Vmc were demonstrated at altitude to the captain, in addition to an instrument approach to the Greater Cincinnati Airport. The director of flight operations also stated that the captain was cautioned against making fast taxi turns just before takeoff and was shown how to position accurately the flaps for takeoff and how to use takeoff and climb speeds of 90 mph and 110 mph, respectively. He also stated that he instructed the captain in single-engine maneuvers in all configurations at an altitude of about 5,000 ft. Moreover, he stated that the captain was given a simulated engine failure in the takeoff configuration and that the captain was surprised by the aircraft's poor single-engine climb performance of 50 to 70 fpm. He further stated that he told the captain, "if your engine quits at low altitude, land straight ahead as the Navajo will not climb on one engine." He believed the captain was "very smooth and coordinated" reacting to the simulated emergencies with a "very professional approach." None of the flight training given to the captain was conducted at or near the Navajo's maximum certificated gross weight, nor was it required by regulation.

COMAIR's records indicated that the check airman gave the captain a 14 CFR 135 recurrent check on October 1 and a routes and airports check on October 2. According to the check airman, power-off stalls, steep turns, and a simulated engine failure in cruise configuration at altitude were given to the captain during the recurrent check; he "flew the airplane smoothly and precisely." The check airman stated that he cautioned the pilot on the inaccuracy of the Navajo's flap indicator and showed him how to check for the correct takeoff setting with aileron deflection (Piper Aircraft recommends this procedure for the Navajo). He said that he informed the captain that a rotation speed of 100 mph was safer than 85 mph, since it reduces the amount of time that the aircraft was in the air below Vyse. The check airman also stated that he flew with the captain for 17 hrs as a copilot during passenger flights on October 2, 3, and 4. The director of flight operations stated that he believed this observation of the captain's line flying would provide solid his command experience, compensating for the fact he did not meet the insurance carrier's requirements of 500 hrs total multiengine time.

The 14 CFR 135 recurrent check given on October 1 was not required by regulation, because the captain had received a similar check in the Aztec on August 21 while with his previous employer. The routes and airports check was required; however, on October 1, the check airman was no longer authorized to act in that capacity or as a pilot-in-command because his 6-month instrument check had expired on September 30. According to the check airman, the captain of the accident aircraft had taken his place as a line captain because the check airman's instrument check had expired. Even though the FAA had given the check airman until December 1, 1979, to obtain his ATP, he was not authorized to conduct flight checks in accordance with 14 CFR 135.33 since an ATP-rated pilot must demonstrate more skills in the performance of his duties.

According to FAA Operations Bulletin No. 76-3, revised March 18, 1977, the Piper Aztec is classified in the same "group" of small multiengine aircraft as the Piper Navajo for flight check purposes. Therefore, the flight check the captain received in the Aztec on August 21, fulfilled the requirement for a complete checkout in the Navajo. On April 20, 1979, the GADO informed all air taxi operators that "In an effort to conserve fuel, reduce the workload on field personnel and furnish some economic relief to industry, selected models of manufacturer's light multiengine airplanes have been grouped according to means of propulsion. A flight check in any one would suffice for any other in the same group. It has been determined that safety will not be derogated by reducing the number of light multiengine airplanes in which flight checks are required so long as pilots demonstrate their abilities in airplanes, separately, having a different means of propulsion, and in airplanes of different makes or conversions to those makes, if, in the opinion of the principal operations inspector, the conversion results in no significant changes in handling or flight characteristics."

1.17.3 Emergency Procedures

According to the Navajo flight manual, "If engine failure occurs when airspeed is at or greater than 95 mph, the pilot must decide whether to abort the takeoff or attempt a single engine takeoff. His decision should be based on his judgment considering the runway remaining, density altitude, loading, obstructions, weather and his own capability." It also states that, if sufficient runway remains, the pilot should immediately cut the power and stop straight ahead. However, if there is not sufficient runway on which to stop and a sufficient margin above Vmc (about 10 mph) is not yet attained, the pilot must secure the engines, close all the fuel valves, and prepare for a forced landing. If the pilot decides to continue the takeoff, the engine failure procedure requires that engine controls be positioned at takeoff power; that the landing gear and wing flaps be retracted; that the boost pumps be turned on; that the inoperative engine be identified; and that the propeller feathering procedure be excuted.

Unlike the Navajo, the engine failure procedures for the Piper Aztec require, in order, identification of the inoperative engine, execution of the propeller feathering procedure, and then retraction of the landing gear and flaps.

1.17.4 Maintenance

To insure that the AVCO Lycoming TIO-540-A2B engines develop rated takeoff power, the density controller must be inspected and adjusted periodically. The density controller regulates bleed oil at full throttle only to position the waste gate valve, which controls the amount of exhaust gas fed to the turbocharger. The aircraft service manual requires the use of special tools to make the adjustment. These tools are a thermocouple and a potentiometer, which permit measurement of the turbocharger compressor discharge temperature. This value and the value of manifold pressure are compared against a power setting chart. Because ambient temperature changes will vary above and below standard temperature (59° F or 15° C) at sea level conditions, the manifold pressure gage reading in the cockpit will also vary. The manifold pressure reading on a standard day should be 38.5 inHg, and with atmospheric changes, it may read below 38.5 inHg or as high as 43 inHg, which is the maximum limit. Therefore, a chart must be used to account for

atmospheric temperature changes to insure that full-rated takeoff power is developed under all conditions.

On February 7, 1975, AVCO Lycoming published Service Instruction No. 1187D, regarding "Turbocharger Density Controller Adjustment." The instruction recommended that adjustment of the controller be accomplished every 100 hrs at the owner's discretion. Also, to further assist maintenance personnel and pilots, on December 15, 1978, AVCO Lycoming published Service Instruction No. 1257C to reiterate the operating features of the turbocharged engine.

During the Safety Board's investigation, COMAIR's director of maintenance reported that full-rated takeoff power was set using only the manifold pressure gage as a reference. He stated that each aircraft was accumulating about 50 flight-hrs per week, which resulted in frequent adjustments of the density controller to set full-rated power. He said that it was necessary to check manifold pressure settings every day, and that the manifold pressures of the accident aircraft were last checked 3 or 4 days before the accident.

Review of COMAIR's aircraft records disclosed no recent discrepancies on the right engine which might have related to a potential engine malfunction. The review also showed that the company's recordkeeping system did not permit the tracing of engine maintenance or components. No files were maintained on individual serialized components nor were files kept on individual engines. There were no service tags available with which to trace the status of a part. The company did not have a work order system until the week before the accident. Consequently, previous maintenance actions could not be related to specific discrepancies.

There was no deferred maintenance discrepancy list kept on board the aircraft, as required by the company's operations manual. An "in-flight worksheet" was used by the company pilots to keep a running list of all discrepancies. Maintenance personnel did not keep an accurate record of repairs, which made it difficult to determine which items, deferred or otherwise, had been corrected.

A review of an "in-flight worksheet" for the accident aircraft showed that on September 25, 1979, the pilot's airspeed indicator was reported to be indicating 5 kns faster than the copilot's. Although maintenance to correct the discrepancy was deferred, it was later determined that the copilots' indicator was in error, not the pilot's. There was no explanation in the records to explain how the check was determined to be accurate.

The director of maintenance was responsible for the supervision of 14 mechanics and was the only authorized inspector. In addition to performing maintenance tasks, he was also responsible for recording most of the maintenance actions.

1.18 New Investigation Techniques

None.

2. ANALYSIS

2.1 The Accident

The captain held the proper airman certificates and was qualified in accordance with Federal regulations. Postmortem examination disclosed no evidence of factors which would have detracted from his piloting ability. He had received an adequate rest period prior to reporting for duty.

The aircraft was certificated, equipped, and maintained in accordance with an FAA-approved aircraft inspection program. The company had no record of recent discrepancies which could be related to an engine malfunction. During its examination of the wreckage, the Safety Board found no physical evidence of a preimpact failure or malfunction of the airframe, powerplant, flight controls, or related components, which could have caused or contributed to the accident. Investigators considered the possibility of obstructions to induction airflow and fuel flow, but found no evidence to support the possibility. Fuel samples taken were free of contaminants. However, witness statements concerning the aircraft's takeoff, the pilot's report of engine difficulty, and the physical evidence of the feathered right engine propeller indicate a power loss on the right engine.

The Safety Board theorized that fuel in the main wing tanks could have unported during a fast taxi turn or rolling takeoff. Seventy-two gallons of usable fuel was on board Flight 444, an amount close to the range specified by Piper to be susceptible to unporting during a fast taxi turn or rolling takeoff. The captain informed the control tower that he was ready for takeoff 1 minute 54 seconds after he called for clearance at the gate. He was probably in a hurry because the flight was about 20 minutes late, and there was no inbound or outbound traffic to delay departure. Also, the Delta captain saw the aircraft turn left onto the runway and immediately begin its takeoff roll. These facts suggest that the pilot may have made a rolling takeoff which could have been conducive to unporting of fuel to the right engine. However, calculations show that it would have taken only about 12 seconds to exhaust the fuel in the line from the right main tank to the engine before power would have been lost completely. Had fuel unported during the takeoff roll, power would have been lost before the point at which Flight 444 lifted off and the pilot probably would have aborted. After discounting these possibilities, the Safety Board was unable to determine the cause of the loss of power.

Although the Safety Board could not determine the reason for the power loss, it believes that the loss of power should not have resulted in an accident. For this reason, the Board evaluated the aircraft's takeoff profile under the conditions that existed at the time of the accident.

The longer-than-normal takeoff roll can be attributed to (1) an over-gross weight condition, which will increase rolling friction; (2) improper flap setting and pilot technique; (3) lower-than-maximum horsepower because of limited manifold pressure (25-hp loss per engine); (4) or engine malfunction. The Safety Board attempted to evaluate these conditions and their interrelationships with respect to the aircraft's takeoff profile and other evidence gathered during the investigation. The evaluation was limited because of the unavailability of certain

aircraft performance information related to this accident, from either a flight recorder or from a review of the manufacturer's certification flight test data. Neither a flight recorder nor the preservation of certification flight test data are required by regulation.

Flight 444 was 195 lbs over its maximum certificated gross weight when dispatched. Although investigators found a 63-lb error in the aircraft's basic operating weight, the captain's weight and balance calculations using standard weights were otherwise correct. His calculations indicated that the aircraft was within weight and balance limits. However, FAA recommends that actual weights be used when the passenger group is larger or smaller than the standard weight. Since the passengers on board Flight 444 were large males, the captain should have evaluated the group carefully before completing his weight and balance calculations. The Safety Board believes that because the flight was 20 minutes late, the captain overlooked the fact that the group was above the standard weight. The additional 195 lbs would have degraded the single-engine climb performance but would have increased the normal takeoff distance only 170 ft.

The flap indicator is located in the lower right-hand portion of the instrument panel and is not graduated numerically. The flap switch does not contain a detent for the takeoff flap setting (15°). Since the captain was hurried in his predeparture activities, he could have easily positioned the flaps incorrectly and failed to check them against aileron deflection. With flaps set at 26°, takeoff roll would have been extended and the climb performance would have been degraded. The control feel of the aircraft also would have been affected seconds before and at liftoff. The increased flap setting would have primarily increased drag and would have caused a slight nosedown pitching moment. These would have been counteracted by the aft center of gravity and the neutral elevator trim setting, which would have caused a noseup pitching moment and light noseup control yoke pressures. These conditions would have produced a tendency for the airplane to pitch up during the takeoff roll, which could explain the abrupt liftoff. The pilot would have compensated with forward control yoke pressure and thereby regained acceleration. The pilot may have attempted to accelerate the aircraft to Vyse in ground effect before initiating a climb. This possibility is given credence by the Delta captain's observation that the pilot leveled the aircraft before beginning a climb.

At a constant temperature, a reduction in manifold pressure from 38.5 to 36 inHg reduces the available horsepower by 8 percent. This reduction increases the ground roll. It is not known, however, whether the readjustment of the density controller with the aid of only the manifold pressure gage provided more or less power than rated takeoff power at the time of the accident because the compressor discharge temperature at the time of readjustment could not be determined.

A substantial loss of power would have adversely affected the takeoff performance of the aircraft. During the takeoff roll, no yawing or directional control problems were observed which could have been the result of a substantial power loss. Calculations showed that the aircraft exceeded the single-engine climb angle of 1.2°. An estimated 22 seconds were required for the aircraft to climb to 150 ft. This time interval produces an average rate of climb of 410 fpm. This rate

of climb with only a single engine operative while in the landing configuration indicates that the right engine was developing at least intermittent horsepower. However, the speed of the aircraft at liftoff is not known, and therefore, the Safety Board cannot conclude with certainty that the altitude gained was due only to partial right engine thrust after liftoff. The initial yaw to the right at liftoff and then to the left suggests that substantial power, but not all power, was lost at or after liftoff--the most critical phase of flight for an engine malfunction. A flight recorder would have provided definitive information as to when the loss of power occurrred during the takeoff.

The Safety Board believes that the loss of power at liftoff probably distracted the captain, and as a result, he did not raise the landing gear and flaps or immediately secure the right engine. His failure to take these actions was critical to a continued positive rate of climb in the event of a complete power loss in one engine and to the prevention of a rapid decrease in airspeed. Additionally, the 100 ft of altitude available to the pilot above the normal 50-ft landing clearance set forth in the aircraft flight manual provided enough margin for the execution of a survivable landing on the runway. The Safety Board believes that the captain became preoccupied with an engine malfunction. As a result, he ignored outside visual references and failed to establish a pitch attitude which would have allowed him to maintain an airspeed at or above the Vmc of 85 mph IAS. This resulted in a deceleration below Vmc and loss of directional control, as observed by witnesses when the aircraft rolled to the right to an inverted position and dived to the ground. Once control was lost, 150 ft of altitude was not sufficient to regain control and recover.

Based on the evidence, the Safety Board concludes that the captain responded inappropriately to the emergency. His actions may have been influenced by his inexperience in twin-engine aircraft and his inexperience and lack of thorough training in the Navajo, particularly its single-engine performance at maximum takeoff gross weight. There are distinct differences between the Navajo and the Aztec, the aircraft with which the captain was more familiar and better trained. First, the Navajo was the largest passenger-carrying aircraft the captain had flown as the sole pilot-in-command. Physical characteristics, such as the extended nose baggage compartment and the location of instruments, switches, and controls, are markedly different from those of the Aztec. The extended nose baggage compartment can give a markedly different perception of the runway from the cockpit. Depending on the pilot's vertical seat position and the aircraft's attitude, it might appear to a pilot that there is less runway available than is actually the case. Second, the maximum certificated gross weight of the Navajo is 1,300 lbs heavier than that of the Aztec. Third, the sequence for executing the single-engine emergency procedures in the Navajo is the reverse of the sequence for the Aztec. In the Navajo, the landing gear and flaps are to be raised first; in the Aztec, the engine is to be secured first. Fourth, there is a 5-mph IAS difference between Vmc speeds for two aircraft. If the pilot's airspeed indicator was reading 5 kns faster as initially reported, the captain could have flown the aircraft 5 kns below recommended airspeeds. It should be noted that COMAIR provided an inconclusive answer concerning verification of a previously reported 5-mph error in the pilot's airspeed indicator.

The Safety Board believes that the captain was not adequately prepared to assume the responsibilities as captain in the Navajo. When the captain was hired by COMAIR, the company was having difficulty maintaining a scheduled service, partially because of rapid growth and a shortage of pilots brought about by a high pilot-attrition rate. As a result, it may have hired a pilot of lesser experience and may have qualified him sooner than it would otherwise have done under more favorable circumstances. The fact that the captain was taking the check airman's place as a line captain indicates there was an immediate need to qualify the pilot as a captain. COMAIR hired the captain knowing that he did not meet its minimum insurance policy requirement of 500 hrs of multiengine time. It also did not conduct a thorough reference check of his previous employment.

FAA's situation monitor team found that the consolidation of the director of flight operations, director of training, and chief pilot duties a month before the captain was hired ". . .resulted in poor recordkeeping and lack of proper supervision." FAA also learned that the six pilots hired since recertification had not been given training in simulated engine failure emergencies on takeoff or at altitude, and some had not been trained for imminent stalls, as required by the company's training program. Additionally, these pilots' company training records showed that each was given more flight training than he had recorded in his personal logbook.

The Safety Board has no reason to believe there was any difference between the training received by the six pilots and that which was reportedly received by the captain involved in the accident. Although the captain seems to have kept a careful record of his flight-time, his logbook did not show the 1.5-hr training flight on September 30, which was contained in his company record. The Safety Board questions the credibility of the statements by company officials regarding the captain's training program, especially in view of discrepancies in the captain's ground training certificate. The check airman could have given the captain some training in single-engine emergency procedures during his routes and airports check on October 2, and on subsequent flights the next 2 days. However, the check airman was not ATP-qualified, as required by regulation, and this training and observation took place during passenger flights. Therefore, the Safety Board believes that the single-engine training probably was never accomplished.

2.2 The Company's Role

COMAIR's management was inexperienced, and the company's structure had undergone significant change after its first year of operation. The company had grown and expanded to a point where management was ineffective in correcting unsafe trends. When the captain was employed, COMAIR had recently been recertificated under new 14 CFR 135. The time frame within which recertification of all air taxis was required to be completed placed a difficult burden on COMAIR and on the GADO as well. The burden undoubtedly detracted from management's supervision of its daily operation.

COMAIR's management's lack of experience in commuter airline operations led to safety deficiencies during the expansion. Some deficiencies which accompanied the rapid, uncontrolled growth were frequent changes in management positions, failure to adhere to planned training procedures, unkept or

inadequate pilot training records, a high pilot-attrition rate, and pilot over-scheduling. These conditions partially resulted from an overburdening of the director of flight operations, who was responsible to insure that the captain was thoroughly competent to fly the Navajo as pilot-in-command.

The Safety Board recognizes that when the captain was hired by COMAIR, there were no 14 CFR 135 requirements for a minimum amount of multiengine experience or training in a particular make and model aircraft, above those required to obtain such a rating. Since this regulation only prescribes general guidelines and minimum safety standards in the area of pilot training, it did provide commercial operators the necessary flexibility to establish training programs suited to the peculiarities of each of its operations. Although FAA's aircraft grouping concept permitted COMAIR to qualify the captain in the Navajo without a flight check in that aircraft, it did not obviate the need for the operator to provide the pilot with additional training. Since the company knew that the captain did not meet its minimum multiengine insurance requirement of 500 hrs, COMAIR should have thoroughly checked his previous experience. Even without the reference check, three flights, totaling 17 hrs, could not reasonably be considered to have provided the equivalent of the knowledge and experience of nearly 300 hrs of multiengine time--the difference between the captain's purported total multiengine time at the time of his employment and the 500-hr insurance minimum.

The Safety Board believes that COMAIR emphasized maintaining its current commuter schedule over its need for thoroughly trained and experienced pilots. It is doubtful that the director of flight operations received the kind of guidance and support necessary to meet this need. Management's lack of expertise and the lack of stringent regulations regarding pilot qualifications and training resulted in the captain's being hired with limited multiengine experience and being inadequately trained to cope with the emergency.

Commuter accident investigation experience has shown consistently that some operators have not exercised prudent judgment in matters of pilot training. In some cases, operators have not had the expertise nor the desire to meet the intent of the regulations. The potential hazards associated with the use of some aircraft with relatively low single-engine performance and weight and balance margins, particularly in single-pilot operations, demonstrate the essential need for improved pilot training regulatory requirements to achieve a higher level of safety. For these reasons and others, in 1972, the Safety Board recommended 2/ that the FAA establish a separate regulation for commuter airline operators. This recommendation preceded several others made by the Safety Board to provide additional safety for the public.

2.3 The FAA's Role

The rapid expansion of COMAIR and problems associated with its growth were monitored by the Louisville GADO. The GADO was aware of some deficiencies and had instituted some corrective actions. Surveillance, however, was conducted on a part-time basis, because the two inspectors assigned to

2/ "Air Taxi Special Study," NTSB-AAS-72-9, Recommendation A-72-171.

COMAIR were also responsible for many of the 40 air taxi operators within the GADO's jurisdiction. While the surveillance directed toward COMAIR was frequent and conscientious, it nevertheless failed to correct unsafe trends.

Many unsafe trends and deficiencies experienced by COMAIR originated from its inexperienced managers. It was not until the situation monitor team performed its inspection that the extent of the deficiencies become known. It should have been evident to the principal maintenance inspector that COMAIR's maintenance department did not have the essential procedures, personnel, and experience to support a safe flight operation. The company's maintenance recordkeeping system did not permit traceability of engines or components. There were no files maintained on individual serialized components nor were files kept on individual engines. This situation hampered the Safety Board's investigation into a possible malfunction of a component which could have caused or contributed to a power loss. This lack of an effective recordkeeping system may also have contributed to degrading the company's ability to effectively troubleshoot and repair maintenance discrepancies.

Accident investigation experience has shown that because of the small margins in single-engine climb performance of light twin-engine aircraft, there is a need for thorough training in these aircraft which must include single-engine flight at maximum certificated gross weight. On October 17, 1979, in a recommendation to the FAA, the Safety Board cited several recent accidents 3/ which involved aircraft that were either at or beyond their maximum certificated gross weights and/or beyond their c.g. envelopes. In each of these cases, the pilot was confronted with an emergency situation which was compounded by unfavorable weight and balance conditions. The Board recommended to the Administrator that pilots involved in 14 CFR 135 operations be thoroughly trained in the marginal performance capabilites and handling qualities of a light twin-engine aircraft when loaded to its maximum certificated gross weight and/or to the limits of its c.g. envelope.

Previous investigations have disclosed that the use of standard weights is a recurring problem, since it does not provide an adequate margin against inadvertent overloading of small multiengine aircraft used in commuter operations. The Safety Board recognizes the FAA's recent attempts to correct this problem with its Notice N8000.183 of October 23, 1979. The Notice instructs GADO principal maintenance inspectors to rescind authorizations for using standard weights by operators of nine-passenger aircraft.

Although the Safety Board recognizes the merit of grouping for purposes of flight checks (primarily by means of propulsion), the practice may not produce the high level of safety needed in commuter operations. Differences in

3/ Aircraft Accident Report: Columbia Pacific Airlines, Beech 99, Richland, Washington, February 10, 1978 (NTSB-AAR-78-15); Aircraft Accident Report: Antilles Air Boats, G-21A, St. Thomas, Virgin Islands, April 5, 1978 (NTSB-AAR-79-9); Aircraft Accident Report: Rocky Mountain Airways, DHC-6, Cheyenne, Wyoming, February 27, 1979 (NTSB-AAR-79-10); and Aircraft Accident Report: Universal Airways, Inc., Beech Model 70 Excalibur, Gulfport, Mississippi, March 1979 (NTSB-AAR-79-16).

instrumentation, control positions, and cockpit layout; physical differences in airframe construction; and particularly differences in emergency procedures can become significant in an emergency. These differences existed between the Aztec and the Navajo; yet, these aircrafts were considered to be within the same group and COMAIR, therefore, was not required to qualify its pilots separately in both aircraft. The Safety Board believes that, for these reasons, the FAA should reevaluate the grouping concept. The Safety Board is encouraged by FAA's recent actions to establish a minimum make and model multiengine experience requirement. This new requirement could negate the need for reevaluating the aircraft grouping concept.

The accident illustrates the need for greater emphasis in initial commuter certification. The findings and actions taken as a result of the FAA's situation monitor team confirm this need.

Considering the popularity and utility of the light twin-engine airplane, these aircraft will probably be used extensively in air taxi and commuter type operations for some time to come. On the basis of its substantial accident investigation experience and its special study of light-twin aircraft, 4/ the Safety Board remains concerned about the vulnerability of these aircraft to accidents resulting from a loss of control following an engine failure or malfunction. The Safety Board believes that thorough training and a substantial increase in the instructions of the single-engine climb performance would significantly reduce the number of accidents of this type.

3. CONCLUSIONS

3.1 Findings

1. The captain was currently certificated and qualified in accordance with Federal regulations. He was inexperienced in reciprocating multiengine aircraft.

2. The captain did not receive the ground and flight training needed to prepare him to cope with the emergency.

3. The aircraft was certificated and, in general, maintained according to regulations.

4. There was no physical evidence of a preimpact failure or malfunction of the aircraft or of its related components.

5. Flight 444 was behind schedule and was dispatched beyond weight and balance limits because approved standard weights were used to compute weight and balance and because inaccurate weight and balance information was contained in the aircraft's records.

4/ Special Study--"Light Twin-Engine Aircraft Accidents Following Engine Failures, 1972-1976" (NTSB-AAS-79-2).

6. Although the aircraft made a rolling takeoff conducive to fuel unporting, had fuel unported during the takeoff roll, power would have been lost before the point at which Flight 444 lifted off.

7. Although substantial power was lost at or following liftoff for undetermined reasons, sufficient runway was available to abort the takeoff safely.

8. The aircraft lifted off abruptly because of the combination of increased flap setting, aft c.g., and neutral elevator trim setting.

9. The engine malfunction at liftoff distracted the pilot to the extent that he failed to retract the landing gear and flaps.

10. The extended landing gear and flaps, the overgross weight condition, the aft c.g., and the asymmetric thrust significantly degraded the aircraft's climb performance and degraded the handling qualities of the aircraft.

11. A successful landing on the runway could have been executed from 150 ft above the runway.

12. The captain feathered the right engine and performed a partial shutdown.

13. The captain became distracted by the loss of power, and control of the aircraft was lost with insufficient altitude available to execute a recovery.

14. There was no evidence that the right front seat passenger was manning any of the flight controls at the time of ground impact.

15. The company's management was inexperienced and was ineffective, and as a result the director of flight operations became overburdened with responsibilities and an insufficiently experienced pilot was inadequately trained.

16. The lack of stringent regulatory minimum pilot qualifications and the aircraft grouping concept contributed to the hiring of an insufficiently experienced pilot and a failure of the company to provide adequate training.

17. The FAA's certification and surveillance were ineffective because they failed to take timely action to correct unsafe trends and practices at an early stage in the company's development.

18. The limited time available to accomplish the 14 CFR 135 recertification program and the inspector's substantial workload detracted from FAA's effectiveness in certification and surveillance of the company.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the loss of control following a partial loss of power immediately after liftoff. The accident could have been avoided if either the pilot had rejected the takeoff or had raised the landing gear and flaps. His failure to take decisive action may have been due to preoccupation with correcting the malfunction, and a lack of familiarity with the aircraft and with its emergency procedures.

Contributing to the accident was the pilot's inexperience in multiengine aircraft, a hurried departure, inadequate training, inexperienced company management, and ineffective FAA certification and surveillance of the operator.

4. SAFETY RECOMMENDATIONS

As a result of this investigation, the Safety Board reiterates the following recommendations:

> Require that pilots involved in 14 CFR 135 operations be thoroughly trained on the performance capabilities and handling qualities of aircraft where loaded to their maximum certificated gross weight and/or to the limits of their c.g. envelope, or both. (Class II, Priority Action) (A-79-80)
>
> Develop in cooperation with industry, flight recorder standards (FDR/CFR) for complex aircraft which are predicated upon intended aircraft usage. (Class II, Priority Action) (A-78-27)
>
> Draft specifications and fund research and development for a low-cost FDR, CVR, and composite recorder which can be used on complex general aviation aircraft. Establish guidelines for these recorders, such as maximum cost, compatible with the cost of the airplane on which they will be installed and with the use for which the airplane is intended. (Class II, Priority Action) (A-78-28)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ ELWOOD T. DRIVER
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PATRICIA A. GOLDMAN
Member

/s/ G.H. PATRICK BURSLEY
Member

May 28, 1980

5. APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The Safety Board was notified of the accident about 1100, on October 8, 1979, and a team of three investigators was dispatched to the scene immediately. Investigative groups were established for the investigation in the areas of operations, airframe, powerplants, and maintenance.

Parties to the investigation included the Federal Aviation Administration, COMAIR, Inc., Piper Aircraft, and AVCO Lycoming, Hartzell Propeller, Inc.

2. Public Hearing

No public hearing or depositions were held.

APPENDIX B

PILOT INFORMATION

Captain William L. Paul

Captain William L. Paul, age 30, held airline transport pilot certificate No. 2015228, issued August 21, 1979, with an airplane multiengine land rating and commercial privileges for single engine land airplane. He also held an airplane and instrument flight instructor certificate (CFII) and held a flight engineer certificate No. 309529546 with a turbojet rating. His current first class medical certificate, issued August 2, 1979, contained no limitations.

Flight Time Experience

Captain Paul's first logbook was not found. He forwarded into his second logbook a total of 337 hrs of which 14 hrs was multiengine. FAA records show he accumulated 10 hours at the time he obtained his multiengine rating. According to his logbook, up until the day of the accident, he had recorded a total of 2,820 hrs, of which about 214 hrs were in small twin engine aircraft.

While employed with COMAIR, Inc., the captain accumulated about 27 hrs of pilot-in-command time, of which about 18 hrs involved either training or line flying with a designated check airman as a copilot.

The following are the pilot-in-command multiengine hours recorded in his logbook:

Type Aircraft	Hours
Aero Commander	1.0
Cessna 310	11.0
Cessna 337 (centerline thrust)	33.6
PA 23-160	10.3
PA 23-250	107.2
PA 30-160	2.3
PA 31-300	12.5
PA 31-310	28.8
PA 31-350	3.7
Unknown	3.3
Total multiengine hours	213.7 hrs.
Total conventional multiengine	180.1 hrs.

The following is a total of the captain's multiengine flight hours through October 8, obtained from FAA records and previous employers (approximate hours):

APPENDIX B

Type Aircraft	Flight Hours Without a Training Pilot or Check Airman On Board	Flight Training Hours
Cessna 337 (centerline thrust)	20	unknown
PA 23-160		10
PA 23-250	29	24
PA 31-300		10
PA 31-310	9	18
TOTAL	58	62

Total multiengine hours: 120
Total conventional multiengine hours: 100

APPENDIX C

AIRCRAFT INFORMATION

N6642L was a Piper Navajo, PA31-310, serial No. 31-580 manufactured November 7, 1969, and issued a standard airworthiness certificate on that date. A certificate of registration was issued to COMAIR, Inc. January 12, 1978. At the time of the accident the aircraft had accumulated a total time of 4,317 hrs, of which 48 hrs were accumulated since its last phase inspection.

Engine and Propeller Data

Engine Data: AVCO Lycoming TIO-540-A2B

Position	Serial No.	Total Time	Time Since Overhaul
Left	L-1841-61	668	668 (factory remanufacture)
Right	L-1019-61	Unknown	813.5

Propeller Data: Hartzell HCE3YR-2ATF

Position	Serial No.	Total Time	Time Since Overhaul
Left	DJ 1836	Unknown	33.3
Right	DJ 22	Unknown	1897.9

The left engine was remanufactured by AVCO Lycoming June 22, 1979. The right engine was overhauled May 10, 1979; the total time at overhaul is unknown. It was installed on another COMAIR aircraft and operated for 520 hrs before being installed on N6642L September 4, 1979. There were no mechanical irregularities reported on either engine subsequent to May 10.