NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

ROCKY MOUNTAIN AIRWAYS, INC.
DeHAVILLAND DHC-6-300, N24RM
CHEYENNE, WYOMING
FEBRUARY 27, 1979

NTSB-AAR-79-10

UNITED STATES GOVERNMENT

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16. Abstract

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The National Transportation Safety Board determined that the probable cause of the accident was the flightcrew's erroneous determination that the aircraft was not capable of single-engine flight and their actions which precluded obtaining maximum available performance from the aircraft. The cause of the engine failure was an erroneous assessment by company maintenance personnel of damage sustained by the right engine during an overtemperature condition and their poor judgment in deciding to repair and release the engine for flight without replacing the engine's power turbine section.

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SYNOPSIS

About 0807 mountain standard time, February 27, 1979, Rocky Mountain Airways, Inc., Flight 801, crashed into rolling terrain shortly after takeoff in visual flight conditions from runway 34 at Cheyenne Municipal Airport, Wyoming. The aircraft came to rest about 1.3 nmi east of the departure end of the runway. There were 14 passengers and a crew of 2 aboard; 2 passengers were injured slightly. The aircraft was damaged substantially.

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1. FACTUAL INFORMATION

1.1 History of the Flight

On February 27, 1979, a Rocky Mountain Airways, Inc., DeHavilland DHC-6-300 (N24RM) was a scheduled flight from Denver, Colorado, to Cheyenne, Wyoming, (Flight 800), and return (Flight 801).

In Denver, on the morning of the accident, the captain had performed a normal preflight engine runup check which included a check of both the automatic and manual feather systems of both propellers. All systems functioned properly as they had the previous day when he had flown the aircraft.

About 0714, 1/ Flight 800 departed Denver with two crewmembers and one passenger. According to the crew, the flight was uneventful and the aircraft was landed at Cheyenne at 0756.

After landing, the aircraft was taxied to the terminal and its left engine was shut down. The passenger deplaned and baggage was taken off. Fourteen passengers for Denver then boarded and their baggage was placed aboard the aircraft. The left engine was restarted and at 0803, the aircraft was taxied to the threshold of runway 34 for takeoff. The captain stated that during the taxi the before takeoff checklist was completed, which includes placing both propeller levers to full increase. The tower gave the flight an instrument flight rules (IFR) clearance to Denver.

About 0805, after selecting 10° of flaps and arming the propeller autofeather system, the crew began takeoff. The first officer was flying the aircraft from the right seat. The wind was from 360° at 18 kns with gusts to 24 kns. According to the crew, they were especially alert to detect any powerplant malfunction because of the maintenance work which had been done on the right engine the night before.

According to the captain, the power application to 44 psi torque, as prescribed by company procedures, was "smooth and positive." When they were approaching rotation speed, the captain looked at all the engine instruments and informed the first officer that they were normal.

According to the first officer, near 65 kns, back pressure was applied to the control wheel and shortly thereafter, the aircraft lifted off. The aircraft continued to accelerate after liftoff to about 90 kns, the best-angle-of-climb speed.

The captain stated that liftoff was normal and adjacent to the airport tower, which is 1,500 ft down the 4,997-ft runway. The aircraft continued on the runway heading and about 150 ft a.g.l., the captain heard a bang and a roaring noise as the aircraft yawed to the right. The first officer confirmed the captain's observation, except that he thought they became airborne a little farther down the runway. He stated that there was a loud bang from the right engine followed by a sudden yaw to the right. The airspeed dropped from 90 kns to 85 kns during "what appeared to be a normal autofeathering sequence...." Some passengers described hearing a squealing noise.

The captain stated, "We heard and felt the prop start an autofeathering sequence, and we expected no problem. As I was moving my vision from the windshield down to the engine instruments, I noticed approximately 20 lbs of torque on the right indicator and at that point in time, I was starting to reach for the fuel control lever, and there

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

was a surge. I moved forward a little bit and was unable to accurately grab what I wanted on the fuel controls so I didn't touch anything. I just let my wrist drop, and after the initial drag from coming out of feather was felt, it accelerated and it was yaw to the left." The captain stated further, "After this yaw was starting to subside, perhaps 2 seconds maybe 3, I was able to accurately grab the fuel control units and I pulled it off, followed immediately by a right prop into feather." He also stated that when he looked outside that "it was obvious that the airplane was in a descent and that we could not clear any terrain and houses to the north...."

The first officer believed that there were two right engine surges. He stated that, upon the onset of what he believed was auto-feather, he advanced both power levers to full and never took his hand off them until the forced landing. He also stated that he did not notice any torque over 50 psi. 2/ He stated that, as the engine surged the second time, he began a turn to the right away from populated rolling terrain to the north of the runway, toward an uninhabited area northeast of the airport. During what both he and the captain described as a shallow turn, a speed of 82 kns to 90 kns was maintained. Minimum control speed with the critical engine inoperative and with 10° flaps was 64 kns, the best single-engine rate-of-climb speed was 80 kns.

Some witnesses stated that they believed the right turn was shallow and that the aircraft began its turn to the right near the departure end of runway 34. However, one pilot who witnessed the accident stated that the angle-of-bank was 20° to 30°.

The flightcrew stated that since they could not maintain both altitude and airspeed they were forced to sacrifice altitude to maintain flying speed. When it became apparent that a forced landing was inevitable, the aircraft was turned toward an open area; the speed of the aircraft was 82 kns. The flaps remained at 10° to aid in choosing a landing spot among the large knolls on the terrain. The first touchdown was made close to stall speed, as indicated by a warning horn and light, and on the main gear on the upslope of a large, grassy knoll. A slight dip in the knoll caused the aircraft to bounce slightly. The aircraft became airborne again as it traversed the crest of the knoll and then touched down again on another knoll about 30 yards away. They stated that the aircraft again became airborne and it was necessary to use some power to prevent a stall on the downslope side of the second knoll. The aircraft touched down a third time on top of a fence which surrounded a fire station. The left main landing gear separated from the aircraft. The aircraft slid through a chainlink fence and hit several barrels of oil located behind the fire department. The barrels of oil ignited, but the

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2/ Under the circumstances, the torque value at full throttle should have been between 45 psi and 50 psi.

aircraft slid past them and did not catch fire. The aircraft came to a stop about 30 yards past the fence. The first officer stated that he did not use his brakes during the landing sequence because he believed that it was better to maintain directional control after coming to the top of the knolls by applying power to the left engine. The left engine was shut down as the aircraft slid to a stop.

The captain stated that as they turned east toward the forced landing area, he informed the passengers to prepare for a crash landing by placing their heads between their knees. The passengers complied with this request.

The flight from liftoff to first impact, lasted about 61 sec. Twenty-six seconds were required for the climb to the point where a right turn was made and 35 sec were required for the remaining distance to the first touchdown.

The accident occurred during daylight hours. The coordinates of the accident site were 41°09'44"N latitude and 104°47'26"W longitude. The elevation of the accident site was about 6,040 ft m.s.l.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other
Fatal	0	0	0
Serious	0	0	0
Minor/None	2	14	0

1.3 Damage to Aircraft

The aircraft was damaged substantially.

1.4 Other Damage

About 150 ft of chainlink fence was destroyed. Four barrels of oil were destroyed by fire and 11 barrels were damaged by impact.

1.5 Personnel Information

The flight crewmembers were qualified and certificated for the flight; they received the training required by current regulations. (See Appendix B.)

1.6 Aircraft Information

The aircraft was certificated and equipped in accordance with current regulations. There were about 2,000 lbs of jet A fuel onboard when the aircraft started its takeoff at Cheyenne.

The aircraft's weight and balance was computed by the Safety Board using: (1) FAA-approved company average weights, and (2) actual weights estimating the fuel onboard. The maximum allowable takeoff weight was 12,500 lbs and the allowable center of gravity (c.g.) limits were 25 to 36 percent mean aerodynamic cord (MAC).

The Rocky Mountain Airways operations specifications show that the FAA had authorized the company to use average passenger weights to compute passenger loads over any route. However, the "use of average passenger weight is not authorized in the case of flights carrying passengers whose average weight obviously does not conform with the normal standard weight." For winter operations (November 1 through April 30), an average weight of 170 lbs may be used. The operations specifications also contains the following statement, "In any event, regardless of which method is used, the aircraft must not exceed allowable weight and center of gravity limits." The Flight Operations Manual states that the captain will assume the responsibility for the proper loading of the aircraft in accordance with the instructions in the weight and balance manual.

Using the average weight computations, the c.g. was within prescribed limits, but the aircraft was 31.5 lbs above maximum allowable takeoff weight. Computations for the actual weight condition showed that the aircraft was about 344.5 lbs over the maximum allowable weight with a c.g. range from about .6 in. aft of the allowable c.g. limit to a forward c.g. within that c.g. limit. Three passenger locations were unknown. There were five passengers who weighed more than 200 lbs each.

The maintenance records of the aircraft and its engines were reviewed to determine if any major repairs had been made to the aircraft's structure, propellers, or engines. The structure and the propellers had had no recent, related repairs. However, parts of the right engine's combustion section had been replaced the day before the accident, February 26. The replacement was necessary because the engine had "seized." The turbine inlet temperature reportedly had reached 800°C during an attempted engine start. Depositions or statements were taken from personnel involved in the incident and repair of the right engine. A pilot involved in the incident stated that the overtemperature occurred during an attempt to do a battery start of the right engine. He did not observe a temperature rise on the turbine inlet (T5) temperature gage. After about 8 or 10 seconds, he abandoned the start and motored the engine for about 10 seconds to clear the engine of fumes and fuel. He then recycled the start switch and began to start the other (left) engine. During this start, he noticed that two mechanics were running toward the aircraft from the hangar area and indicating that he should discontinue his start of the left engine. When the mechanics came up to the aircraft, they said that they had noticed the propeller of the right engine slowing down and they were concerned because they could still hear a starter engaged. They were also concerned because they had seen either flames or exhaust vapors coming from the right engine exhaust stack. They did not realize that the captain had discontinued the start of the right engine and was attempting to start the left engine.

The captain then attempted to start the right engine again. He stated that he observed 19 percent on the gas generator tachometer which was within limits. He then advanced the engine power lever and observed ignition and a T5 gage rise to 800°C where it remained for about 4 seconds. He also observed that the gas generator speed had reached about 40 percent at which time he "realized things were not right" and discontinued this start attempt. He stated that he was not concerned since the temperature had only gone to 800°C, whereas, 1,090°C for 2 seconds is required before a start is considered to be a hot start. He stated that he noticed that the mechanics were on their way back to the aircraft, because they had not seen the propeller turn during the start sequence. When the mechanics tried to manually turn the propeller, which normally rotates freely, they found it would not move. The aircraft was towed into the hangar for examination of the right engine.

According to the Director of Maintenance for the carrier, the compressor turbine wheel and its blade tips were burned and metal had been deposited on the guide vane assembly. Metal had also splattered on the power turbine guide vane assembly and on the power turbine. A glass-bead peening procedure was used to remove this metal splatter from the power turbine and its guide vanes. The engine manufacturer had not suggested or recommended this procedure nor is it covered specifically in the engine manufacturer's maintenance manual. The compressor turbine disc, the compressor turbine stator housing, the compressor turbine housing heat shield, the compressor turbine shroud segment, the compressor turbine vane ring, the small combustion chamber exit duct assembly, the exhaust gas temperature thermocouple probes, and the fuel nozzles were replaced. The combustion liner and the power turbine assembly were inspected and were reinstalled in the engine. After the engine was reassembled, it was reinstalled on the aircraft. The aircraft was then towed out of the hangar area where the right engine was run up and checked. After the engine met all the normal requirements, it was returned to the hangar for reinspection for leaks and retorque of the right engine's fuel manifold adapter assembly. The aircraft was then released for service.

When questioned as to what criteria were used to determine if the power turbine and guide vane assembly could be returned to service, the Director of Maintenance stated that there was no information in the Pratt & Whitney Heavy Maintenance Manual for cleaning the parts. He instructed his store manager to call a large FAA-certificated engine repair station in California and obtain their advice. The repair station reportedly gave him instructions which he followed to determine that the power turbine and assembly were serviceable. During his visual inspection after cleaning, he did not notice any heat distress, discoloration, or bending on the turbine blades. Based on this inspection, he determined that the assembly was airworthy and returned it to service. He was satisfied with all work performed.

When asked if he had attempted to obtain another engine or another power section, the Director of Maintenance stated that he had tried for 2 or 3 hrs and found that either could have been obtained by the following afternoon. He also stated that there was no company pressure to get the aircraft back into service.

When asked if he had received any advice from the local Pratt & Whitney representative, he stated that he could not recall having had a conversation with him that evening.

The Pratt & Whitney representative testified that when he was notified by the company of the right engine problem on the afternoon of February 26, 1979, he went to the Rocky Mountain Airways hangar where work had begun on the engine. He found that he was unable to manually rotate the propeller. After the engine was disassembled, he looked into the power section and saw the compressor turbine disc and blade assembly damage including the melted blade tips. He also noticed the condition of the power turbine section. He stated that the temperature must reach 1,700°C to begin to melt the tips of the compressor turbine blades. The Pratt & Whitney Maintenance Manual, which the carrier used to assess the problem, does not contain complete criteria for determining if an engine had experienced an overtemperature. He stated that the only criterion in this case was based on the pilot's report of T5 temperature. He further stated that when a pilot reports that an overtemperature has occurred and the engine is opened and distress is found, the judgment of the person involved in the repair must be relied upon to determine whether an overtemperature had occurred.

The Pratt & Whitney representative stated that he advised the Director of Maintenance, after pointing out the distress in the engine, that the director should think about an engine change. The director told the representative that he could probably get by with changing the hot section and replacing the power turbine assembly. The Pratt & Whitney representative testified that he told the director, "that would be the least that you would get by with." The Director of Maintenance could not recall this advice.

1.7 Meteorological Information

The surface weather observations for Cheyenne taken before and after the accident by National Weather Service personnel were:

> 0755: ceiling--partial obscuration, measured 1,000 ft overcast; visibility--5 mi, light snow; temperature--32°F; dewpoint--20°F; wind--360° at 15 kns gusting to 24 kns; altimeter setting--29.81 inHg.; remarks--snow obscuring 2/10 sky.

0813: ceiling--paritial obscuration, measured 1,500 ft overcast; visibility--5 mi, light snow; temperature--32°F; dewpoint--20°F; wind--360° at 18 kns gusting to 24 kns; altimeter setting--29.82 inHg.; remarks--snow obscuring 1/10 sky; aircraft mishap.

The density altitude at the surface at Cheyenne Municipal Airport at the time of the accident was 5,810 ft.

1.8 Aids to Navigation

Not applicable.

1.9 Communications

No communications difficulties were reported.

1.10 Aerodrome Information

Runway 34 at Cheyenne Municipal Airport is hard surfaced and is 4,997 ft long and 150 ft wide. The elevation at the departure end of the runway is 6,125 ft m.s.l. and at the probable point of liftoff of N24RM is 6,130 ft m.s.l. The elevation at the approach end of runway 34 is 6,135 ft m.s.l. The effective gradient of the runway is .32 percent.

The terrain beyond the departure end of runway 34 is essentially rolling hills; however, the terrain to the west rises about 50 ft per nautical mile. The terrain slopes down to the east about 30 ft per nautical mile.

1.11 Flight Recorders

The aircraft was not, nor was it required to be, equipped with a cockpit voice recorder and a flight data recorder.

1.12 Wreckage and Impact Information

The aircraft settled to the ground .9 nmi east of the departure end of runway 34. The initial crash heading was about 065°. The aircraft came to rest on a heading of about 005°. The bottom skin, the frames, and the fuel bays on the fuselage were damaged. The baggage pod had separated. The nose gear was crushed upward into the cockpit area and had jammed the rudder pedals. The left main gear attachment bolts failed in bending and shear as the gear separated from the aircraft. The right main gear was intact; however, its fairing was damaged.

All systems operated normally except the right propeller constant speed control. The flaps were found at 10°.

The undamaged cockpit area was examined and documented. Pertinent documentation follows:

(1) Power levers (throttles) - 1/2 in. forward of idle
(2) Propeller levers - 1/2 in. aft of full increase
(3) Fuel levers - OFF
(4) Friction locks - mid position
(5) Flap indicator - 10°
(6) Checklist (scroll) - climb/cruise
(7) Intake deflectors - OFF
(8) Autofeather switch - ON

Both engines and propellers remained attached to the aircraft. The cowls of both engines were securely latched. Both engines could be rotated freely by hand.

Except for some slight leading edge gouges, the only visible damage to the left propeller blades was that the blade tips were fractured from 29 to 33 ins. outboard of the blade clamp. The right propeller was not damaged. Both propellers were found in the feathered position.

The left engine and its various accessories were intact. There was no visible damage. The right engine and its various operating accessories were intact and appeared undamaged except that the control rod to the right propeller constant speed unit (propeller governor) was broken in the threads near the eyebolt of the teleflex operating rod. Additionally, the right engine exhaust case had been penetrated from the inside outward; the puncture was located at the 11:30-o'clock position, about 2 ins. forward of the "C" flange which attaches the exhaust duct to the gas generator.

Removal of the right engine's exhaust stack revealed that five power turbine blades had been broken about midspan. Additionally, 14 power turbine blades were damaged at the outer tip shroud supports.

The left and right propeller autofeather pressure switches were intact and were not damaged. These switches were tested for electrical continuity and mechanical operational capabilities. Both switches functioned normally. Test results showed that both switches opened and closed at 12 and 15 psi, respectively. These switches normally open at or above 15 to 17 psi as pressure rises and close between 11 to 13 psi as pressure drops.

The fuel control mounted fuel shutoff valve for each engine was in the "CUTOFF" position. All the various operating controls for both engines and propellers were intact, continuous, and did not bind when activated.

The engines and their components were taken to Pratt & Whitney Aircraft of Canada, Ltd., for further examination. The propellers were examined by Hartzell Propeller Co.

1.13 Medical and Pathological Information

The two passenger injuries were minor and were limited to a cracked rib and a bruised knee.

1.14 Fire

Although barrels of oil did ignite, the aircraft did not catch fire.

1.15 Survival Aspects

This was a survivable accident. The structural integrity of the cabin and cockpit area was not compromised. The entire fuselage remained intact. All passenger and crewmember restraints functioned normally. There were no injuries sustained during the evacuation. Evacuation time was about 1 min.

The Cole Fire Station, located at the crash site, responded immediately with two, 1,000-gallon capacity pumpers. The city fire department was notified at 0808 and arrived on the scene at 0814. Their response included a rescue truck, three pumper trucks, and a ladder truck. Five firefighting vehicles were also sent from the Air Force Fire Team located on the airport.

1.16 Tests and Research

1.16.1 Turbine Temperature Gages

Both turbine temperature gages were tested and found to meet manufacturer's specifications, except for the right instrument which lagged slightly--20° to 80° between 600°C and 800°C. This lag is within specified limits.

1.16.2 Aircraft Performance

Performance data indicate that the flight's rate-of-climb performance should have been 245 fpm with a feathered propeller and 735 fpm with an engine producing 20 psi torque. With the right propeller windmilling, the aircraft would descend about 10 fpm.

The minimum climb gradient with a feathered propeller should have been 3.2 percent, or 200 ft per nautical mile. Expected climb performance can be degraded by an overgross weight condition, by turns into the failed engine, by failure to minimize drag by inducing a sideslip or not maintaining correct speeds, and by turns away from the headwind.

The Safety Board calculated the possible success of a rejected takeoff immediately upon the onset of the engine problem. Using the points along the takeoff path where the aircraft should have been at 150 ft a.g.l. and 200 ft a.g.l., an immediate descent and landing within the confines of the runway was possible if the flaps had been extended immediately to 37.5° (landing flaps).

The following data were used to compute the performance of the aircraft:

(1) Estimated takeoff gross weight - 12,837 lbs (12,500 lbs maximum allowable)
(2) Estimated landing gross weight - 12,800 lbs (12,300 lbs maximum allowable)
(3) Runway length - 4,997 ft
(4) Altimeter setting/temperature - 29.82 inHg./32°F
(5) Computed density altitude - 6,000 ft m.s.l.
(6) Surface winds - 360° at 18 kns with gusts to 24 kns
(7) Intake deflectors - extended

Pertinent climb performance data were extracted from the aircraft's flight manual:

Condition	Indicated Airspeed (10° Flaps) (kns)
Two Engines	
Best Angle Climb Speed	87
Best Rate Climb Speed	100
Stall Speed	55
Single-Engine (Failed Engine Feathered)	
Best Rate Climb Speed	80
Approach Speed-10° Flaps	86
Approach Speed-37.5° Flaps at 50 ft	74
Minimum Control Speed	64

The probable time of flight was about 61 seconds. For the climb to the point where a right turn was made, 26 seconds were required at a constant 63-kn groundspeed. The remaining distance to first impact required 35 seconds at a constant 80-kn groundspeed.

Performance data from the aircraft's airplane flight manual were used in the takeoff, climb, and landing calculations. The data did not include landing performance from 150 ft a.g.l. with 10° flaps.

Therefore, DeHavilland was requested to provide estimated landing data from 100 ft and 200 ft with 10° flaps. The single-engine data in the flight manual are based on a failure of the critical engine.

The following is the expected takeoff performance for takeoff with two engines and 10° flaps:

Performance	12,500 lbs	12,800 lbs
Ground roll	820 ft	925 ft
Distance to 50 ft a.g.l.	1,435 ft	1,540 ft
Rate of climb	1,380 fpm	1,340 fpm
Climb gradient		
percent/degrees	15.0%/9.0°	15.0%/8.0°
ft/nmi	935 ft/nmi	910 ft/nmi

The following is the single-engine climb performance with the failed engine's propeller feathered, 10° flaps, and the aircraft at 150 ft a.g.l.:

Performance	12,500 lbs	12,800 lbs
Rate of climb	275 fpm	245 fpm
Climb gradient		
percent/degrees	3.2%/1.8°	2.8%/1.6°
ft/nmi	195 ft/nmi	170 ft/nmi

The following is the single-engine performance with a windmilling propeller on the failed engine and 10° flaps at 150 ft a.g.l.:

Performance	12,500 lbs	12,800 lbs
Rate of climb	20 fpm	-10 [illegible]
Climb gradient		
percent/degrees	0.2%/0.1°	-0.1/-0.06°
ft/nmi	12 ft/nmi	-6 ft/nmi

DeHavilland estimated the landing performance from flight test data based on full landing flaps (37.5°), both engines at idle, and an airspeed of 75 kns. The resulting air plus ground distance was estimated at 2,000 ft. Landing data for 10° flaps were not available. The flight manual's en route descent data for 10° flaps and two engines at idle were 750 fpm at 86 kns and would place the aircraft at 50 ft a.g.l., 1,160 ft beyond the takeoff distance.

The headwind component, 17 kns, was equal to about 20 percent of the indicated climb airspeed which means that the climb gradient in a 17-kn headwind was about 20 percent higher than that in a calm wind. Therefore, the one-propeller-feathered climb at 12,800 lbs gross weight would increase from 170 ft/nmi to about 200 ft/nmi. The one-engine-windmilling climb gradient would increase, but since it was essentially zero the benefits would be minimal. Once the aircraft turned right near the end of the runway, it encountered a crosswind which eliminated the positive effects of the headwind on climb performance.

The flightcrew stated that the right turn shortly after liftoff was made at a shallow angle of bank. Pilots who witnessed the turn from several vantage points on the airport stated that the angle of bank was steeper; one reported an angle of 20° to 30°. In a turn at a constant airspeed, climb performance will be degraded because of the lift lost because of the angle of bank. This loss of lift and, therefore, loss of climb capability, increase as the bank angle increases.

The Safety Board requested DeHavilland Aircraft of Canada to conduct flight tests to verify the Board's calculated climb performance: 750 fpm with the right engine at 20 psi torque, the left engine at 45 psi torque, 10° flaps, and 90-kn climb speed. DeHavilland conducted two flight tests at gross weights of 9,000 and 9,700 pounds. The test results confirmed that the right propeller would be governed fully at 90 percent rpm at 20 psi engine torque. With two engines at 45 psi torque, the rate of climb was 1,850 fpm (9,000 lbs) and 1,800 fpm (9,700 lbs). With 20 psi torque on the right engine and 45 psi torque on the left engine, the rates of climb reduced to 1,200 fpm (9,000 lbs) and 1,050 fpm (9,700 lbs), a loss in climb performance of 35 to 42 percent. The tests were conducted at 5,200 ft density altitude, whereas N24RM was operating near 6,000 ft density altitude. The effect of the flight's higher gross weight was to decrease the climb performance to about 800 fpm. Correcting for the flight's higher density altitude reduces the 800 fpm value to 780 fpm. This value agrees closely with the 750 fpm value.

According to the flight manual, when an engine fails above minimum single-engine speed and a decision is made to continue the takeoff, a pilot must "maintain heading by applying rudder and lowering the wing against the live engine as necessary." After feathering the propeller of the failed engine, "climb at 80 knots IAS with flaps 10°. Trim aircraft as desired."

1.16.3 Examination of Fractured Teleflex Control Rod, Right Engine Propeller Control

The "teleflex" control rod P/N 10638-120 from assembly 23215 was returned to the Safety Board's Metallurgical Laboratory for examination. The examination indicated that the rod had fractured in fatigue through the thread roots near where it attaches to the spherical bearing rod end.

Fatigue had begun at numerous locations along the thread root and generally had propagated in opposite directions and produced by reverse bending fatigue. No material defects were found which could have contributed to the fracture's initiation.

1.16.4 Engine, Engine Component, and Propeller Disassembly, Examination, and Tests

Left Engine

The main oil filter, the oil filter housings, the magnetic chip detector, and the front oil scavenge screen recess were free of foreign debris.

The power turbine vanes were in good condition; however, the turbine interstage baffle was loose and the downstream center airseal was deformed. Apparently, it became deformed when it contacted the power turbine disc airseal rim during the orbiting of the power turbine disc. The power turbine blade tips and shroud ring airseals were rubbed lightly.

The power turbine shaft and the first- and second-stage reduction gear drive trains rotated smoothly and freely and were functionally correct. The compressor turbine blades had been rubbed lightly on the squealer tips. The compressor turbine shroud segments, the compressor impeller, and the impeller housing had also been rubbed. Such damage is consistent with that expected from sudden stoppage after the propeller has struck objects after impact.

Right Engine

The main oil filter and oil filter housing contained a small quantity of nonmagnetic particles identified mainly as cadmium. No magnetic particles were found on the magnetic chip detector.

The exhaust duct had ruptured beneath the containment ring at the 8-o'clock position. The rupture was 1/2 in. wide by 1 1/2 ins. long.

One side of the No. 3 bearing airseal had been rubbed lightly.

The compressor turbine blades had been rubbed. The compressor shroud segments had been rubbed at the 7-o'clock position. All but three compressor turbine vanes were dented on their downstream side. Forty-nine compressor turbine blades were nicked on their leading edges. The compressor turbine shroud segments were also nicked and burred.

The first-stage carrier and planet gears rotated smoothly and correctly. The first-stage sungear did not appear to be damaged.

Engine Component Tests

The fuel pump, the fuel control unit, the overspeed governor, the constant speed unit, and compressor bleed air valve from each engine were tested and were found to operate within specifications.

Propeller Disassembly and Examination

Both propellers cycled normally throughout their operating ranges. Impact marks found on the buttface of two of the left propeller blades were consistent with the propeller operating in the low pitch regime at the time of impact.

1.17 Additional Information

1.17.1 Pilots Approved Flight Manual

The following is excerpted from Section 3 of the Emergency Operating Procedures Section:

"Engine Failure During Takeoff (Insufficient Runway to Stop)

1. Maintain heading by applying rudder and lowering wing against the live engine as necessary.
2. Advance power levers up to the T5, torque, or Ng limit, whichever is reached first.

NOTE

Under single engine emergency conditions, the torque computer referenced power level may be exceeded. With the propeller levers at full INCREASE (96% Np), 3/ advance the power levers until the first certificated red line limit of T5, torque, or Ng has been reached. Torque computer power settings assure engine performance throughout the engine overhaul life but this is not a consideration under emergency conditions.

CAUTION

Do not retard the power lever of the failed engine until autofeathering is complete and the propeller lever of the failed engine has been placed in FEATHER. Otherwise, the propeller will unfeather.

3. Fuel lever of failed engine - OFF.
4. Climb at 80 knots IAS with flaps at 10°.
5. Trim aircraft as desired.
6. Booster pump switch of failed engine - OFF.

NOTE

If the booster pump caution lights do not illuminate immediately, a fuel booster pump pressure switch failure has occurred. This will prevent the automatic switching on of the standby booster pump and may be the cause of the engine flame-out. An engine re-light can be attempted after restoring the fuel supply in accordance with paragraph 3.4.1 b.

3/ Propeller speed.

7. Fuel emergency shutoff switch of failed engine - OFF.
8. Propeller lever of failed engine - FEATHER.

NOTE

If propeller lever of failed engine is not selected to FEATHER the propeller is liable to unfeather.

9. Generator switch of failed engine - OFF.
10. Propeller autofeather switch - OFF. SEL light out."

1.17.2 FAA Surveillance

The Safety Board reviewed the task assignments of FAA Inspectors assigned to Rocky Mountain Airways, Inc., and found that the principal operations inspector was responsible for monitoring 15 air taxi operators--2 of which were out-of-State operators --2 heavy helicopter operators, 6 flight schools, 21 agricultural operators, and 8 FAA-approved flight examiners. Three of the air taxi operators conduct scheduled operations. Rocky Mountain had about 65 pilots and had a route structure over adverse terrain. In addition, its navigational facilities are privately owned and must be monitored. During January 1979, the principal operations inspector conducted six en route inspections and seven flight checks among the operators for which he was responsible.

The principal maintenance inspector for Rocky Mountain Airways, Inc., monitored 20 other air taxi operators, 10 repair stations, and 47 FAA-approved airworthiness inspectors.

The newly revised 14 CFR 135 has extensively upgraded the operator requirements which, in turn, places an increased workload on the available FAA personnel.

1.17.3 Maintenance Program

The Maintenance/Inspection Program for N24RM was controlled by the aircraft manufacturer's recommended program. The program is identified as Product Support Manual (PSM) 1-6-7, Equalized Maintenance Maximum Availability (EMMA) Preventive Maintenance Program. The EMMA Program was approved and authorized by FAA's Rocky Mountain General Aviation District Office No. 3 on Operations Specifications Form 1014 in accordance with 14 CFR 135.60. Amendment No. 15 to these specifications, dated June 6, 1978, authorizes and requires the use of the program. N24RM was first listed on these operations specifications authorizing the usage of the approved aircraft inspection program on November 20, 1973.

1.18 New Investigation Techniques

None

2. ANALYSIS

The flightcrew was properly certificated and qualified in accordance with company and FAA requirements.

The aircraft was certificated and maintained according to applicable regulations. There was no evidence of preimpact failure, malfunctions, or abnormalties of the airframe, the control systems, or the left engine.

Power turbine blades and the constant speed unit "teleflex" control rod failed on the right engine. One power turbine blade probably failed between engine start at Denver and engine surge after liftoff at Cheyenne. The Safety Board based this conclusion on the circumferential crack in the forward part of the exhaust duct inner section of the exhaust case and the broken "teleflex" control rod. Consequently, the engine ran in an unbalanced condition for some time, which further weakened the power turbine blades previously subjected to the overtemperature. The overtemperature was so high that weakened areas were created in one of the airfoil fracture surfaces of the failed blade. Additionally, some evidence of incipient melting was found during the metallurgical examination.

Since all the blades had been subjected to the same operational environment, the Safety Board concludes that they had all been weakened, which resulted in a total of five failed blades. The additional four blades apparently failed when the engine surged and thus caused the remainder of the engine damage. The gas generator continued to operate and to turn the power turbine, which recovered and freed itself of the turbine blade debris. The clearing process probably occurred during the second surge and recovery of the engine. The engine, therefore, continued to operate and produce some degree of torque until it was shut down by the flightcrew.

The right propeller governor control rod failed in fatigue sometime after the before takeoff checklist was accomplished at Cheyenne; however, the Safety Board could not determine exactly when it failed in relation to the accident sequence after liftoff at Cheyenne. Since the flightcrew reported that they had finished the before takeoff checklist at Cheyenne, which includes checking propeller movement and the system reportedly functioned normally, the propeller governor control rod was probably intact when the before takeoff checklist was accomplished. If the control rod becomes disconnected, the governor will endeavor to hold the engine at the selected speed. Therefore, the flightcrew would have detected the malfunction during the checklist.

In view of the foregoing, the Safety Board examined factors associated with the right engine and operational procedures used by the crew after the engine failed.

The Safety Board could find only one viable explanation for the fact that the pilot involved in the hot start the day before the accident saw only 800°C on the T5 gage--the overtemperature occurred when the pilot's eyes were diverted from the T5 gage during either the first or second attempt to start the engine. The overtemperature had to have occurred sometime between these attempted starts and the accident flight, because no right engine malfunctions or overtemperatures had been recorded before that time.

According to the company Director of Maintenance, his decision to neither replace the right engine nor change the power turbine was made after teardown and examination of the engine and after consultation with an accredited engine overhaul facility. The powerplant maintenance manual available at the field maintenance level did not specify criteria for accepting or rejecting a power turbine based on a visual inspection. The only criterion for such action was based on an observed T5 overtemperature indication. Therefore, the maintenance personnel had to base their decision on the pilot's report, their past experience, their knowledge of the engine, and advice from other knowledgeable personnel. In this case, the engine manufacturer's representative testified that he advised the company Director of Maintenance that a hot section change and a power turbine section replacement would be the least he would get by with, although the Director of Maintenance could not recall this advice. Regardless of the reported 800°C T5 gage observation, it should have been evident to the Director of Maintenance that a severe overtemperature had occurred, considering the metal splatter throughout the engine and heat damage to the compressor turbine blades. Also, the glass-bead peening procedure used to clean the power turbine is neither recommended nor approved by the engine manufacturer at the company maintenance level. Therefore, the Safety Board concludes that the Director of Maintenance exercised poor judgment when he did not replace the engine or change the power turbine. This, together with the deficient maintenance practices, ultimately led to the engine failure and are thus factors in the accident.

In spite of the engine failure and subsequent shutdown, the aircraft should have been able to sustain flight on one engine and, according to the performance study, was able to do so provided the propeller of the failed engine had feathered fully and was not windmilling or provided the engine had been developing torque at a level above the autofeather threshold. In order to determine why the takeoff and climbout was not successful under these circumstances, the Safety Board examined: (1) The significance of the failed right propeller governor "teleflex" control rod; (2) the actions of the autofeather system; (3) the performance capabilities of the aircraft; and (4) the flightcrew's decisions, actions, reactions, and training.

Metallurgical analysis indicates that the right propeller governor "teleflex" control rod failed from preexisting fatigue cracks caused by the stress of reverse bending. Since propeller control was being maintained manually throughout the start and takeoff sequence, the rod must have failed after liftoff at Cheyenne. The engine damage probably caused severe low-amplitude, high-frequency in-flight vibrations, which could have produced the bending cycles which caused the rod to fail.

In order to determine what effect the failed control rod had on the sequence of events, the Safety Board assumed that it failed at the worst possible time--immediately after the turbine failed. Under these circumstances, had the crew attempted to feather the right propeller by retarding the propeller lever to the feather mode, it would not have feathered because of the failed control rod. However, the flightcrew stated that they had followed the proper procedure and shut off the right fuel control before retarding the propeller lever. In this case, the propeller would have feathered within 10 seconds to 14 seconds regardless of the failed rod since the governor had no role in the fuel shutdown sequence. The Safety Board, therefore, concludes that the failed control rod had no effect on the outcome of the flight.

Analysis indicates that the autofeather system was capable of operating properly. If the torque of the right engine had decayed to or below the 13 psi required for autofeather system activation, the propeller would have feathered automatically. The captain noted a 20 psi torque value on the right engine instruments, 7 psi above the value at which autofeather will occur. Shortly thereafter, the right engine surged and the aircraft yawed to the left. At this time, the captain was reaching for the fuel lever for the right engine, but he stated that because of the surge and yaw, he did not pull the lever to the OFF position for fear that he would grab the wrong control. Therefore, the Safety Board believes that the propeller failed to feather automatically because the engine continued to operate at torque values above the autofeather threshold until the engine was shut down.

Crew statements indicate that everything was normal until the right engine failed after the aircraft became airborne. The takeoff was into a 17-kn headwind. They stated that they experienced what appeared to them to be the beginning of a normal autofeathering sequence. They assumed that the right propeller was feathering and believed that the aircraft was capable of continuing flight. They apparently did not consider the decision to reject the takeoff and land straight ahead on the runway which remained. The Safety Board believes that the decision to continue flight at this point was sound based upon the circumstances as evaluated by the flightcrew.

Both crewmembers recalled that they were convinced that the aircraft was not able to sustain a climb and they became concerned with the aircraft's ability to clear populated terrain ahead of them. Therefore, they decided to turn right toward lower terrain and an unpopulated area. About the time of the right turn, the aircraft was nearing the end of the runway. The captain stated that it was about that time that he successfully moved the right fuel lever to the OFF position. Thus, the propeller feather sequence was started. Given the time for feathering (about 14 seconds) and the estimated time to impact, the right propeller should have feathered 20 seconds before impact.

Evidence indicates that the flight could have been continued even after climb capability was degraded by the right turn. Since the feather sequence would have been completed, 20 seconds should have remained for the aircraft to regain the altitude lost during the right turn. Had the altitude been regained, or even level flight attained, flight could have been continued out of the situation.

The flight manual indicates that the aircraft would sustain a positive rate of climb when the right propeller was feathered or was developing low but positive thrust levels. A feathered propeller will cause an 82-percent loss of two-engine climb performance. Under the environmental conditions affecting this flight, a windmilling propeller would result in the loss of all climb performance. This loss would result in either level flight or in a descent, which the flightcrew stated they experienced. However, there is no evidence of a windmilling propeller. In fact, there is considerable evidence that some power was being produced by the right engine after the five turbine blades were lost and before the pilot moved the fuel lever to the OFF position.

After the right engine cleared itself of turbine blade debris, it would have continued to develop some torque until it was shut down. Assuming that a 20 psi torque was being developed while the other engine was developing maximum torque, the flight would be expected to climb at 735 fpm with inlet deflectors extended. This value was validated by flight tests conducted by DeHavilland Aircraft. In addition, the right engine momentarily developed torque above 20 psi in order to surge and cause the aircraft to yaw to the left. Therefore, the flight should have had more climb performance temporarily before the right turn to the east than that expected with a feathered propeller. However, the following environmental and mechanical factors degraded climb capability: (1) Varying torque on the right engine which caused the pilot to reapply and retrim the aileron and rudder surfaces which resulted in the loss of a stable minimum drag configuration and optimum speed; (2) the turn into the failed engine with the resultant loss of climb performance; and (3) the turn crosswind which eliminated the positive effect of a headwind to climb performance.

The Safety Board believes that the aircraft was capable of climbing out of and should have climbed out of the situation. However, at the time, the crew was faced with a time-critical decision since they were convinced that the aircraft would not climb. They had maneuvered the aircraft away from the residential area and what they thought to be rising terrain in front of them to find an area where a crash landing could be made. During the turn and the time involved in feathering the right propeller, the aircraft lost altitude; therefore, when faced with a landing in open terrain versus attempting to continue their flight, the flightcrew chose to land.

The flightcrew had been trained to cope with engine failures during takeoff; however, they were not trained, nor were they required to be trained, in engine failures during a maximum weight takeoff. Also, they had not been trained, nor were they required to be trained, in the situation which faced them when the right engine surged and they were faced with an unstable power situation. Nevertheless, they had sufficient training and were considered qualified to understand and recognize the losses suffered in aircraft performance when a turn is made in the direction of the failed engine. They should also have known the consequences of any delay in initiating the feather of a propeller. And finally, after the turn was completed and the right propeller was feathered, when the aircraft should have had sufficient performance to climb and the terrain had a downward slope, their past experience and training should have caused them to attempt to continue flight. As demonstrated by this accident, the Safety Board believes that pilots should be familiarized during training with the problems they can face with heavy aircraft at high density altitudes when an engine is lost during the takeoff and climb sequence. The Board realizes that it would not be prudent for this training to be given in a fully loaded aircraft; however, derate takeoffs could be utilized, simulators are available, and knowledge can be gained through classroom discussion.

In summary, this accident resulted from a combination of factors. Initially, the judgment of the maintenance personnel involved was faulty. They had the experience and knowledge to see that the right engine had been exposed to temperatures which exceeded 800°C. Therefore, regardless of the lack of specific instructions on what to do unless specific overtemperatures had been reported, they should have reasoned that the engine temperatures had reached or exceeded the temperature for which an overhaul or replacement of the power turbine was mandatory. The judgment of the flightcrew that the aircraft would not sustain flight was also erroneous. Although all of their actions were time critical, their decision to turn into the failed engine compromised the performance of the aircraft. Also, the aircraft woul have flown even after the turn was completed.

Flight safety relies on knowledgeable personnel making correct decisions. A successful operation depends on many such decisions for which there are no specific guidelines. Therefore, it is imperative that both maintenance personnel and pilots make every effort to know their aircraft and their procedures to the degree that they have the knowledge to make a proper decision and make that decision with safety of flight in mind.

As a result of the investigation, the Safety Board again expresses its concern about the degree of surveillance which can be effected by FAA personnel. As can be seen by the workload of the Principal Operations Inspector and the Principal Maintenance Inspector assigned to this company, they would be hard pressed to keep their standards of inspection up to the high standards expected. The advent of a new and more comprehensive 14 CFR 135 will not relieve, but rather will increase, this workload.

Therefore, the Safety Board reiterates three recommendations made to the Federal Aviation Administration in connection with commuter airline accidents, which occurred on September 6, 1977, and September 2, 1978:

> "Revise the surveillance requirements of commuter airlines by FAA inspectors to provide more stringent monitoring. (Class II, Priority Action) (A-78-37)"
>
> "Identify FAA offices responsible for the surveillance of large numbers of air taxi/commuter operators and insure that adequate inspectors are assigned to monitor properly each operator. (Class II, Priority Action) (A-78-38)"
>
> "Strengthen surveillance and enforcement programs directed toward Part 135 operators to: (1) Provide adequate staffing of FAA facilities charged with surveillance of Part 135 operators; (2) assure uniform application of surveillance and enforcement procedures; and (3) upgrade enforcement procedures and actions in order to provide a viable deterrent to future violations. (Class II, Priority Action) (A-79-31)"

The investigation of this accident was made more difficult and more time-consuming by the lack of definitive information concerning the aircraft's performance and the flightcrew's reaction to the emergency situation. Information from a flight data recorder and a cockpit voice recorder would have provided invaluable information and would have contributed significantly to the total investigative effort. The Safety Board believes, as it has stated in the past, that these recorders are virtually a prerequisite to improvements in safety in commuter/air taxi operations involving complex multiengine aircraft.

3. CONCLUSIONS

3. Findings

1. The flightcrew was properly certificated and qualified.

2. The aircraft was properly certificated and maintained according to approved procedures.

3. The aircraft's weight was over limits but its balance was probably within limits.

4. Neither the weather, the flight control systems, the airframe, or the left engine were factors in the accident.

5. The right engine power section had experienced a severe overtemperature on the day before the accident and some damaged components had been replaced, cleaned, and put back into service.

6. The engine manufacturer's manuals available to the maintenance personnel at the time of the engine repair did not specify criteria for acceptance or rejection of a power turbine based on visual observation.

7. The severity of the overtemperature should have been obvious to experienced maintenance personnel.

8. The Director of Maintenance exercised poor judgment when he did not replace the engine or change the power turbine.

9. One blade of the right engine power turbine failed sometime between engine start at Denver and takeoff at Cheyenne.

10. The right engine failed as the result of the failure of four power turbine blades immediately after takeoff from Cheyenne.

11. The failure did not reduce right engine torque to a value that would cause the propeller to feather automatically.

12. The flightcrew delayed their actions to manually feather the right propeller because they believed that it would feather automatically.

13. The flightcrew was faced with time critical decisions under adverse conditions.

14. The flightcrew had not been trained nor were they required to be trained for engine failures during maximum weight takeoffs.

15. The aircraft was capable of maintaining flight with the right propeller feathered but with an 82-percent loss of its two-engine climb performance.

16. Circumstances did not dictate that the flightcrew attempt a landing on the runway immediately after the right engine failed.

17. The flightcrew's judgment was erroneous when they made a right turn instead of continuing flight straight ahead on runway heading.

18. The right turn degraded the climb performance of the aircraft.

19. The flightcrew used poor judgment when they assumed that a landing was inevitable after they had completed the turn to the right.

20. The aircraft should have been able to continue level flight or to climb after the right turn was completed and the right propeller feathered.

3.2 Probable Cause

The National Transportation Safety Board determined that the probable cause of the accident was the flightcrew's erroneous determination that the aircraft was not capable of single-engine flight and their actions which precluded obtaining maximum available performance from the aircraft. The cause of the engine failure was an erroneous assessment by company maintenance personnel of damage sustained by the right engine during an overtemperature condition and their poor judgment in deciding to repair and release the engine for flight without replacing the engine's power turbine section.

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

July 19, 1979

5. APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The Safety Board was notified of the accident about 0900 on February 27, 1979. The investigative team went immediately to the scene. Working groups were established for operations, air traffic control, witnesses, weather, human factors, structures, systems, powerplants, and maintenance records.

Participants in the on-scene investigation included representatives of the Federal Aviation Administration, Rocky Mountain Airways, Inc., the DeHavilland Aircraft of Canada, Ltd., Pratt & Whitney Aircraft of Canada, Ltd., Hartzell Propeller, Inc., and Woodward Governor Company.

2. Public Hearing

There was no public hearing held concerning this accident.

3. Depositions

Deposition proceedings were held on March 7, 1979, in Denver, Colorado. Testimony was taken from Rocky Mountain's Director of Maintenance and the Pratt & Whitney Aircraft field representative. A pilot and a mechanic employed by Rocky Mountain were also deposed. Participants in the deposition proceedings included representatives of the Federal Aviation Administration, Rocky Mountain Airways, Inc., and Pratt & Whitney of Canada, Ltd.

APPENDIX B

PERSONNEL INFORMATION

Captain Paul Douglas Brose

Captain Paul Douglas Brose, 26, was hired by Rocky Mountain Airways, February 6, 1978. He holds Airline Transport Pilot Certificate No. 2063902 for airplane single- and multiengine land. He has a First Class Medical Certificate dated October 19, 1978, with no limitations or waivers.

Captain Brose was qualified as a first officer, February 23, 1978, and as a captain, January 11, 1979. He passed his last proficiency check in the DHC-6, January 11, 1979. He had accumulated about 3,742 total flight-hours, 794 hours of which were in DHC-6 aircraft. His total instrument time was 260 hours. His flying time during the last 90 days was 201.6 hours and in the last 30 days was 73.0 hours. In the last 24 hours he had flown 2.1 hours. His duty time for the last 24 hours was 4.0 hours and his rest period in the 24 hours before this flight was 20.0 hours.

Captain Brose had successfully completed the company's initial and recurrent ground and flight training programs. He was route qualified for the flight involved.

First Officer Richard Edward Green

First Officer Richard Edward Green, 34, was hired by Rocky Mountain Airways, February 21, 1978. He holds Airline Transport Pilot Certificate No. 2094082 with ratings of airplane multiengine land with commercial privileges and airplane single-engine land. He has type ratings in Boeing 707 and 720 aircraft. He has a First Class Medical Certificate dated February 1, 1979, with no limitations or waivers.

First Officer Green was checked out as a first officer, February 21, 1978. He passed his last flightcheck, February 21, 1978, and was due for another check before the end of February 1979. He had accumulated about 2,672 total flight-hours, 1,110 hours of which are in DHC-6 aircraft. His total day time was 2,317 hours, his total night time was 420 hours, and his total instrument time was 159 hours. His flying time during the last 90 days was 209 hours and in the duty time for the last 24 hours was 4.0 hours and his rest period in the 24 hours before this flight was 20.0 hours.

First Officer Green had successfully completed the company's initial training and was route qualified for the flight involved.

APPENDIX C

AIRCRAFT INFORMATION

DeHavilland DHC-6-300, serial No. 372 was manufactured, September 21, 1973. It was certificated and maintained according to procedures approved by the FAA. At the time of the accident, the aircraft had accumulated 16,024 flight-hours; 24 hours 48 minutes had been flown since the last major inspection.

The aircraft was equipped with two Pratt & Whitney of Canada, Ltd., PT6A-27 turboprop engines and two Hartzell Propeller, Inc., Model HC-B3TN-3DY three-bladed propellers. Design No. T10282HB propeller blades were installed in each propeller.

Engine Data

Installed Position:	Left	Right
Serial Numbers:	PC-E 40719	PC-E 40452
Total Times:	14,821:10	10,793:16
Total Cycles:	19,762	14,392
Time Since Last Overhaul:	7,705:10	7,705:10
Cycles Since Last Overhaul:	10,274	10,274
Date of Last Overhaul:	July 10, 1976	August 19, 1976
Date of Installation:	October 26, 1976	October 25, 1976
Date of Manufacture:	December 1972	December 1969

The above times are in hours/minutes and are as of 0600 on February 27, 1979.

An entry in log sheet number 263-6 indicated that a power section, serial No. 40452, was installed in the right engine, August 22, 1978. Engine time since overhaul at the time of the power section installation was 5897:37 hours.

The last right engine combustion section inspection was performed, November 4, 1978. Engine time since overhaul was 6,555:41 hours at the time of the inspection.

The left engine was last overhauled by Cooper Airmotive, Inc., Dallas, Texas. The right engine was last overhauled by Pratt & Whitney Aircraft of Canada, Ltd., Longueuil, Quebec, Canada.

Propeller Data

Installed Position:	Left	Right
Hub Serial Number:	BU4512	BU4106
Total Time:	9,856:18	11,763:0
Time Since Last Overhaul:	1,472:12	1,038:24
Date of Last Overhaul:	September 25, 1978	June 29, 1978
Date of Manufacture:	December 12, 1974	May 5, 1973
Date of Installation:	December 18, 1977	November 4, 1978

The left propeller logbook showed an entry indicating that the propeller was manufactured, December 12, 1974; however, a second entry indicated that the propeller was received at DeHavilland on March 25, 1974. Therefore, the manufacture date is apparently in error.

Both propellers were overhauled by Aero Propeller, Inc., Broomfield, Colorado, which is a Federal Aviation Administration certificated repair station.