ROCKY MOUNTAIN AIRWAYS, INC.
AERO COMMANDER 680V, N6359U
ASPEN, COLORADO
JANUARY 22, 1970

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File No. 3-0033

NATIONAL TRANSFORTATION SAFETY BOARD
WASHINGTON, D. C. 20591
AIRCRAFT ACCIDENT REPORT

Adopted: December 29, 1971

ROCKY MOUNTAIN AIRWAYS, INC.
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SYNOPSIS

Rocky Mountain Airways, Inc., Flight 10, Aero Commander 680V, N6359U, crashed at approximately 0806 mountain standard time, January 22, 1970, near Aspen, Colorado. While the aircraft was in a left turn, it struck obstructing high terrain during a go-around after the pilot discontinued an approach to land on Runway 15 at Sardy Field, Aspen, Colorado. Eight persons, seven passengers and the pilot, were aboard. All received fatal injuries. The aircraft was destroyed by ground impact.

The National Transportation Safety Board determines that the probable cause of this accident was the pilot's deviation from the company's informal go-around procedure for Sardy Field. It was necessary for the pilot to make a go-around because the aircraft was too high on a straight-in approach. The execution of the go-around was hindered by ice accumulation on the windshield, which obscured obstructing terrain in the maneuvering area. The Board further finds that the company operations manual was inadequate since it did not provide a go-around procedure for this specific airport.

The Board refers to previous recommendations made to the Federal Aviation Administration regarding ice protection for all aircraft operating in known icing conditions and reaffirms that all such aircraft should be equipped with deicing and/or anti-icing equipment meeting the requirements of Part 25.

1. INVESTIGATION

1.1 History of the Flight

Rocky Mountain Airways, Inc., Flight 10, an Aero Commander 680V, Aeroliner, N6359U, departed Stapleton Airport, Denver, Colorado, about 0711 m.s.t. 1/ on January 22, 1970, for Sardy Field, Aspen, Colorado. The flight was a scheduled air taxi flight, operating under the provisions of Part 135 of the Federal Aviation Regulations. 2/ Flight 10 was cleared from Denver to Aspen, in accordance with an Instrument Flight Rules (IFR) Center Stored Flight Plan. 3/ (See Appendix D.)

According to the Air Route Traffic Control Center (ARTCC) transcript of communications with Flight 10, after takeoff, the flight was cleared to climb to 17,000 feet altitude. The pilot reported reaching 17,000 feet at 0723:55.

At 0731:50, Flight 10 was operating in clouds and the pilot reported light rime icing. When he was passing Sandstone 4/ at 0745:55, the pilot requested a lower altitude and, at 0745:55, the flight was cleared for a descent to 14,000 feet. At 0746:45, the pilot reported that Flight 10 was still in the clouds and that the aircraft was "picking up" light-to-moderate clear ice. The 0756 radar position of Flight 10 was 8 miles south of Eagle, Colorado.

At 0757, Denver ARTCC cleared Flight 10 for a Carbondale beacon approach to Sardy Field, Aspen, Colorado, with instructions for the pilot to report over Carbondale that he was either executing a missed-approach 5/ or canceling his IFR flight plan.

The pilot of Flight 10 cancelled his IFR flight plan at 0759. He reported that the flight had broken out into the clear at 11,400 feet.

About 0800, the pilot requested landing instructions from the Sardy Field Tower. At this time he reported the flight was 7 miles northwest of the airport. Flight 10 was cleared by the tower controller to make a straight-in approach to Runway 15. The pilot requested Aspen weather information and was furnished the 0700 reported weather for Sardy Field which was: partial obscuration, 3,000 feet scattered, estimated 5,000 overcast, 8 miles visibility, very light snow, temperature 30° F., dew point 28° F., wind calm, altimeter setting 30.12 inches.

At 0802, the pilot advised the tower that he would circle 5 miles west of the airport to lose altitude. At 0803, the controller observed Flight 10 as it approached the runway but it appeared to be high for landing. Shortly thereafter, the pilot

NOTE: All footnotes appear on page 21.

radioed that he would circle to land. He said he had ice on the windshield. The controller acknowledged the pilot's intentions and advised him that his position was "just east" of the thresh-' old of Runway 15. The pilot acknowledged this advisory and then began a left turn to a northeasterly heading. At 0806, while it was still turning left, Flight 10 struck rising terrain northeast of the threshold of Runway 15.

Several persons witnessed the go-around and/or the crash of Flight 10. Most of these witnesses agreed that the pilot initiated the go-around with a left turn as the aircraft approached the end of Runway 15. The turn was continuous, as was the engine noise, until the aircraft struck the mountain ridge located three-fourths of a mile northeast of, and about opposite the threshold of Runway 15. The aircraft appeared to climb slightly during the initial part of the turn, level off and then descend slightly before it crashed on the ridge.

Two witnesses observed the aircraft from their automobile while they were traveling on the McClain Flats Road east of the airport. The aircraft was in a left-climbing turn and the landing gear was up. One of these witnesses estimated that the angle of the bank was 45° and said that it increased to almost vertical just before the aircraft struck the ground. Both witnesses thought the aircraft appeared heavy during the climb and that it was losing altitude before impact. One of these witnesses described the weather conditions as freezing rain with icing on the automobile's windshield. (Witnesses Nos. 3 and 4, Appendix D.)

Other witnesses described the weather as "snowing lightly with fine flakes," and "quite a bit of sleet-type snow."

One witness observed the go-around and crash of Flight 10 from his residence, which was located approximately 1,000 feet north of the accident site. (Witness No. 2, Appendix D.) He said that the aircraft's angle of climb was fairly shallow, the airplane did not seem to be going very fast, and, as it made a long sweeping turn toward him, he could see that the landing lights were burning. 6/ He said this turn was not hurried or sharp, but it seemed to be a climbing turn and, after the turn was completed, the aircraft appeared to be on a north-northeast course, at a very low altitude. He said that the ground and the aircraft seemed to be closing together rapidly but that he could not determine whether the aircraft was sinking or if the rate of climb was insufficient for the upslope gradient of the terrain in the direction of flight. His impression was that the plane was climbing. He said, "The plane did not change its heading or angle of attack. It flew unwavering on a collision course with the hillside, and the Murray's house in particular. Just as it seemed that it might crash into the house, it suddenly dropped

out of the sky." He said it was very close to the Murray's house but that it was high enough for him to see it pancake; it did not fall off on one wing or nose down. He estimated the Murray's house was about 1,000 feet to the south of where he was standing.

The aircraft made initial ground contact near the northwest corner of the Murray's residence.

The accident site was at an elevation of 8,020 feet m.s.l., 1/ three-fourths of a mile from Runway 15, opposite a point on the runway approximately 1,000 feet southeast of the threshold. The magnetic heading from the runway threshold to the accident site was 072°.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other
Fatal	1	7	0
Nonfatal	0	0	0
None	0	0	

1.3 Damage to Aircraft

The aircraft was destroyed by impact.

1.4 Other Damage

An automobile parked near a private residence and the wooden retaining wall in front of the residence were damaged substantially.

1.5 Crew Information

The pilot was properly certificated and qualified for this flight. (For detailed crew information, see Appendix B.)

1.6 Aircraft Information

The aircraft had been maintained in accordance with applicable Federal Aviation Administration and company regulations. The weight and balance were within limits at takeoff and at the time of the accident.

The aircraft had been fueled with aviation kerosene. (For additional aircraft information, see Appendix C.)

1.7 Meteorological Information

Surface weather observations for Aspen, Colorado. on the day that the accident occurred were, in part, as follows:

0700 Partial'obscuration, 3,000 scattered, estimated 5,000 overcast, 8 miles, very light snow 30° F., 28° F., calm, 30.12 inches. 8/

0800 Partial obscuration, 3,000 scattered, estimated 5,000 overcast, 8 miles, light snow, 31° F., 29° F., calm, 30.11 inches.

0807 Special, partial obscuration, 3,000 overcast, 5 miles light snow, 1900 4 knots, 30.17 inches.

The Aviation Area Forecast issued by the Weather Bureau Forecast Office at Denver, Colorado, at 0545, valid 0600 to 1800, included a forecast of light icing with chance of moderate icing in clouds above the freezing level. The freezing level was generally 6,000 to 8,000 feet m.s.l.

Rocky Mountain Airways, Inc., Flight 12, a DHC-6-300 Twin Otter aircraft, arrived at Sardy Field, Aspen, Colorado, about 0820, from Denver after a stop at Eagle, Colorado. The Eagle to Aspen portion of the flight was conducted in visual flight conditions, via the Carbondale radio beacon at an altitude of 9,500 feet. The pilot of Flight 12 did not encounter icing conditions on this leg of the flight but said that the aircraft accumulated between 1 1/2 and 2 inches of rime ice at 16,000 feet in the vicinity of Sandstone while en route Denver to Eagle.

1.8 Aids to Navisation

The company-owned nondirectional radio beacon (NDB) located at Carbondale, Colorado, is the IFR clearance limit for flights inbound to Aspen's Sardy Field. The minimum IFR altitude over the beacon is 10,800 feet m.s.l.

The magnetic heading from Carbondale to Sardy Field is 117°; the distance is 17 miles.

There are no navigational aids installed between the Carbondale beacon and sardy Field, or on Sardy Field. Because of this, company procedures require inbound IFR flights to establish visual flight conditions at or above 10,800 feet m.s.l., or execute a missed-approach at Carbondale. 9/ Since there is no airport at Carbondale, the flight would have to proceed to an alternate destination if a missed-approach were executed.

1.9 communications

There were no communications difficulties.

1.10 Aerodrome and Ground Facilities

Pitkin County Airport (Sardy Field) is located 3 miles northwest of Aspen, Colorado. The airport is located in a mountain valley, at an elevation of 7,794 feet above sea level. The valley is narrow and surrounded by steeply rising higher terrain.

Sardy Field has a single runway. It is 6,000 feet long, 60 feet wide, asphalt surfaced, and oriented 150° to 3300. Due to the hazardous terrain environment, all landings are made on Runway 15 and takeoffs are from Runway, 33 unless prior arrangements are made with the controlling authority. The control tower operates during daylight hours only.

1.11 Flight Recorders

N6359U did not have a flight recorder or a cockpit voice recorder installed and none was required.

1.12 Wreckage

N6359U made initial ground contact with its left wingtip and lower fuselage while on a heading of 340° magnetic. There were shallow gouge marks in the snow-covered ground at this point. The terrain sloped downward 13.5° at right angles to the initial line of contact. At this point the bank angle of the aircraft was approximately 33°. The aircraft slid forward 60 feet from the initial impact point, and it was then projected 160 feet across a slight depression before it made primary contact with the upslope of an embankment and came to rest 16 feet beyond.

Except for a tip broken from one blade of the right propeller, the entire aircraft structure was accounted for at the scene.

The windshield anti-icer alcohol tank was ruptured and empty. The tank filler cap was in place. The lines at the bottom of the tank were broken and had separated from the tank.

The cockpit area was heavily damaged but the following were noted:

Landing gear selector	Up
Flap selector	Position undetermined due to damage.
Propeller controls	Full forward, right bent over left

Left throttle	Full forward
Right throttle	Flight idle
Ignition switches	On
Generator switches	On
Firewall shutoff switches	Both open
Fuel interconnect (cross feed)	Off
Fuel valves	Both on
Ignition override	Normal
Pilot's altimeter	Setting 30.12, hands missing
Copilot's altimeter	Setting 30.02, 8,160 feet indicated
PN101 compass (RMI) type	341°
windshield alcohol switch	Off with toggle bent toward low position. This panel torn from mount.
Deicer boot switch	Off position
Engine inlet anti-icing switches	Both on
Left exhaust gas temp. (EGT)	4710 C. Instrument intact with minor damage.
Right EGT	492° C. Instrument intact with minor damage.

The left main gear and nose gear were in the retracted position with the doors closed. The right main gear was extended. The right landing gear doors and the right nacelle were separated from the main structure.

The position of the wing flaps at impact could not be determined due to extensive damage to the aircraft.

1.13 Fire

Fire did not occur.

1.14 Survival Aspects

This accident was nonsurvivable.

1.15 Tests and Research

1.15.1 Propulsion System

A Propulsion System Teardown Inspection of Aero Commander 680V, N6359U, Turboprop Engine Model TPE331-43A, serial Nos. P-61087C and P-61123, was conducted by the Board at Airesearch Manufacturing Company of Arizona, Phoenix, Arizona, on February 3, and 4, 1970. The propellers were disassembled and inspected by G-ttosen Propeller Service, Inc., of Phoenix, Arizona. The engine and propeller teardowns were witnessed by representatives of the National Transportation Safety Board and the Federal Aviation Administration. A representative of Hamilton Standard Company assisted in the disassembly and inspection of the propellers.

a. Powerplants

All engine components of each engine received operational tests, except those damaged by impact to the extent that testing was impossible. Most of the components tested met operational requirements. The deviations from normal in those which did not meet operational requirements were determined to have been caused by impact damage.

b. Propellers

The propellers of both engines were disassembled and inspected and no evidence of preimpact malfunction or failure was found. The damaged condition of the propeller hub and blades precluded any definite findings as to the blade angle of either propeller at the time of impact.

1.15.2 Engine Instruments

The two damaged BH185R-71 Autotemp Indicators were examined by Howell Instruments, Inc., Fort Worth, Texas.

Before power was applied to the units, the following information was noted:

a. Right Engine Indicator (EGT - Exhaust Gas Temperature)

1. Digital counter read 492°

2. Connector pulled loose from rear cover but wiring was intact.

b. Left Engine Indicator (EGT)

1. Diaital counter read 471° C.

2. Case bent slightly about 2 inches behind dial.

3. Connector pushed into rear cover about one-quarter inch.

When 115 volts 400 cycles per second (c.p.s.) power was applied, the units responded normally to a calibrated thermocouple input signal and both units operated normally through a test range of 100° C. to 1,1000 C.

The digital counter in these units will not change reading unless 115 volts 400 c.p.s. power is applied.

The manufacturer computed engine horsepower under the conditions existing at the time of the accident. The computations were based on the following figures:

Altitude	7,800 feet
Temperature	31° F. (static)
Airspeed	120 knots
Engine speed	100 percent r.p.m.

At these conditions they found that at the EGT readings of 471° C. and 492° C., the horsepower should have been 310 s.hp (shaft horsepower) and 348 s.hp, respectively.

Additional computations produced the following estimated horsepowers:

Maximum Continous Power	550° C. EGT.	41C s.hp/eng.
Takeoff power	576° C. EGT,	452 s.hp/eng

1.15.3 Aircraft Svstems

a. Windshield Anti-ice System

The aircraft windshield, left side only, was equipped with an external alcohol anti-icing system. 10/ This system

includes an electric-driven pump and a 3-gallon tank installed in the right engine nacelle. Appropriate plumbing connects the pump to a spreader bar located on the fuselage just forward of the pilot's windshield. When fully serviced, the tank holds sufficient fluid for 87.5 minutes of operation at a minimum flow rate of 2.06 gallons per hour (g.p.h.) and 61.8 minutes at a maximum flow of 2.92 g.p.h.

The pump was removed from the wreckage and bench-checked. An electrical source of 28 volts 1.5 amperes was applied and the pump flow cut in at 14 p.s.i. A maximum flow rate of 2.9 g.p.h. was obtained without a flow regulator. When fluid flow was restricted, the pump developed 60 p.s.i. The pump was found to be operational.

The alcohol tank had been filled before Flight 10 departed Denver.

b. Windshield Defossing

Windshield defogging utilizes hot air from the cabin heater system.

The cabin heater was disassembled and bench-tested. No evidence or preimpact failure or malfunction was found. Fuel was found in the heater. When power was applied to the igniter unit, the igniter plug produced a sustained arc.

1.15.4 Aircraft Performance Tests

a. Computer Performance

Performance calculations conducted for the Board by the manufacturer were used in an attempt to determine the nature of the terminal maneuver of N6359U. These calculations showed that, with gear and flaps retracted and at a power setting commensurate with the EGT readings of 4720 C. and 492° C., the aircraft should have been able to clear the terrain at the site of the accident by a considerable margin, if a 170° climbing left turn had been initated at a point short of and 300 feet over the end of Runway 15.

b. Flight Test Performance

National Transportation Safety Board and Federal Aviation Administration personnel conducted flight tests on February 9, 1970, in the Denver, Colorado, area. An Aero Commander, Model 680V, with performance parameters essentially the same as those of N6359U, was used. The tests were performed specifically to determine what combination of bank angle, flap setting, and power

application would produce an essentially level turn, the diameter of which would be three-quarters of a mile or less.

To simulate the conditions that existed on January 22, 1970, the test aircraft was flown at a comparable gross weight. All test runs were started at 7,800 feet. The outside air temperature was 36° F. at 8,000 feet. Four runs were made at various flap and power settings, and bank angles. However, once the aircraft was established in a turn, the flap setting, bank angle, and power setting remained constant throughout the turn.

The results of these tests indicated that the aircraft would remain essentially level while turning within a diameter of three-quarters of a mile (with a power setting based upon an EGT of 4710 and 492°) if the following conditions were met:

Engine r.p.m.	98 percent	**IAS**	**120** kts.
Flaps	1/2	Bank Angle	45
Gear	Retracted	Engine Anti-ice	

Other combinations of a lower flap setting, and higher power or lower bank angle produced either climbing turns of greater turn radius or turns which resulted in considerable altitude gain.

A simulated balked landing and go-around was started at 7,800 feet using flight manual procedures (Appendix G). The aircraft was flown in a climb straight ahead for about one-quarter of a mile: a left standard rate climbing turn (approximately 25° bank angle) was started and maintained through 1700 of'turn. During this turn, 1,700 feet of altitude was gained and the diameter of the turn was slightly more than 1 mile.

1.16 Pertinent Information

The possibility of airframe ice was discussed with the Pitkin County sheriff who had considerable experience with aircraft accidents and was familiar with aircraft accident investigating techniques. He received notification of the accident at approximately 0808. He immediately departed Aspen for the accident site and arrived at the site at approximately 0813. He did not observe any ice on the aircraft structure or on the wing deicer boots.

A company pilot, who flew N6359U in mid December of 1969, reported that he encountered "extra icing conditions" on the flight. He used windshield alcohol which was successful until

the alcohol supply was depleted. The windshield iced up and restricted his forward visibility for the landing at Sardy Field. He stated that he had excellent side visibility and that he used a forward left slip approach with a kickout at the threshold when he made his approach and landing. He further stated that there was no malfunction in the alcohol and anti-ice system, but that the alcohol supply, which he did not check prior to the flight, was not full at takeoff.

This company pilot reported his procedure for a balked landing from a landing approach configuration to be:

> Full power, gear up, straight and level attitude, flaps up in stages. Then turnout and climb.

The company operations manual did not contain instructions for a balked landing or VFR go-around procedures for the Aero Commander 680V at Aspen, Colorado. Company officials stated the go-around procedures at Aspen, and at all other stations, were included in their procedures by oral instructions to all pilots.

According to the president of Rocky Mountain Airways, for a go-around at Sardy Field he would expect the pilot to:

> Apply maximum power, retract the gear, raise the flaps to the one-quarter position. climb straight ahead down the runway at 110 knots IAS (single engine climb speed), and begin a left turn when an altitude of 9,000 feet m.s.l. could be assured on the downwind leg.

Subsequent to the accident, the company revised its operations manual to include missed-approach procedures at Aspen, Colorado. They also amended the manual to direct that company pilots shall not enter the traffic pattern or control zone area of the Aspen airport with a windshield obscured by ice, frost, or fog. The same restriction also applied to a takeoff from Aspen.

N6359U was not equipped with a windshield wiper system.

The aircraft flight manual states, "flight into known icing conditions prohibited unless aircraft is in compliance with Service Letter No. 196." The subject of the service letter is "Flight into known icing conditions." Compliance is recommended "at Owners discretion."

The aircraft records indicate that, except for a windshield wiper, ice protection equipment was installed in accordance with Service Letter No. 196C dated February 12, 1968. The Service Letter contained a list of equipment which included a windshield wiper.

Company officials reported they did not desire a windshield wiper on the aircraft. They asked for and were given (verbal) authority to operate without it from the FAA principal operations inspector assigned to Rocky Mountain Airways. The company was operating this flight under the provisions of FAR Part 135, Air Taxi Operators and Commercial Operators of Small Aircraft. Paragraph 135.85 (b) states:

(b) NO pilot may fly

(1) Under IFR into known or forecast light or moderate icing conditions; or

(2) Under VFR into known light or moderate icing conditions, unless the aircraft has functioning deicing or anti-icing equipment protecting each rotor blade, propeller, windshield, wing, stabilizing or control surface, and each airspeed, altimeter, rate of climb, or flight attitude instrument system.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The investigation of this accident found the aircraft to have been maintained in an airworthy condition, and the pilot to have been certificated and qualified for the operation involved.

Flight 10 departed Stapleton Airport, Denver, Colorado, for Sardy Field, Aspen, Colorado, at 0710:45. The initial portion of the flight was conducted in accordance with Instrument Flight Rules. At 0723:55, the pilot reported reaching 17,000 feet m.s.l., the assigned altitude. At 0731:50, the pilot reported light rime ice. At 0746:45, the pilot reported he had encountered light to moderate icing and some clear icing during a descent from 17,000 to 14,000 feet. At 0759:25, Flight 10 reported clear of clouds at 11,400 feet, proceeding to Aspen by Visual Flight Rules.

Based on the pilot's reports during the flight from Denver to Aspen, the flight encountered light rime icing for approximately 15 minutes and light-to-moderate rime and some clear icing for an additional 13 to 14 minutes, for a total exposure of approximately 30 minutes.

At takeoff, the pilot had sufficient windshield anti-icing alcohol for 86 minutes of system operation. Used properly, the system would have kept the windshield ice-free, under the conditions of this flight.

There are no navigational facilities at sardy Field, Aspen, colorado, and the limit of the pilot's IFR clearance was the Carbondale nondirectional radio beacon which is owned and maintained by Rocky Mountain Airways. The minimum descent altitude IFR is 10,800 feet m.s.l. over the Carbondale radio beacon. If VFR conditions are established prior to or upon reaching this altitude, the flight may continue to Sardy Field VFR, for a landing. If he does not encounter VFR conditions at 10,800 feet over the beacon, the pilot must execute a missed-approach at the beacon and may not proceed to Sardy Field.

The elevation of Sardy Field is 7,794 feet m.s.l. The field is located 17 miles from the Carbondale radio beacon on a magnetic heading of 117°. At 0759:25, the pilot reported that he had established VFR conditions and had "broken out" at 11,400 feet m.s.l. over Carbondale.

The 0800 surface weather observation at Aspen was reported as: Partial obscuration, 3,000 scattered, estimated 5,000 overcast, 8 miles, light snow, 31° F., 29° F., calm, 30.17 inches.

The amount of the obscuration was not specified in tenths of sky coverage; however, light snow was reported and the freezing level would have been at the surface. Also, a witness traveling by auto near the airport reported windshield icing at the approximate time of the approach and crash of Flight 10.

The Aviation Area Forecast, valid 0600 to 1800, included a forecast of light icing with chance of moderate icing in clouds above the freezing level, which was forecast to be 6,000 to 8,000 feet, generally.

In view of the evidence, the Board believes that most likely the pilot of Flight 10 properly handled the en route icing problem and that he departed from the Carbondale radio beacon VFR. The Board also concludes that the pilot initiated the landing checklist after he reached a point about 5 to 7 miles northwest of Runway 15, since he had the airport in sight, and that he turned off the windshield anti-ice alcohol to provide better forward vision for landing because the aircraft was not equipped with windshield wipers. Without the alcohol, the windshield accumulated an ice film when the aircraft entered a localized area of precipitation and freezing temperatures similar to that which caused the icing on an automobile windshield.

The position of the windshield anti-icing switch as found in the wreckage [OFF) indicates that the pilot did not use the alcohol to attempt to remove the ice on the windshield. The system is designed to prevent ice formation. It is not very efficient in its ability to remove ice after its formation; however, since it was the only means available, it is logical to conclude that if the ice on the windshield were of major concern, the pilot would have had it on in the hope that the alcohol would alleviate the condition.

sardy Field is located in a narrow mountain valley and is restricted to use during the hours of daylight, in VFR conditions only. Departures and go-arounds associated with Runway 15 are extremely hazardous because of the rising terrain adjacent to the airport. Takeoffs on Runway 15 and landings on Runway 33 are not authorized without prior approval. The traffic pattern that was in use graphically illustrates the nature of potential problems that must be reckoned with when arriving at or departing from the airport. (See Appendix F.)

Company officials have stated that at the time of the accident, an understanding existed between the company and its pilots to the effect that the go-around procedures outlined in the aircraft flight manual would be used when they made a go-around at Aspen. The technique advocated by the company included a requirement for the pilot to climb straight ahead, using

maximum power, until terrain clearance was assured. However, these instructions were not contained in the company operations manual that was in use at the time of the accident. Subsequent to this accident, the company operations manual was amended to include detailed instructions for a go-around procedure to be used at Aspen. This procedure includes a straight ahead climb at maximum power to an altitude of 8,500 feet m.s.l., where a left climbing turn is started and continued until reaching normal traffic pattern altitude of 9,000 feet m.s.l.

The reason for the go-around, in this instance, is not entirely clear. En route from the Carbondale NDB to Sardy Field, the flight contacted the Sardy control tower operator and reported his position as 5 miles west and circling to lose altitude. The next transmission to the tower informed the controller that the aircraft had ice on the windshield and the pilot was taking it around. The controller had noted just prior to this transmission that the aircraft "appeared to be too high to land." It is not clear whether ice on the windshield or excess altitude on the approach (or a combination of both) was the reason for the go-around. Regardless, a consensus of the witnesses places the aircraft in a level left turn, with about a 45° bank, from a point approximately over the threshold of Runway 15 to the accident site on the slope of a hill three-fourths of a mile to the northeast.

The pilot was seated in the left pilot seat. With ice on the windshield the only means of obtaining forward vision, under the circumstances facing the pilot of N6359U, was to utilize a left slip and kick out just before touchdown. Most pilots are familiar with the slipping maneuver which permits forward vision through the side window. One company pilot stated that he used a slip and kickout on a flight he flew in December when his windshield became coated with ice.

If the pilot of N6359U was in a proper position, altitude-wise, during the approach to effect a landing, it is logical to expect that he would have used the slip maneuver to gain forward visibility and thus line up with the runway and land. That he chose to go-around would tend to indicate that he was too high on the approach.

The Board does not condone the slip and kickout maneuver to gain forward visibility during an approach to a landing, especially by a pilot who is carrying passengers and/or cargo. Moderate slips are an accepted maneuver for crosswind landings in small aircraft. However, slips of the magnitude necessary for forward visibility could result in unbalanced flight forces which are, in the least, uncomfortable to the passengers and can shift unsecured cargo resulting in changes in the aircraft's center of qravity.

The elevation of the accident site was 8,020 feet. The runway elevation was 7,794 feet. As stated previously, witnesses place the aircraft in an essentially level turn throughout the 1700 of turn. This means that the turn was started from a position approximately 200 feet above the runway threshold. The altitude throughout the approach would also have been high and condusive to a decision to continue on around and lose the excessive altitude in the final phases of the "circling approach."

To aid in determining the terminal maneuvers of N6359U, the Board conducted a series of in-flight simulations utilizing a similar aircraft. The aircraft's configuration and terminal manuvers as depicted by wreckage examination and witness observations were most nearly duplicated under the following conditions:

a. 45° left bank

b. constant altitude, constant airspeed (12F knots)

c. landing gear retracted

d. one-half flaps

e. engine power setting based on an EGT of 4710 and 4920

f. engine anti-ice on

These in-flight simulations and the manufacturer's performance calculations indicate that the turn radius would have been larger, and/or the altitude at the completion of 1700 of turn would have been higher, if the aircraft had flown the maneuver with flaps retracted.

If the standard go-around procedure had been executed, sufficient altitude would have been gained to clear all terrain.

The in-flight simulations and performance calculations also showed that the attempted maneuver could have been safely conducted if maximum power had been used at the initiation of the go-around. With maximum power, 45° of bank, and the airspeed held constant (approximately 120 knots), the turn radius would be similar but the aircraft would climb during 170° of turn to a position well clear of obstructing terrain.

Since he was familiar with sardy Field, the pilot must have assumed that a left-hand turn from his position over the thresh-

old of the runway would put him well inside the high terrain which lay three-fourths of a mile to his left. He had only to make a level left turn, keeping the threshold of Runway 15 in sight through the left side window and descend to the runway during the final 180° of the turn. The proper placement of his aircraft with relation to the runway and the hill could only be made through observation of the runway, as the aircraft came around to the runway reciprocal heading (330°). The proximity of the hill to the right could not be determined due to the ice on the windshield.

The Board therefore concludes that the pilot, finding himself high on the approach with ice on the windshield, decided to take the airplane around in a tight, level, circling approach to the left. His inability to see the high terrain to the northeast of his intended landing point because of ice on the windshield and the banked attitude of the aircraft caused him to ignore this danger. His turn radius was greater than expected and he flew into the high ground which lay in his flightpath white his attention was directed to his left toward the end of Runway 15.

A discrepancy is noted in the altimeter setting found on the captain's altimeter in the wreckage (30.12 inches Hg) and the altimeter setting (30.17 Hg) as determined during the surface weather observations taken at 0800 and 0807 on the day of the accident. This difference in pressure is equivalent to 50 feet in altitude. Since the pilot's altimeter setting was the lower of the two, the aircraft would have been 50 feet higher than the indicated altitude.

2.2 Conclusions

(a) Findings

(1) The aircraft was airworthy at the time of departure from Denver, the pilot was properly certificated and qualified, and the flight was properly dispatched.

(2) There was no evidence of an in-flight failure or malfunction of the aircraft, the powerplants, or systems.

(3) There was no evidence of pilot incapacitation.

(4) The aircraft encountered icing conditions for approximately 30 minutes during the IFR portion of the flight.

(5) At Denver, the alcohol tank of the windshield anti-ice system of N6359U was serviced for 86 minutes of operation.

(6) There was no evidence of a failure or malfunction of the windshield alcohol anti-ice system.

(7) The flight departed the Carbondale radio beacon for Sardy Field in visual flight conditions.

(8) One witness in an automobile traveling approximately parallel to the approach path for Runway 15 encountered freezing precipitation that caused an accumulation of ice on the windshield.

(9) When Flight 10 arrived at Sardy Field for an approach to landing, the pilot reported he had ice on the windshield and would circle to land.

(10) Ice on the windshield obstructed forward vision during the landing approach.

(11) The pilot did not attempt to remove the windshield ice with alcohol.

(12) The pilot did not see the obstructing terrain due to the ice on the windshield, the banked attitude of the aircraft, and his concentration on the runway.

(13) The air taxi operator did not have a procedure in its operations manual specifically for the execution of a go-around for Sardy Field, although the operator had informally instructed its pilots in such a procedure for that airport.

(14) The pilot of Flight 10 had knowledge of the company's informal go-around procedure for Sardy Field. However, he did not follow it in this instance.

(15) Flight 10 collided with obstructing terrain on a heading of 3400 magnetic at an elevation of about 226 feet above the runway threshold and approximately three-fourths mile laterally from Runway 15.

(b) Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the pilot's deviation from the company's informal go-around procedure for Sardy Field. It was necessary for the pilot to make a go-around because the aircraft was too high on a straight-in approach. The execution of the go-around was hindered by ice accumulation on the windshield, which

obscured obstructing terrain in the maneuvering area. The Board further finds that the company operations manual was inadequate, since it did not provide a go-around procedure for this specific airport.

3. RECOMMENDATIONS

Following a Volpar Super 18, N437PA, accident on October 31, 1969, near Kad River Airstrip, North Slope, Alaska, the Board recommended by letter dated September 2, 1970, to the Federal Aviation Administration that: (1) all ice protection equipment installed on aircraft in the future meet the appropriate certification requirements of Part 25: (2) consideration be given to the establishment of requirement whereby all aircraft employed by air carrier and air taxi operators in the carriage of passengers would be required to meet these same as Part 25 specifications; and (3) an intensive educational program be conducted to alert the operators to the limits of effectiveness of their ice protection equipment.

In reply to these recommendations the Federal Aviation Administration by letter dated 7 December 1970 stated,

> "We have considered proposing a requlation to revise all aircraft to meet the FAR 25 icing criteria if they were to be used by air carrier or air taxi operations for flight into known icing conditions. This has been accomplished, in part, by Amendment 18 to FAR 135 which precribes additional airworthiness standards for airplanes with ten or more passenger seats. FAR 135.144 and Appendix A to FAR 135 specify that after 31 May 1972, these airplanes may not operate into known icing conditions unless they have been shown to comply with the icing criteria of FAR 25."

FOOTNOTES

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

2/ Air Taxi Operators and Commercial Operators of Small Aircraft.

3/ Prefiled by Rocky Mountain Airways at Denver Air Route Traffic Control Center (ARTCC).

4/ Intersection of Denver VOR 2490 radial and Kremmling VORTAC 162° radial.

5/ Carbondale radio beacon is the IFR clearance limit. VFR conditions must be obtained before departing Carbondale for Sardy Field.

6/ Company policy and airport rules require that the landing lights be on for all takeoffs and landings at Aspen.

7/ Mean sea level.

8/ This observation was known to the pilot of Flight 10 prior to departure from Denver.

9/ Immediate pullup to the left, climb to 11,600 feet m.s.l. and establish a holding pattern on the inbound heading of 1240 from Carbondale NDB.

10/ An anti-ice system prevents the accumulation of ice.

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The Board received notification of the accident at 0815 on January 22, 1970, from the Federal Aviation Administration. An investigator from the Board's Denver office was immediately dispatched to the scene of the accident.

Interested parties included the Federal Aviation Administration, Rocky Mountain Airways, Inc., Aero Commander Division of North American Rockwell, and Airesearch Manufacturing Company, a Division of the Garrett corporation.

The on-scene investigation was completed January 25, 1970.

2. Public Hearing

A public hearing was not held in connection with this accident.

3. Preliminary Report

An aircraft accident preliminary report was published by the Board on March 12,1970.

APPENDIX B

CREW INFORMATION

Russell Starling Harrison, aged 35, possessed airline transport rating certificate No. 1367857, airplane multiengine land, and a flight instructor rating. Included were commercial privileges in airplane single-engine land. He held a current first-class medical certificate with no limitations listed.

Company records show he had completed initial ground and flight training in the aircraft involved. His last company line check in the Aero Commander 680V was on November 20, 1969, and he was graded qualified. His last FAA en route check was conducted in the same aircraft on December 18, 1969, and was graded satisfactory. According to the company, the pilot's last period of duty, prior to the accident flight, ended at 1300 on January 21, 1970, and he next went on duty at 0600, the day of the accident. According to company estimate, the pilot's solo flight experience was as follows:

	Last 24 hours	Last 90 days	Total
Make and Model	5 hours	71 hours	525 hours
Night	0 "	32 "	637 "
Day	5 "	189 "	5,228 "
Instrument:			
Actual	2 hours	47 hours	368 hours
Simulated	0 "	0 "	58 "
Single-engine	0 "	0 "	2,116 "
Multiengine	5 "	221 "	3,848 "

APPENDIX C

AIRCRAFT INFORMATION

Aero Commander 680V, N6359U, serial No. 1536-4, had accumulated 2,977 total operating hours. The date of the last periodic inspection was September 20, 1969. The last inspection, a 100-hour inspection, was completed December 31, 1969, at 1,980 aircraft-hours.

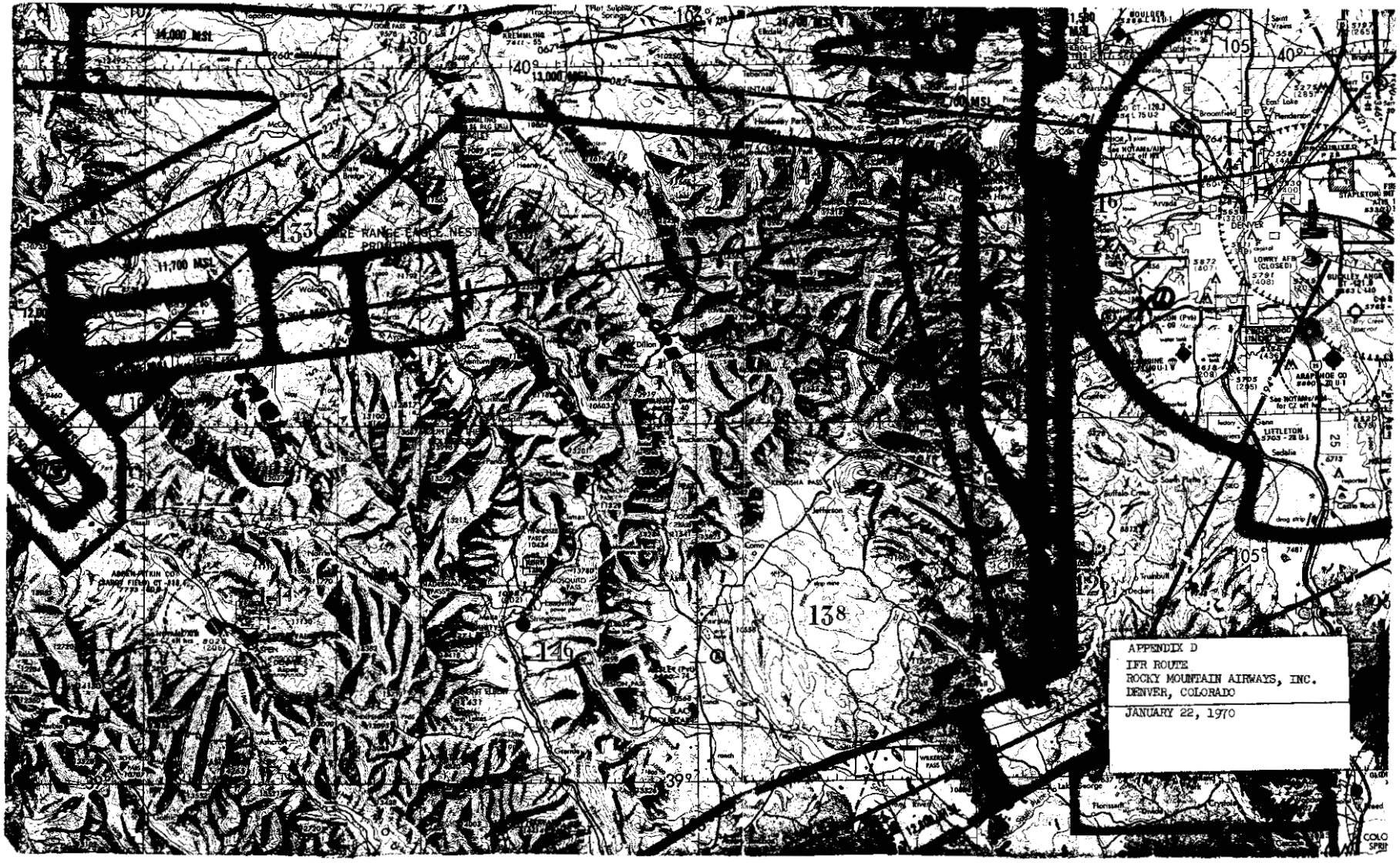
Engine: Left - Garrett Airesearch model TPE 331-43A, serial No. P61087C. Total time, 313; time since upgrade to -43A, 153. Time since last 100-hour inspection, 97.

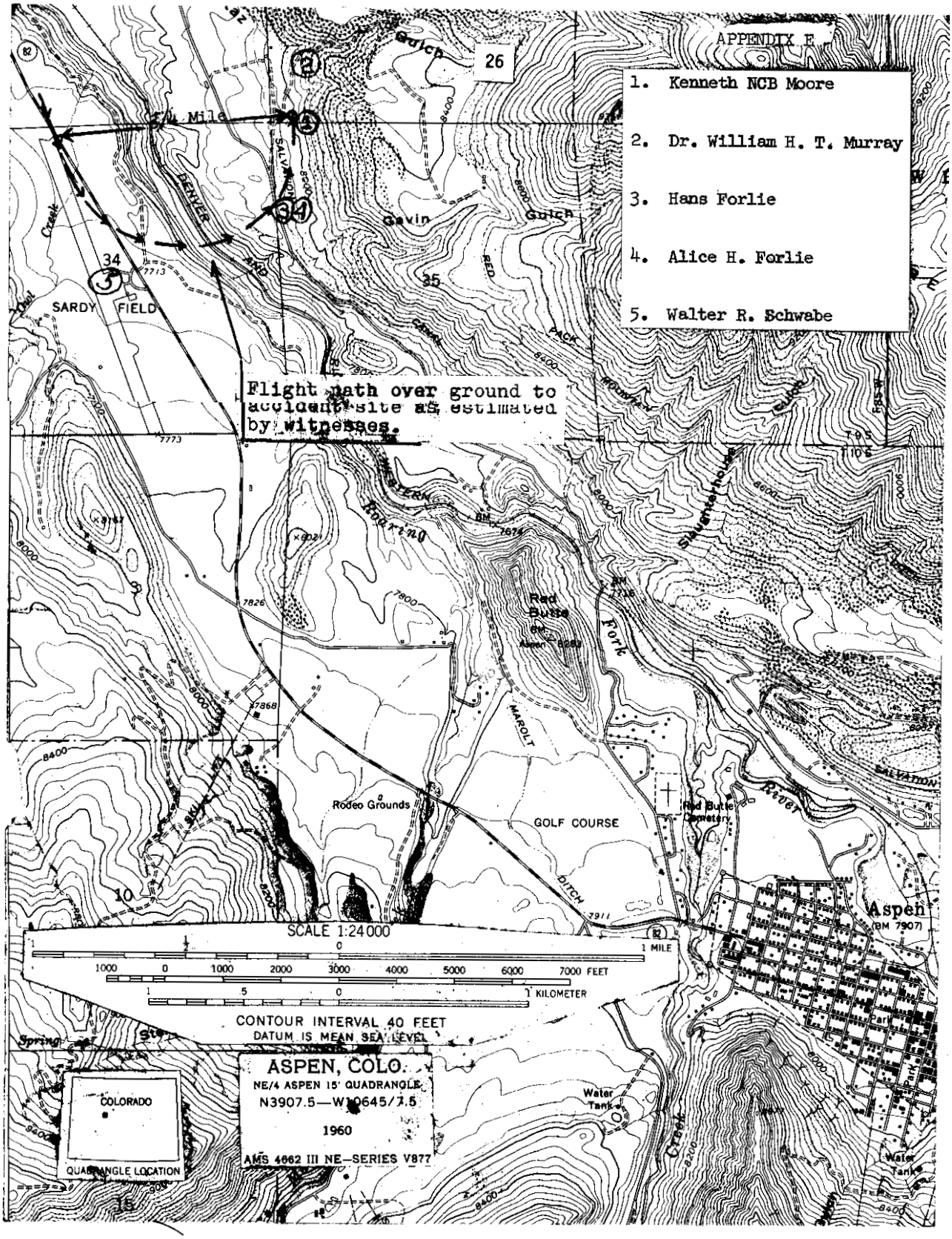
Right - Garrett Airesearch model TPE 331-43A, serial No. P61123. Total time, 756; time since upgrade to -43A, 153, Time since last 100-hour inspection, 97.

Propellers: Left - Hamilton Standard model 33LF-325P12, serial No. 227243. Total time, 1,386

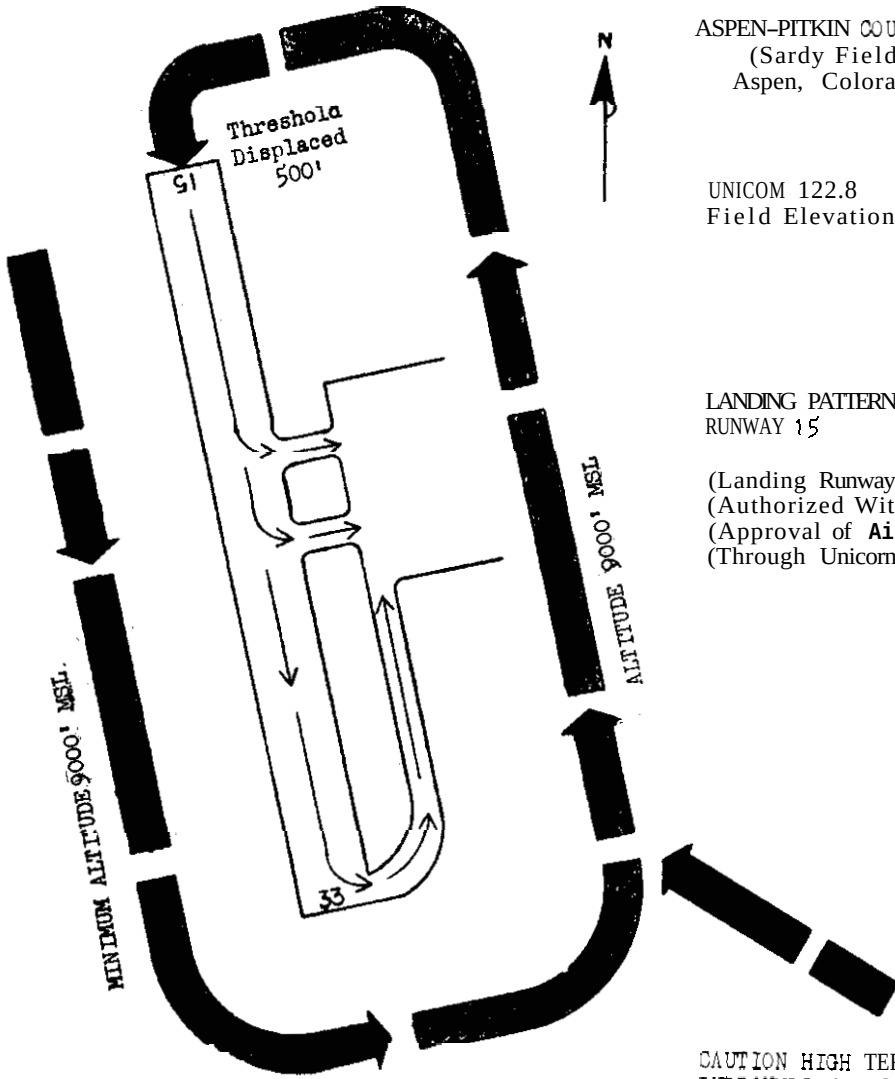
Right - Hamilton Standard model 33LF-325P1/P9-913, serial No. 255199. Total time, 197.

The aircraft and engine records of N6359U were examined in detail from date of last flight back through July 10, 1969. No significant uncorrected maintenance items were noted.


APPENDIX D
IFR ROUTE
ROCKY MOUNTAIN AIRWAYS, INC.
DENVER, COLORADO
JANUARY 22, 1970


APPENDIX E
1. Kenneth NCB Moore
2. Dr. William H. T. Murray
3. Hans Forlie
4. Alice H. Forlie
5. Walter R. Schwabe
Flight path over ground to accident site as estimated by witnesses.
SARDY FIELD
Gavin Gulch
Gulch
Rodeo Grounds
GOLF COURSE
Red Butte Cemetery
Aspen
(BM 7907)
SCALE 1:24000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETER
CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL
ASPEN, COLO.
NE/4 ASPEN 15' QUADRANGLE
N3907.5—W10645/7.5
1960
AMS 4662 III NE—SERIES V877
COLORADO
QUADRANGLE LOCATION

ASPEN–PITKIN COUNTY
(Sardy Field)
Aspen, Colorado



UNICOM 122.8
Field Elevation 7795'

LANDING PATTERN
RUNWAY 15

(Landing Runway 33 Not)
(Authorized Without Prior)
(Approval of Airport Manager)
(Through Unicom.)

CAUTION HIGH TERRAIN SURROUNDS AIRPORT. AIRCRAFT IN PATTERN USUALLY NOT VISIBLE FROM GROUND.

Traffic Pattern Flow

Taxi Routes After Landing

APPROVED: _____
Airport Manager, Sardy Field

APPROVED: G A Parker
Chief, Air Traffic Branch
FAA Denver Area Office

EFFECTIVE: _____

SECTION III
EMERGENCY PROCEDURES

Table of Contents

BALKED LANDING

Execute a Go-Around prior to landing:

1. Power levers - MAX POWER (575 SHP Maximum). (See Figure 4-12 for SHP requirements.)

CAUTION

Observe maximum EGT and SHP limits.

2. Climb - 100 Knots CAS (115 MPH CAS).
3. Rate-of-climb - ESTABLISH.
4. Landing gear - RETRACT.
5. Wing flaps - UP.
6. Airspeed - ACCELERATE to 130 Knots CAS (150 MPH CAS).
7. Normal takeoff procedures - PERFORM.

ENGINE FAILURES

If engine failure is due to improper operating technique, an airstart can usually be made to restore engine operation. If an obvious mechanical failure occurs, an airstart should not be attempted. Unbalanced engine thrust has a slight tendency to yaw the aircraft toward the dead engine. This yaw can be neutralized with rudder trim and aileron.

ENGINE FAILURE DURING TAKEOFF

Sufficient runway remaining to stop.

1. Power levers - RETARD and REVERSE PROPELLER(S) to aid deceleration. Maintain condition lever of operative engine in HIGH RPM.
2. Wheel brakes - AS NECESSARY.

Insufficient runway remaining to stop and airspeed is less than takeoff speed 95 Knots (109 MPH).

1. Power levers - RETARD and REVERSE PROPELLER(S) to aid deceleration.
2. Wheel brakes - MAXIMUM BRAKING.
3. Engine control switches, master generator and battery switches - OFF (after aircraft has stopped).