



PB1773393

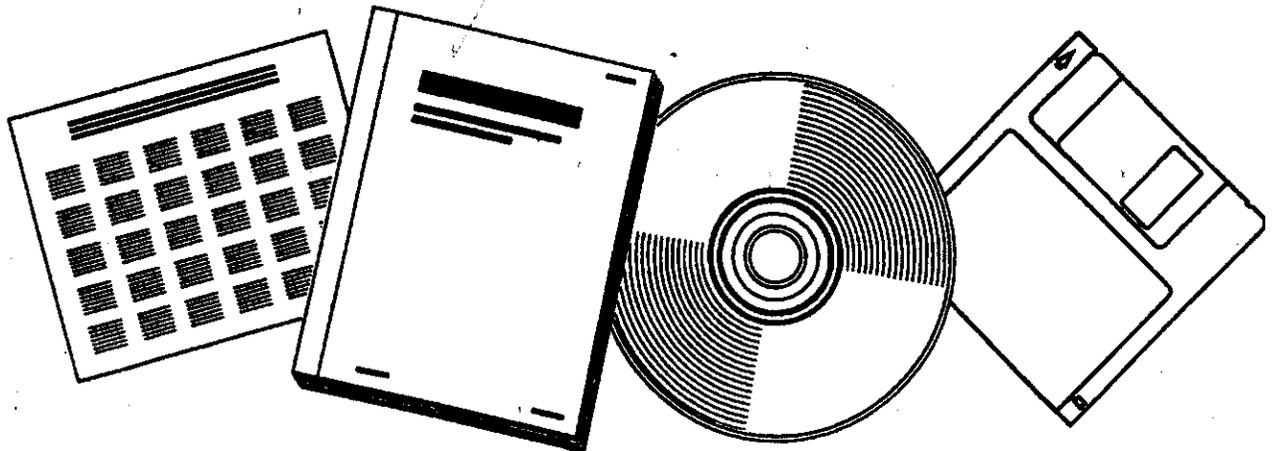
E.R.A.U. LIBRARY

NTIS[®]
Information is our business.

**AIRCRAFT ACCIDENT REPORT: WEST COAST
AIRLINES, INC., FAIRCHILD F-27, N2712,
NEAR KLAMATH FALLS, OREGON, MARCH 10, 1967**

**NATIONAL TRANSPORTATION SAFETY BOARD,
WASHINGTON, D. C**

06 MAR 1968



**Doc
NTSB
AAR
68
AD**

**U.S. DEPARTMENT OF COMMERCE
National Technical Information Service**

PB1773393



SA-None

File 1-0007

AIRCRAFT ACCIDENT REPORT

Adopted: March 6, 1968

WEST COAST AIRLINES, INC.
FAIRCHILD F-27, N2712
NEAR KLAMATH FALLS, OREGON
MARCH 10, 1967

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

WEST COAST AIRLINES, INC.
FAIRCHILD F-27, N2712
NEAR KLAMATH FALLS, OREGON
MARCH 10, 1967

TABLE OF CONTENTS

	<u>Page</u>
Synopsis	1
Probable Cause	2
1. Investigation	3
1.1 History of the Flight	3
1.2 Injuries to Persons	8
1.3 Damage to Aircraft	8
1.4 Other Damage	8
1.5 Crew Information	8
1.6 Aircraft Information	9
1.7 Meteorological Information	10
1.8 Aids to Navigation	11
1.9 Communications	12
1.10 Aerodrome and Ground Facilities	12
1.11 Flight Recorders	12
(a) Flight Data Recorder	12
(b) Cockpit Voice Recorder	15
1.12 Wreckage	18
1.13 Fire	19
1.14 Survival Aspects	19
1.15 Tests and Research	19
1.16 Other Information	19
(a) Ice Accretion	19
(b) Company Policy for Winter Operation	20
2. Analysis and Conclusions	21
2.1 Analysis	21
2.2 Conclusions	30
(a) Findings	30
(b) Probable Cause	31

NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
AIRCRAFT ACCIDENT REPORT

Adopted: March 6, 1968

WEST COAST AIRLINES, INC.
FAIRCHILD F-27, N2712
NEAR KLAMATH FALLS, OREGON
MARCH 10, 1967

SYNOPSIS

At 0503 P.s.t. on March 10, 1967, a West Coast Airlines, Inc., Fairchild F-27, N2712, operating as Flight 720, crashed 4.1 miles southeast of Kingsley Field, Klamath Falls, Oregon, at a terrain elevation of about 5,049 feet.

The aircraft struck the northwest face of Stukel Mountain (elevation 6,525 feet) two minutes after takeoff and was demolished by impact. One revenue passenger and three crewmembers were aboard and all sustained fatal injuries.

Flight 720 departed from Klamath Falls at 0501 P.s.t. en route to Seattle, Washington, with scheduled stops at Medford, North Bend, and Portland, Oregon. Just after the aircraft was airborne, the tower controller issued instructions for the flight crew to change to departure control frequency. At this time the departure controller observed a radar target left of the extended centerline of the runway, and he called Flight 720 to advise radar contact. The target continued to drift to the left toward the area of Stukel Mountain, where it subsequently disappeared off the radar display.

Radio communications were never established by the flight crew with Departure Control. About 1-3/4 minutes after takeoff, however, the first officer called the tower controller and requested radar guidance. Since the radar equipment is located in the military-operated Approach/Departure Control facility, the tower informed the pilot to contact Departure Control. Sometime between these two radio transmissions, the aircraft crashed into Stukel Mountain.

The flight was being conducted in darkness and operating under Instrument Flight Rules. The local weather at the time of departure was reported to be: indefinite ceiling 700 feet, sky obscured, visibility one mile, light snow, temperature 33 degrees F., dewpoint 28 degrees F., wind calm.

The aircraft, after being removed from the hangar, was exposed to falling snow for approximately 11 minutes prior to departing the ramp, and for an additional 4 minutes prior to takeoff. During this period snow was observed to be sticking to the aircraft both by maintenance personnel and by the captain. However, neither the station mechanic nor the captain took action to have deicing fluid applied to the aircraft surfaces.

The Board determines that the probable cause of this accident was loss of control due to ice accretion on airframe surfaces. The Board further determines that the pilot should have required that deicing fluid be applied to the aircraft to remove the accumulation of ice and snow prior to takeoff. This had not been done by the appropriate maintenance personnel.

1. INVESTIGATION

1.1 History of the Flight

West Coast Airlines (WC) Flight 720, a Fairchild F-27, N2712, was a regularly scheduled passenger flight from Klamath Falls, Oregon, to Seattle, Washington, with intermediate stops at Medford, North Bend and Portland, Oregon.

N2712, flown by the same crew, arrived at Klamath Falls at 0035 ^{1/} on Friday morning, March 10, 1967. The crew then drove into Klamath Falls to a motel for a period of rest. The aircraft was towed into a hangar, where a weekly service maintenance check and a preflight inspection were performed by WC maintenance personnel. They reported that there were no discrepancies noted during these inspections, and that during the period the aircraft was in the hangar the hangar doors were not closed.

The WC senior agent at Klamath Falls reported that the crew was alerted for Flight 720 at the motel about 0350. They returned to the terminal at about 0420 and performed their duties with respect to the initiation of Flight 720, which was scheduled to depart at 0450. A company official reported that the standard procedure for flight weather analysis employed by WC was for both the captain and the flight dispatcher to make independent analyses of the weather along the routes to be flown and for a reasonable distance beyond the destination, and at all alternate airports. He stated that adequate weather information was made available to the captain from

^{1/} All times used herein are Pacific standard, based on the 24-hour clock.

which a definitive analysis of the current and expected weather conditions could have been made. Additionally, the company provided the means by which the flight crew could have contacted the flight dispatcher in Seattle by telephone to obtain any additional information found to be necessary for flight planning. Company officials reported that this flight crew made no request for such additional information.

The flight dispatcher who analyzes the weather conditions along the route of flight is authorized by the company to delay departure of flights because of adverse weather conditions. No such authority was exercised.

An Instrument Flight Rules (IFR) flight plan had been prefiled with the Seattle Air Route Traffic Control Center (ARTCC), requesting a cruising altitude of 10,000 feet via Victor Airway 122 to Medford.

The station agent reported that after the captain completed his flight planning, the passenger and three crewmembers were driven from the terminal to the hangar and, deviating from the normal procedure, the aircraft was loaded in the hangar, rather than at the ramp area in front of the terminal building. The station agent reported that this deviation was necessitated by the then existing weather conditions (falling snow) and was used when necessary to reduce, to the extent possible, the amount of time an aircraft would be subjected to inclement weather conditions while on the ground. Ground crew personnel observed both pilots performing a preflight inspection prior to boarding the aircraft.

During the time the aircraft had been hangared the reported weather conditions included rain mixed with snow and light snow. At the time of initiation of the flight snow conditions were variously estimated by several witnesses to be between an inch and three inches accumulation, and varying from dry to moist, wet snow.

About 0446, after the passenger and flight crew explained, the aircraft was pushed tail-first out of the hangar. When the tow tractor wheels contacted the snow outside the hangar, traction was lost. WC personnel stated that because of this they had to shovel snow from beneath the wheels and to sand the ramp area in order to enable the tractor to push the plane into position to start engines. Because of this delay, the aircraft remained exposed to the falling snow, prior to departing from the ramp, for a period estimated by WC personnel to be about 11 minutes. Although snow was observed by several WC employees to be sticking to the aircraft, neither the station mechanic nor the captain took action to have deicing fluid applied to the aircraft surfaces.

At approximately 0457 the aircraft departed from the ramp and taxied to Runway 14. An IFR clearance was delivered by the Klamath Falls Tower as filed at a cruising altitude of 10,000 feet. In addition, the flight crew was advised to contact Departure Control after takeoff on 124.1 MHz.

In response to a request from the flight crew, the tower provided the then current weather as "Indefinite ceiling 700, sky obscured, visibility one, light snow." At 0501 the flight was observed to take off and one minute later it was instructed to contact Departure Control. However, this contact

was never established. At 0502:43 the flight crew asked the tower if it could get them on radar. Since the radar equipment is located in the military-operated Approach/Departure Control facility, the tower controller informed the flight, at 0502:55, that it was still on tower frequency and to contact Departure Control on 124.1 MHz. It was determined later that the aircraft crashed at 0502:49.

A transcript of recorded conversations between the tower and Approach/Departure Control shows that when the tower asked Departure Control if the flight came over to its frequency, the departure controller advised that it did not. He then added that the aircraft made an "awful sharp left turnout right off the runway there right around the area of Stukel . . ." and that he had lost radar contact. Numerous calls to the aircraft by both facilities were unanswered. About 0509, information was received that an aircraft had crashed on Stukel Mountain. The accident scene was subsequently located at latitude, 42°07'15.2" North, and longitude, 121°39'14.9" West. The accident occurred during the hours of darkness.

Approximately 20 minutes after the departure of Flight 720, the Air Force duty officer at Kingsley Field was notified of the accident and proceeded directly to the runway, where he observed the tire tracks of N2712 in the snow. He reported that the tracks commenced a gradual swerve to the left at a point about 1,000 feet from the start of the takeoff roll. The gentle swerve continued as the aircraft traveled an additional 2,000 feet down the runway where the tracks ended at liftoff. The nose wheel left the ground about 600 feet prior to the main gear and at a point where its track was half-way between the center of the runway and the left row of runway lights.

The tracks showed that the left main landing gear was about 12 feet off the left edge of the runway, and 5 to 6 feet outside the left runway lights for a distance of about 250 feet prior to liftoff. This track extended 45 feet farther than the right landing gear track. At the time of liftoff, the aircraft was about 4,000 feet from the takeoff end of the runway, with about 6,000 feet of runway remaining ahead of it.

It was reported that, at the time the runway was inspected, snow was falling in large, heavy flakes which were wet, but not to the point of being slushy. The inspecting officers stated that the tracks did not indicate that the aircraft had slipped or skidded on the runway, nor was there any evidence that the aircraft had struck any object prior to liftoff.

Witnesses interviewed during the investigation all agreed that it was snowing hard at the time of the accident and that visibility was reduced. The aircraft was observed in flight by four witnesses, whose attention was attracted because of its loud and/or labored engine sounds, its low altitude over the ground, or by lights on the aircraft. Those witnesses located off the end of the runway stated that the aircraft was low, sounded very loud, and was flying toward the area of Stukel Mountain. In all, six witnesses reported hearing or seeing the aircraft, and no one reported any abnormalities of this flight other than the foregoing. None of these witnesses saw the aircraft crash but five reported seeing a bright orange glow on the mountain after the aircraft had passed their locations. One witness heard the sounds of impact.

1.2 Injuries to Persons

<u>Injuries</u>	<u>Crew</u>	<u>Passengers</u>	<u>Others</u>
Fatal	3	1	0
Nonfatal	0	0	0
None	0	0	

Post-mortem pathological and toxicological examinations of the flight crew revealed no evidence of pre-impact incapacitation.

1.3 Damage to Aircraft

The aircraft was demolished by ground impact.

1.4 Other Damage

None.

1.5 Crew Information

Captain Dale W. Anderson, age 38, held an airline transport pilot certificate with type ratings in the DC-3 and F-27 and commercial privileges for airplane single and multiengine land. Captain Anderson became a captain on DC-3s on January 20, 1965, and on F-27s on April 28, 1966. His total time in the F-27 was 4684:01 hours and as captain 370:21. In the 30 days prior to the accident he had flown 71:39 hours in the F-27 of which 22:30 were instrument time. His last proficiency check was passed successfully on October 10, 1966. His first-class medical certificate was dated February 27, 1967, with no waivers noted.

First Officer Thomas D. Zeiders, age 30, held a commercial pilot certificate with privileges for airplane single-engine land and sea and was also instrument rated. He became a first officer on April 4, 1966. His total time in the

F-27 was 258:54 hours with 52:33 hours in the 30 days prior to the accident. Of his total pilot time of 1064:48 hours, 119:05 were instrument time. He passed his last proficiency check on June 7, 1966, and his medical certificate was dated January 17, 1967, with no waivers noted.

Stewardess Connie Berryman, age 22, began her training on October 17, 1966, and completed the course successfully on November 4, 1966. Her last six month proficiency check was on March 5, 1967.

Company officials reported that, during the 24-hour period prior to this flight, Captain Anderson had flown a total of 4:28 hours and had 17:32 hours rest period and First Officer Zeiders had flown a total of 2:18 hours and had 21:42 hours rest period.

1.6 Aircraft Information

Fairchild F-27, N2712, S/N 02-804-73, registered to West Coast Airlines, Inc., was manufactured on February 5, 1960, and at departure of its last flight had a total airframe time of 16,202:59 hours. A turnaround check and a service check were performed immediately prior to this flight. Investigation revealed that all discrepancies recorded in the logbook had been corrected and were properly written off. There were 7,200 pounds of JP-1 aviation turbine fuel and 314 pounds of water/methanol aboard prior to departure. The gross takeoff weight of 33,007 pounds and the computed center of gravity (c.g.) of 34.8 percent Mean Aerodynamic Chord (MAC) were within the limits specified for this operation.

The aircraft was equipped with two Rolls-Royce Dart Mark 514-7 engines. The left engine, S/N 5089, had 259:35 hours since overhaul and a total time of 14,798:23 hours. The right engine, S/N 12034, had 557:02 hours since overhaul and a total time of 16,411:16 hours. Both propellers were Rotol Model (c) R175/4-30-4/13E. The left propeller, S/N 58/87, had 1136:34 hours since overhaul and a total time of 13,772:28 hours. The right propeller, S/N 57/3, had 337:41 hours since overhaul and a total time of 20,520:30 hours. Compliance with all Airworthiness Directives applicable to this aircraft had been recorded.

Two samples of fuel, one from the fuel storage tank and the other from the fuel truck from which N2712 was last refueled, were analyzed. Laboratory reports revealed that the samples were found to be clean and to meet all specification requirements for JP-1 aviation turbine fuel.

1.7 Meteorological Information

Surface and upper air charts showed a low pressure system centered just off the Washington coast. Cold, moist, unstable air prevailed over southern Oregon and a diffuse quasi-stationary front was located not far south of Klamath Falls.

Mixed rain and snow began at Klamath Falls at 1900, March 9, changed to snow by 0200, March 10, and snow continued until the following day.

Official weather observations at Kingsley Field were being taken by the U. S. Air Force. The weather at departure time was reported as: indefinite 700 feet ceiling, sky obscured, visibility 1 mile, light snow, temperature

33 degrees F., dewpoint 28 degrees F., wind calm, altimeter setting 29.47 inches. Remarks: runway visibility 1 mile plus, visibility southwest to west $1\frac{1}{2}$ miles, tower visibility $3/4$ mile.

In summary, the then current Weather Bureau area forecasts called for low ceilings and visibilities, mountains obscured, frequent moderate turbulence and icing, and strong up and downdrafts east of the mountains. The terminal forecast for Klamath Falls anticipated conditions occasionally down to ceiling 800 feet, sky obscured, visibility 1 mile in light snow and fog.

The flight crew neither solicited nor received a preflight weather briefing from the company or the Weather Bureau. However, they were seen by a West Coast Airlines employee at the counter in the company operations office where weather data are posted and used for self-help type briefing.

1.8 Aids to Navigation

Approximately one minute after the aircraft took off, the tower controller observed a red warning light on the monitor alarm circuit for the middle marker compass locator (LMM), and about 30 seconds later he observed a similar light for the low frequency nondirectional radio beacon. Federal Aviation Administration (FAA) personnel reported that those monitor alarms were activated because of the accumulation of heavy, wet snow on or near the antenna structures of both facilities.

These facilities are not utilized in the standard departure procedure but either one or both could have been selected for use by the flight crew. Since the first alarm occurred about a minute after takeoff, the LMM facility would still have been functioning normally after the aircraft passed over it.

There were no other reported discrepancies to navigational aids installed at Klamath Falls at the time of this accident. The VOR and ILS facilities were flight checked subsequent to the accident and found to be operating satisfactorily.

1.9 Communications

There was some difficulty in the initial establishment of radio communications between the aircraft and the tower, but this was corrected prior to taxi and there were no other reported technical problems.

1.10 Aerodrome and Ground Facilities

At Kingsley Field, there is a Combined Station/Tower operated by the FAA and a radar-equipped, military-operated Approach/Departure Control facility.

Runway 14 is 10,300 feet long, 150 feet wide and its elevation is 4,092 feet. Runway lights are spaced 200 feet apart and there are distance remaining markers spaced 1,000 feet apart. All lights were reported to be functioning during the time of takeoff and all markers were in place and lighted. The aerodrome is utilized by both military and civil aircraft.

1.11 Flight Recorders

(a) Flight Data Recorder

This aircraft was equipped with a United Control Corporation flight recorder unit, Model F-542, S/N 1035, located in the radio rack panel in the cargo compartment area. The recorder had sustained impact and fire damage in the accident, but the recording medium was not damaged substantially and readout of the flight record was not impaired.

A readout of the recorder data reveals that shortly after the start of the takeoff roll, the aircraft commenced a veer to the left of the runway heading of 140 degrees. This left drift remained relatively constant until liftoff on a magnetic heading of about 137 degrees. During this period the indicated airspeed increased gradually to about 70 knots and then remained nearly constant for 10 to 12 seconds. About 3 seconds before liftoff, the airspeed rapidly increased to about 93 knots. The heading trace showed that just after liftoff, the aircraft swerved sharply to the right about 11 degrees to a magnetic heading of 149 degrees. This turn occurred in $1\frac{1}{2}$ seconds, or more than twice as fast as a standard rate turn. Following this sharp swerve, the aircraft immediately turned back to the left to a heading of 138 degrees.

During these rapid changes of aircraft heading, the vertical acceleration trace showed 4 sharp excursions, two positive and two negative of about equal magnitude, in a period of 6 seconds. While the magnitude of these excursions was not great, they were sharply defined.

Between 30 and 40 seconds after liftoff, the heading trace showed a heading change to the left of small magnitude, after which the heading remained constant for 2 seconds, followed by a correction to the right to the published departure heading of 140 degrees. During the same period the airspeed increased 10 knots to 124 knots while the altitude (m.s.l.) increased from 4,600 feet to about 4,900 feet. There was a corresponding roughness in the vertical acceleration trace during this period.

One minute after liftoff the indicated airspeed trace showed a speed of 123 knots, and in the following 10 seconds it increased to about 156 knots. In the same period the heading trace showed a veer to the left of about 16 degrees, from 136 to 120 degrees. The vertical acceleration trace remained relatively stable during this period. The altitude trace one minute after liftoff indicated about 5,150 feet. It then showed that the aircraft climbed about 100 feet in $1\frac{1}{2}$ seconds (about 4,000 feet per minute) to 5,250 feet, leveled off at about 5,300 feet and remained nearly level for some 20 seconds.

One minute and 12 seconds after liftoff the vertical acceleration trace dipped sharply to a negative .4 "G" increment, where it remained constant for about 11 seconds. In the next $2\frac{1}{2}$ seconds it climbed sharply to a point just above the positive .5 "G" increment.

About 40 seconds before impact, the indicated airspeed trace reflected an increase from about 160 knots to 190 knots within 13 seconds. During this same period the heading trace wavered left and right, but always much more toward the left. Several corrections in the heading trace were observed to the right, back toward the outbound heading of the Klamath Falls departure course. However, these course corrections were of short duration and ineffective, and the general track of the aircraft was always left, toward the area of Stukel Mountain. Commencing some 35 seconds before impact, the heading trace revealed a very rapid left turn from 112 to 054 degrees, a turn of 58 degrees in only 12 seconds. The turn rate then decreased although

the aircraft continued to drift to the left. During the period the aircraft was turning hard to the left and the airspeed was rapidly increasing, the altitude trace was dropping from about 5,250 to 4,700 feet. This 550-foot descent occurred in about 10 seconds, or at a rate of about 3,300 feet per minute. In this same period the vertical acceleration trace was extremely erratic, but with limited magnitude and always tending toward positive "G" forces.

About 10 seconds before impact all traces had become relatively stable. Then the heading trace veered sharply left, 20 degrees in about 1.5 seconds. The turn decreased a little but the heading continued to change to the left another 10 degrees in 3.5 seconds. Thus, in 5 seconds the heading changed 30 degrees. In the final 5 seconds of flight, the heading trace swung sharply back to the right a total of about 20 degrees. During this same period, there was a sudden decrease of indicated airspeed of 23 knots and a rapid climb of 350 feet in altitude. In addition, the vertical acceleration suddenly rose to its greatest positive value of about 2.5 "G's".

The flight data recorder revealed that at impact the aircraft was at an altitude of 5,000 feet, at an indicated airspeed of 162 knots, on a magnetic heading of 042 degrees, and with a vertical acceleration of minus .3 of a "G" force.

(b) Cockpit Voice Recorder

The aircraft was equipped with a United Control Corporation Model V-557 Cockpit Voice Recorder, S/N 1488. This recording unit was recovered eight days after the accident. It had sustained impact damage but the tape

magazine storage area was intact and the recording medium was not damaged. Due in part to the location of the cockpit area microphone and to the elevated noise level of this type of aircraft, a portion of the cockpit conversation on the recording was obscured because of background noise. However, almost all of the intelligence on the cockpit area microphone channel was obtained by utilization of electronic measures to reduce the interference.

The recorded conversations of the flight begin with the recitation by the flight crew of the preflight checklist. It was not until the pilots had started engines and taxied out to the runway that the first significant remarks began. The first officer then remarked that "It's starting to freeze outside." The captain replied "I wouldn't care if we were below - they didn't put any isopropyl on here and that stuff sticks outside."

After being cleared for takeoff at 0459:50, the captain stated "We gotta go before that groun' freezes", to which the first officer replied "Yeah." The pilots then proceeded to go through the takeoff checklist, with the first officer issuing the challenge and the captain making the response. The recorded conversation indicates that the pilots covered all of the items on the checklist with the exception of the last two, which are "Controls - Free" and "Flight Rec. - On."

At 0500:19 power was applied and at 0500:40 the first officer called out "V two." At 0500:46 the captain uttered an exclamation, which corresponds in time to the sharp swerve to the right and turn back to the left reflected on the heading trace of the flight recorder immediately after takeoff.

At 0500:52 the captain called for "Gear up" and "Lights out and retract", which commands were acknowledged by the first officer. The captain then remarked "If I had a good answer I'd tell you what happened but I sure don't have it." At 0501:11 the first officer stated "I feel sorta like a pioneer on this sorta drill," to which the captain replied "Yeah, I do too."

The captain then repeated the command "Lights out and retract" and at 0501:30 asked "Got all three of 'em up yet?" The first officer answered "Naw, the nose gear is still down." At 0501:38 the captain remarked "We're out of trim tab, too" and thereafter asked "Is your gear up?", to which the first officer responded in the affirmative.

At 0501:56 the captain stated "We've got something wrong here, - flaps up." This was at the time Kingsley Tower instructed the flight to contact Departure Control. At 0502:06 the captain remarked "We don't have any control" followed by an apparent reference to the aircraft. He then proceeded to make the following series of comments:

0502:21 "ah, . . . (pause) hang on here, Doyle (pause)"
0502:28 "I'm gonna make a tight turn here"
0502:36 "I don't know where . . . the hills are."
0502:39 "Get us on radar real quick."

These exclamations were made during the period of erratic flight recorder traces which commenced about 40 seconds before impact.

At 0502:43 the flight called Kingsley Tower and asked if the aircraft was being observed on radar. At 0502:47 the captain uttered an expletive and at 0502:49 the cockpit voice recording ended.

1.12 Wreckage

The aircraft crashed on a steep ridge on the northwest slope of Stukel Mountain at a terrain elevation of about 5,049 feet. Observations at the wreckage site indicated that at impact the aircraft was traveling on a true course of about 66 degrees (46 degrees magnetic) in a right-wing-low attitude. Contact with the mountain was made initially by the right-wing tip followed by the right propeller and powerplant. The aircraft then cartwheeled up the 30 degree upslope of the mountain. The wreckage was scattered in an area about 1,080 feet long and 376 feet wide, oriented in the direction of flight.

Investigation revealed that no portion of the airframe separated from the plane prior to initial ground contact. Examination of the control system and its components disclosed no evidence of pre-impact failure or malfunction. The landing gear and wing flaps were found fully retracted. The elevator trim tab was found in its full up position, indicating the aircraft was in a full nose-down trim condition, while the rudder and aileron trim tabs were in near neutral positions.

Both engines were found to have been developing power at impact. Examination of engines, to the extent possible, did not disclose evidence of any pre-impact failure or malfunction.

1.13 Fire

There was extensive but superficial charring of the wreckage as the result of a post-impact flash fire. Fire did not reach into the cabin or cockpit and by the time ground rescue personnel arrived on-scene, it had burned itself out. There was no evidence found to indicate fire prior to impact.

1.14 Survival Aspects

This was a nonsurvivable accident.

1.15 Tests and Research

No special tests or research have been conducted.

1.16 Other Information

(a) Ice Accretion

Airline pilots have made reports of inflight control problems involving other Fairchild F-27 aircraft as a result of ice accretion. In those cases, the aircraft developed an unusual tail heaviness, shortly after takeoff in icing conditions, which required strong application of forward yoke pressure and/or large increments of nose-down elevator trim to control the aircraft about its lateral axis. In one case, the aircraft also tended to be left-wing heavy and to roll to the left but in all these instances remained controllable. In one instance, visual inspection of the aircraft by qualified maintenance personnel revealed about 1/8 inch of clear, rough ice on the top surface of the elevators, trim tabs, and horizontal stabilizer.

During the initial stage of this investigation, an unsuccessful effort was made to reach the wreckage and examine it for evidence of structural icing. Weather conditions at the scene were so inclement for several days following the accident and before the wreckage could be reached that any ice which may have been present on the airframe at the time of impact could not be distinguished from ice formed thereafter.

(b) Company Policy for Winter Operation

WC directives regarding winter operation of their aircraft are quoted below:

Flight Operations Manual, Section 03:03, paragraph C (Dispatch and Takeoff)

"No airplane will be dispatched or taken off when the wings, control surfaces, or propellers are coated with either frost, sticking snow, or ice. Flights may be dispatched when it is agreed by the Captain and the Supervisor responsible for the release of the airplane from the blocks that the snow on the surface of the airplane is of such consistency that it will dissipate or blow off during taxiing or on the immediate start of the takeoff run. No take-offs will be made with ice, snow or frost adhering to any other part of the airplane structure which, in the opinion of the Captain, might adversely affect the performance of the airplane."

Flight Operations Manual, Section 03:06, paragraph E (Take-off and Landing)

"Aircraft prepared in accordance with anti-icing procedures of the Maintenance Manual requirements may be cleared to take-off when light or moderate freezing drizzle, light or moderate wet snow, or light freezing rain is reported or falling."

Maintenance Manual, Index 2-11, paragraph 1 (Removal of Frost and Snow from Surfaces) "Careful visual checks should be made for frost or light snow deposits on surfaces and accessible control surface hinge points of all aircraft prior to every take-off. Frost and thin ice shall be removed by using rags soaked with deicing fluid or other freezing point depressants which are non-corrosive or damaging to the metal or fabric surfaces.

It is very important that the surfaces are clean, as even a very light film of frost can easily decrease the lift available from a wing, increase the profile drag of a wing and make the control surface hinge points inoperative to such an extent that it will be virtually impossible for the aircraft to take off." 2/

WC maintenance personnel involved in performing the service and preflight inspections conducted while the aircraft was at Klamath Falls reported that the directives which were contained in those manuals with respect to the deicing procedures were not accomplished. They further reported that they received no instructions in this regard.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

Aircraft maintenance was conducted and completed in accordance with applicable regulations. There was no structural, powerplant, or system failure which contributed to the cause of the accident. At impact both engines were developing a high level of power and the landing gear and wing flaps were retracted.

2/ It should be noted, at this juncture, that the aircraft deicing system with respect to the airframe consists of a conventional pneumatically operated deicer boot installation on the leading edges of the wing and empennage, which generally are the only airframe areas afforded protection against icing on any aircraft.

All aerodynamic control surfaces, control cables, push/pull rods, and associated hardware were examined and no evidence of inflight failure or malfunction was discovered.

No evidence of inflight fire was found in the wreckage, nor did the flight crew indicate such occurrence during cockpit conversations.

The airport and runway were in no way deficient. All navigation aids were operable except two radio aids which were reported to have malfunctioned after the aircraft took off. However, because of the fact that the primary navigational radio aids were operating and available for use by the pilot, the possible malfunctioning of the radio beacon and IMM is not considered significant.

The cockpit voice recorder tape contains no mention of either failure or malfunction of navigation or flight instrumentation equipment. Had such a failure or malfunction occurred during the flight, normal pilot procedures would have required intra-cockpit coordination and verbal response. Therefore, the causal factors responsible for the loss of aircraft control are contained in another area.

The captain commenced flight duty at about 1840 on the day prior to the accident. He had flown about 4:28 hours, under night and some instrument conditions, upon arrival at Kingsley Field at 0035. The crew then drove into Klamath Falls to a motel for a period of rest, which lasted until about 0350, when they were alerted to initiate Flight 720. They arrived at the terminal at 0420, and the flight departed from Kingsley Field at approximately 0500. From all indications, including the autopsy, the captain had nothing for breakfast other than coffee prior to the flight.

The use of a rapid crew turnaround, such as that preceding Flight 720, is considered by most air carriers to be an economic and operational necessity and thus is common practice throughout the industry. The provisions of the Federal Aviation Regulations concerning maximum crew duty time were not exceeded in this case. Moreover, the post-mortem pathological and toxicological examinations of the flight crew revealed no evidence of pre-impact incapacitation.

Nonetheless, it is possible that the schedule followed by the crew produced a condition of fatigue which may have been a factor in the accident. While the extent of any such fatigue which might have existed is impossible to measure, it may have adversely affected the judgment of the pilots to the point where they either did not fully recognize the potentially hazardous weather conditions which existed or, once recognizing the hazards, failed to take timely and appropriate preventive measures.

At the time of the accident, the weather in the Klamath Falls area was influenced by a frontal zone, characterized by cold, moist air together with associated extensive low cloudiness and precipitation. Snow had been falling for a considerable period and it continued to fall during the entire time the aircraft was out of the hangar. In view of the temperature regime and the consistency of the snow, conditions were conducive to the accretion of ice on the airframe while the aircraft was outside the hangar prior to takeoff. They continued to be favorable for airframe icing during takeoff and throughout the brief duration of the flight.

Both the captain and the flight dispatcher reviewed, to some unknown extent, the existing and forecast weather conditions along the planned route of flight. Official weather reports and forecasts pertinent to this flight, which could have been used for flight planning purposes, are considered to have reflected adequately the current and forecast weather conditions. Both the captain and the flight dispatcher apparently agreed that the flight could be conducted safely, because neither one took action to delay departure.

The fact that the hangar doors remained open while the aircraft was inside meant that it was subjected to near-freezing temperatures during this period. This would have markedly increased the susceptibility of the aircraft surfaces to ice accretion when brought into contact with precipitation. The delay on the ramp, caused by the difficulty in positioning the aircraft due to the slippery ramp surface, exposed the aircraft to falling snow for a period of approximately eleven minutes prior to taxi. Moreover, two of the WC maintenance personnel did in fact see snow sticking to the surface of the aircraft as it departed from the ramp.

WC directives regarding winter operation of their aircraft provide in essence that an aircraft shall not be dispatched or taken off under icing conditions unless careful visual checks of surfaces are made and any frost or thin ice removed by using rags soaked with deicing fluid. However, in spite of the presence of weather conditions which were conducive to icing, neither the captain nor appropriate maintenance personnel took action to have the aircraft surfaces treated with deicing solution prior to departure.

The conversation between the captain and first officer while taxiing out to the runway clearly indicates an awareness both of the possibility of ice accretion and the need for deicing protection. Thus, in response to the first officer's remark that it was starting to freeze outside, the captain stated "they didn't put any isopropyl on here and that stuff sticks outside." Immediately thereafter, the captain remarked that "We gotta go before that groun' freezes."

It is worthy of note at this point that the crew, when performing the takeoff checklist immediately prior to takeoff, made no oral reference to checking the controls for freedom of movement. It is, of course, possible that the captain checked the controls without stating aloud that he was doing so. Even assuming that the controls were not checked, there is no way of knowing whether any ice accretion which did exist at that point could have been detected by a control check. The most that can be said is that if there were an omission of this checklist item it could have been a factor in the accident.

Tire tracks made in the snow during the takeoff indicated that after commencing the takeoff roll in the center of the runway the aircraft drifted gradually to its left to a point where the left landing gear was 12 feet off the left edge of the runway when the aircraft left the ground. In addition, the fact that the right landing gear lifted off the ground 45 feet before the left landing gear disclosed that a left rolling tendency of the aircraft had developed. The cause of this drift and roll to the left is difficult

to ascertain. It can in no way be attributed to a crosswind since the wind was reported as calm. The cockpit voice recorder contains no expression of concern on the part of either pilot during the takeoff roll with respect to the lateral position of the aircraft on the runway. While the visibility from the aircraft during takeoff may have been lower than the reported one mile, the runway lights and the lighted distance markers should have been clearly distinguishable. Moreover, it is doubtful that the view through the cockpit windshield would have been obscured to any appreciable extent by snow or ice accumulation in light of the fact that the windshield heating system had been placed in the "high" position by the captain during the performance of the takeoff checklist. Accordingly, the pilots should have been aware of the proximity of the aircraft to the left row of runway lights and, in particular, of the fact that the main landing gear were straddling this row of lights during the final few hundred feet of the takeoff roll. Assuming that the pilots were so aware and that they were unable to correct the left-moving tendency of the aircraft, it is possible that a directional control problem existed, caused either by the nose gear steering not operating properly or by a restriction in control surface movements due to airframe icing.

Following lift-off, the flight recorder trace reveals that the aircraft immediately yawed to the right a total of 11 degrees in $1\frac{1}{2}$ seconds, and then turned sharply back to the left slightly past the departure heading. Simultaneously, the captain uttered an exclamation and about 15 seconds later

remarked, probably in reference to these abrupt turns and/or the off-runway position of the left main landing gear at takeoff, "If I had a good answer I'd tell you what happened but I sure don't have it." A possible explanation for the abrupt right turn after lift-off is that the pilot, in order to combat the left-moving tendency of the aircraft during the takeoff roll, had applied a substantial amount of right rudder. Thus, when the aircraft left the ground thereby removing the drag effect produced by the contact of the wheels with the surface, the right rudder input jerked the nose of the aircraft to the right.

Throughout the brief duration of the flight, both the cockpit voice recorder tape and the flight recorder trace indicate that the pilot had increasing problems with maintaining controlled flight. Although the standard departure procedure from Runway 14 prescribes continuing on runway heading until reaching 6,000 feet, the flight recording reveals the almost constant tendency of the aircraft to drift to the left of this course from the time the takeoff roll was started until impact on the mountain. Some control of the aircraft is evidenced in all traces during the takeoff and initial climb period. However, about a minute after lift-off, when the wing flaps were retracted, all traces rapidly become erratic. The heading trace shows a continuous left turning tendency toward a mountainous area the location of which should have been known to the pilots in view of their familiarity with the terrain. While there is evidence of several attempted heading changes to the right, such attempts never brought

the aircraft back to the published departure heading. The indicated air-speed trace increases rapidly after flap retraction to speeds well in excess of the normal climbing speed. The altitude trace flattens out after retraction of the flaps and then descends steeply, levels out, and descends again to a level about 1,000 feet below the highest altitude attained. The trace then climbs steeply just prior to impact.

Just before impact the tracings reveal that the aircraft was maneuvering erratically in an uncontrolled manner. During this period the tracings also reveal that the plane entered a very high rate of left turn at an elevated airspeed, yet the vertical acceleration trace does not show a marked rise in "G" forces associated with such an abrupt turning moment. Some 5 seconds before impact the heading trace depicts a steep right turn while the altitude and acceleration traces reflect a sharp climb and decrease in airspeed respectively.

The recorded conversation of the crew indicating control difficulty closely parallels the flight recorder's indications of increasing control problems. Less than a minute after takeoff, the captain remarked that "We're out of trim tab", a statement which corresponds to the physical evidence in the wreckage revealing that the elevator tab was in the full nose-down trim position. This indicates that the pilot was attempting to rectify a tail-heavy condition. About a minute after takeoff, the captain observed that "We've got something wrong here" and then ordered the flaps up, following which the flight recorder traces, as noted above, become particularly erratic. During the final minute of flight, the captain

flatly stated that "we don't have any control" and made an apparent reference to the aircraft. This was followed by a series of statements, just prior to impact, indicating the desperate nature of the situation.

In view of the absence of any physical evidence in the wreckage to support a premise of airframe, powerplant or system failure, and because all conditions were most propitious for airframe icing, it appears that the most probable cause of the loss of control experienced by the pilots was ice accretion on aircraft surfaces. Pilot reports concerning ice accretion incidents on other Fairchild F-27 aircraft described control problems substantially similar to those which occurred in this instance. In these prior incidents, the pilots experienced unusual tail heaviness shortly after takeoff which necessitated substantial forward yoke pressure and, in one of the incidents, full aircraft nose-down elevator trim. In addition, one of these pilots reported a marked tendency of the aircraft to roll to the left. One of these pilots reported that at about 1,500 feet the elevator suddenly became free and the flight was continued, while another pilot returned and landed. In the latter instance, it was discovered that about 1/8 inch of rough clear ice had formed on the top surface of the elevator and horizontal stabilizer.

From all the available evidence, the Board concludes that ice accretion on aircraft surfaces led directly to the loss of control, and that this condition could have been avoided by the application of deicing solution prior to departure. Accordingly, it is further concluded that the factor which most likely made this accident inevitable was the action of the

pilot in taking off under conditions in which the weather was conducive to airframe icing, snow was adhering to the aircraft, and deicing fluid had not been applied to aircraft surfaces.

2.2 Conclusions

(a) Findings

1. The aircraft was currently certificated and airworthy.
2. All pilot write-ups had been corrected and all maintenance checks were properly signed off.
3. The aircraft had been given a service check and a preflight inspection by WC maintenance personnel prior to departure, and no discrepancies were reported.
4. The gross weight and center of gravity were well within limits.
5. The pilots were currently certificated and qualified for the flight.
6. The flight crew was within the maximum duty and flight time limitations imposed by regulations.
7. In view of the temperature regime and the presence of precipitation, weather conditions were conducive to icing before and at the time of departure.
8. During the period between engine start and takeoff, snow was observed adhering to the aircraft surfaces both by ground maintenance personnel and by the captain.
9. The aircraft was not prepared for flight in accordance with applicable WC directives in that deicing solution was not applied to aircraft surfaces prior to departure.

10. The cockpit voice recording and the flight recorder trace contain substantial evidence that the pilots experienced control problems which commenced during the takeoff roll and increased throughout the flight until impact.
11. The aircraft was demolished by impact.
12. There was no evidence of pre-impact failure of powerplants, systems or structure.
13. Post-mortem examinations of the pilots disclosed no evidence of conditions which would have had an adverse effect on their flying ability.

(b) Probable Cause

The Board determines that the probable cause of this accident was loss of control due to ice accretion on airframe surfaces. The Board further determines that the pilot should have required that deicing fluid be applied to the aircraft to remove the accumulation of ice and snow prior to takeoff. This had not been done by the appropriate maintenance personnel.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOSEPH J. O'CONNELL, Jr.
Chairman

/s/ OSCAR M. LAUREL
Member

/s/ JOHN H. REED
Member

/s/ LOUIS M. THAYER
Member

/s/ FRANCIS H. McADAMS
Member