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National Transportation Safety Board, Washington, D. C.

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16. Abstract

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The captain of Flight 60 had conducted an approach to runway 11 under conditions of low ceilings and low visibility. The aircraft touched down on the wet runway beyond the normal touchdown point and at an excessive speed.

The National Transportation Safety Board determines that the probable cause of the accident was the captain's faulty judgment in initiating a go around after he was committed to a full-stop landing following an excessively long and fast touchdown from an unstabilized approach.

Contributing to the accident was the pilot's unprofessional decision to abandon the precision approach.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

Adopted: December 22, 1976

ALASKA AIRLINES, INC.
B-727-81, N124AS
KETCHIKAN INTERNATIONAL AIRPORT
KETCHIKAN, ALASKA
APRIL 5, 1976

SYNOPSIS

About 0819 P.s.t. on April 5, 1976, Alaska Airlines, Inc., Flight 60, a Boeing 727-81 N124AS, overran the departure end of runway 11 at Ketchikan International Airport, Ketchikan, Alaska. The aircraft crashed in a ravine about 700 feet past the runway threshold. There were 43 passengers and a crew of 7 on board. As a result of the crash, 1 person died and 32 persons were injured. The aircraft was destroyed by impact and ground fire.

The captain of Flight 60 had conducted an approach to runway 11 under conditions of low ceilings and low visibility. The aircraft touched down on the wet runway beyond the normal touchdown point and at an excessive speed.

The National Transportation Safety Board determines that the probable cause of the accident was the captain's faulty judgment in initiating a go-around after he was committed to a full-stop landing following an excessively long and fast touchdown from an unstabilized approach.

Contributing to the accident was the pilot's unprofessional decision to abandon the precision approach.

1. FACTUAL INFORMATION

1.1 History of the Flight

About 0738 1/ on April 5, 1976, Alaska Airlines, Inc., Flight 60, a B-727-81, N124AS, departed Juneau, Alaska, on a regularly scheduled passenger flight to Seattle, Washington; an en route stop was scheduled for Ketchikan International Airport, Ketchikan, Alaska. There were 43 passengers and a crew of 7 on board.

Anchorage air route traffic control center (ARTCC) cleared Flight 60 on an instrument flight rules (IFR) flight plan to the Ketchikan International Airport; the flight was routine en route.

At 0805, Anchorage ARTCC cleared Flight 60 for an approach to runway 11 at Ketchikan. At 0807, the flight was 30 DME 2/ miles from the airport. At 0811, Flight 60 reported out of 10,000 3/ feet and was cleared to contact Ketchikan Flight Service Station (FSS); the FSS advised the flight that the 0805 weather was: Ceiling--800 ft., obscured, visibility--2 mi, light snow, fog, wind--330° at 5 kn. The FSS also advised the flight that braking action on runway 11 was poor; this report was based on braking tests performed by the airport manager. The captain testified that he did not recall hearing the braking condition report.

Upon receipt of the clearance, the crew of Flight 60 began an ILS approach to Ketchikan. Near the 17-mile DME fix, as the flight descended through 4,000 feet, the crew acquired visual contact with the ground and water. As the flight approached Guard Island, the captain had the Island in sight and decided to abandon the ILS approach and to continue the approach visually. The captain testified that he established a "visual glide slope of my own" at an altitude of about 1,000 feet, and stated that his eyes were "... the most reliable thing I have." Visual contact with the approach lights was established about 2 miles from the runway threshold. The airport was visible shortly thereafter.

The captain did not recall the airspeed at touchdown, but estimated that he touched down about 1,500 feet past the threshold of runway 11. He also testified that he did not see the yellow, 1,000-foot markers on the runway; he further testified that the runway "... was just wet." A passenger on Flight 60, who was seated in seat 5A (just forward of the wing's leading edge), stated that the yellow runway marks were visible to him.

1/ All times here are Pacific standard, based on the 24-hour clock.

2/ Distance measure equipment at Ketchikan is collocated with the ILS localizer transmitter for runway 11.

3/ All altitudes herein are mean sea level, unless otherwise noted.

The first officer has no recollection of the sequence of events leading to the accident; however, the second officer testified that airspeeds and descent rates were called out during the last 1,000 feet. The captain could not recall the flap setting either on approach or at touchdown. However, the second officer testified that after the landing gear was extended the first officer remarked, "We're high," and lowered the flaps from 30° to 40°. None of the cockpit crew remembered the airspeeds, descent rates, or altitudes of the aircraft during the approach and touchdown.

Reference speed was calculated to be 117 kns with 40° flaps and 121 kns with 30° flaps.

The captain testified that after touchdown he deployed the ground spoilers, reversed the engines, and applied the wheel brakes. Upon discovering that the braking action was poor, he decided to execute a go-around. He retracted the ground spoilers, called for 25° flaps, and attempted to obtain takeoff thrust. The thrust reverser mechanism did not disengage fully and the forward thrust could not be obtained. He then applied full reversing and quickly moved the thrust levers to "idle." This attempt to obtain forward thrust also was not successful.

The captain then reapplied reverse thrust and again deployed the ground spoilers in an attempt to slow the aircraft. When he realized that the aircraft could not be stopped on the runway, he turned the aircraft to the right, raised the nose, and passed over a gully and a service road beyond the departure end of the runway. The aircraft came to rest in a ravine, 700 feet past the departure end of runway 11 and 125 feet to the right of the runway centerline.

Flight attendants reported nothing unusual about the approach and touchdown, except for the relatively short time between the illumination of the no-smoking sign and the touchdown. The two flight attendants assigned to the rear jumpseats and the attendant assigned to the forward jumpseat did not have sufficient time to reach their assigned seats and had to sit in passenger seats. None of the flight attendants felt the aircraft decelerate or heard normal reverse thrust. Many passengers anticipated the accident because of the high speed of the aircraft after touchdown and the lack of deceleration.

Two ground witnesses, who are also pilots, saw the aircraft when it was at an altitude of 500 to 700 feet and in level flight. The witnesses were located about 7,000 feet northwest of the threshold of runway 11. They stated that the landing gear was up and that the aircraft seemed to be "fast" for that portion of the approach. When the aircraft disappeared behind an obstruction, these witnesses moved to another location to continue watching the aircraft. They saw the nose gear in transit and stated that it appeared to be completely down as the aircraft crossed over the first two approach lights. The first two approach lights are located about 3,000 feet from the runway threshold.

A witness, who was located on the fifth floor of the airport terminal, saw the aircraft when it was about 25 feet over the runway. The witness stated that the aircraft was in a level attitude, but that it appeared "very fast." He stated that the aircraft touched down about one-quarter way down the runway, that it bounced slightly, and that it landed again on the nose gear only. It then began a porpoising motion which continued until the aircraft was past midfield.

Most witnesses placed the touchdown between one-quarter and one-half way down the runway and reported that the aircraft seemed faster-than-normal during the landing roll. Witnesses reported varying degrees of reverse thrust, but most reported only a short burst of reverse thrust as the aircraft passed the airport terminal, about 3,800 feet past the threshold of runway 11.

The accident occurred in daylight hours at about 0819 P.s.t., at latitude 55° 21' N. and longitude 131° 42' W.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other
Fatal	0	1	0
Nonfatal	5	27	0
Minor/None	2	15	

1.3 Damage to Aircraft

The aircraft was destroyed by impact and ground fire.

1.4 Other Damage

The ILS localizer antenna array was damaged slightly.

1.5 Personnel Information

The captain, first officer, second officer, and flight attendants were trained and certificated according to current regulations. (See Appendix B.) The captain had flown into Ketchikan more than 50 times before the accident.

The captain testified that during his flight training with Alaska Airlines, Inc., he had practiced touch and go landings; however, he did not recall whether reverse thrust was used. During a routine en route inspection conducted by a Federal Aviation Administration (FAA) inspector, an Alaska Airlines check airman was giving an en route check, also, to the captain of the accident aircraft. The FAA inspector stated that the company check airman advised the captain that "... once reverse was selected and the reverse lights were illuminated, the aircraft was committed to stop." This advice was based on the difficulty which had been encountered when attempts were made to go from reverse thrust to forward thrust.

1.6 Aircraft Information

N124AS was certificated, maintained, and equipped according to FAA regulations. (See Appendix C.) The aircraft's gross weight and center of gravity at the time of the accident were 126,500 lbs and 24.6 percent MAC, respectively. Both were within specified limits.

The aircraft had been fueled with 34,998 lbs of Jet-A fuel at Juneau. About 28,000 lbs of fuel were on board when the aircraft crashed.

1.7 Meteorological Information

All FSS personnel at the Ketchikan Airport were accredited weather observers certified by the National Weather Service. The aviation terminal forecast which was issued by the forecast office at Juneau at 0640, valid from 0700 to 1900, for Ketchikan, was:

> 0700-1900, ceiling--1,200 feet overcast, visibility--3 miles, light rain, occasional ceiling--700 feet obscured, visibility--1 mile, light rain, light snow, and fog.

At the time of the accident, the following weather observations for the Ketchikan Airport were relevant:

0754 - Record Special, ceiling--indefinite 800 feet obscured, visibility--1 1/2 miles, light snow, fog, temperature--34°F, dewpoint--32°F, wind--340° at 5 kns, altimeter setting--29.64 inches.

0805 - Special, ceiling--indefinite 800 feet obscured, visibility--2 miles, light snow, fog, wind--330° at 5 kns, altimeter setting--29.64 inches.

0819 - Local, ceiling--indefinite 800 feet obscured, visibility--2 miles, light snow, fog, wind--350° at 6 kns, altimeter setting--29.64 inches, accident special.

At 0400, the Annette, Alaska, winds aloft observation for 4,000 feet and below were as follows:

Feet	Direction	Speed
(m.s.l.)	(true)	(kn)
4,000	070	8
3,000	070	10
2,000	060	16
1,000	055	16
Surface	050	8

The natural light condition at the time of the accident was sunlight.

1.8 Aids to Navigation

The ILS/DME front course approach to runway 11 is on an inbound course of 109°. The glide slope is intercepted at 4,200 feet; the glidepath angle is 3.61°. The final approach fix (FAF) is 9.7 nmi from the runway threshold; the glide slope crosses the FAF at 3,951 feet. Decision height is 1,000 feet and occurs on the glide slope at 3.5 DME (2.2 miles from the threshold). Minimum visibility for the approach is 2 miles. The glide slope crosses the threshold at 60 feet above ground level. (See Appendix D.)

A postaccident flight inspection of the ILS approach aids for runway 11 indicated that the ILS was operating within tolerances.

1.9 Communications

There were no air-to-ground communications difficulties.

1.10 Aerodrome Information

Runway 11 at the Ketchikan International Airport is asphalt surfaced and is 7,500 feet long and 150 feet wide. The approach lighting system includes high-intensity runway lights, a medium-intensity approach light system, a runway alignment indicator lighting system, and a visual approach slope indicator (VASI). The runway lights are variable control, 5-step intensity, and the approach lights are 3-step intensity. Both runway and approach lights were set at maximum intensity, and the VASI was on during Flight 60's approach. There were no runway distance markers installed. The runway markings on runway 11 are the prescribed configuration for a precision instrument runway.

The airport elevation is 88 feet; the elevation of the touchdown zone is 86 feet. The runway is relatively level. There is no control tower at Ketchikan; traffic is handled by the FSS.

The airport manager testified that the area of the runway which had been cleared of snow was 80 feet wide and the full length of the runway. The runway had been plowed and swept just before Flight 60 touched down. The airport manager estimated that when Flight 60 landed there was between 1/8 and 1/4 inch of slush remaining on the runway surface.

1.11 Flight Recorders

N124AS was equipped with a Sundstrand Data Control, model FA-542, flight data recorder (FDR) serial No. 1687. The recorder was located just aft of the rear pressure bulkhead in the ventral stairway. The parameters for the last 10 minutes of flight were read out. (See Appendix F.)

For the times indicated, the following altitudes and airspeeds were derived from the FDR:

Time	Altitude	Airspeed
(minutes and seconds)	(ft.m.s.l.)	(kn)
08:29.4	914	208
09:03.0	700	205
09:21.6	241	182
09:28.2	98	180
09:33.0	57 (touchdown)	145
10:00	end of recording	

The Safety Board derived the following flightpath for Flight 60 from a study of the parameters measured on the aircraft's FDR. When the aircraft was 11 DME miles from the threshold, it's altitude was about 2,700 feet, at a true airspeed (TAS) of 225 kns and with a rate of descent of 1,400 feet per minute (fpm). When the aircraft passed Guard Island, 8.25 nmi from the calculated touchdown point, the altitude was about 2,100 feet, the TAS was 227 kns, and the rate of descent was 1,360 fpm. When the aircraft was about 4.75 nmi from the calculated touchdown point and at an altitude of 750 feet, it leveled off and then began a slight climb. Its TAS was 207 kns, and its rate of climb was about 500 fpm. The aircraft passed through the glide slope, for the first time, about 2.75 nmi from the calculated touchdown point and at an altitude of about 950 feet. Its TAS was 209 kns and its rate of climb was about 200 fpm.

The aircraft began a second descent about 150 feet above the glide slope. At the beginning of this descent, the TAS was 210 kns and the rate of descent was about 315 fpm. During the next 12 seconds, the rate of descent increased to 1,400 fpm and was maintained at that rate for 10 seconds. The TAS decreased gradually to a minimum of about 145 kns at initial touchdown.

From the 11 DME fix until the aircraft reached 750 feet about 4.75 nmi from touchdown, the flight paralleled the glide slope but was about 1,000 feet below it. After reaching 750 feet, the aircraft climbed and arrived at 1,000 feet at about the 4.5-DME.

The aircraft was also equipped with a Collins Radio Company, model 642C-1, cockpit voice recorder (CVR); it was located in the rear of the baggage compartment. The CVR and its recording medium were destroyed by ensuing ground fire.

1.12 Wreckage and Impact Information

The wreckage area was about 120 feet long and 250 feet wide, and was located 700 feet from the departure end of runway 11. The terrain included numerous tree stumps, and was in a valley about 40 feet lower than the end of the runway. The elevation at the end of the runway was 86 feet. As the aircraft left the runway overrun, it cleared a gully and a service road. The left wing hit the localizer antenna array support structure at about 63 feet. The structure is centered on the runway centerline and about 150 feet beyond the runway 11 overrun. The aircraft then struck large rocks and tree stumps and came to rest on a magnetic heading of 105°, and at an elevation of 45 feet m.s.l. (See Appendix G.)

1.12.1 Structures

The fuselage broke into three sections--one break was near the wing's leading edge and the other near the wing's trailing edge. The left wing remained attached to the fuselage, but the right wing separated. The nose gear and main landing gears separated from their respective attachment structures. The tires, wheel rims, and antiskid assemblies remained attached to the strut assemblies.

Several deep cuts appeared on both tires of the left main landing gear, but no damage to the wheel rims and brakes was apparent. Both antiskid detectors were intact and with no visible damage. Both tires were inflated and in good condition; there was no evidence of reverted rubber. The left main landing gear retract actuator was attached within the left wing and was in the fully extended position.

The remains of the tires from the right main landing gear were examined, and no evidence of reverted rubber was found. The retract actuator for the right main landing gear was in the fully extended position.

During the runway examination, the first marks found which could be related to the aircraft were those of the left and right main landing gear tires. These were visible and continuous starting 7,200 feet from the takeoff end of runway 11. The first nose gear marks were found in the gravel section of the runway overrun, 7,646 feet from the takeoff end. No reverted rubber was found on the runway and no evidence of hydroplaning was found.

Jackscrew measurements indicated that the flaps were positioned about 25°. The spoilers were down and locked.

1.12.2 Systems

The aircraft's battery was intact and capable of delivering power. The No. 1 and No. 2 VHF navigation receivers were checked and found to be operational on 109.3 MHz, the ILS frequency for the Ketchikan International Airport.

All of the brake assemblies were examined. There was no evidence of preimpact failure and all of the brakes were in serviceable condition. The antiskid transducers, the left antiskid valve, the left and right brake metering valves, and the left nose and left main landing gear inboard brake assemblies were tested and were found to function normally. Impact or fire damage, or both, prevented testing of the other brake assemblies.

1.12.3 Powerplants

The No. 1 engine assembly separated from the engine strut support. The No. 1 engine thrust reverser assembly was attached to the rear flange of the turbine exhaust case. The thrust reverser directional valve's piston was extended 1/4 inch. The thrust reverser followup cam was in the interlock position, which limited further movement of the reverse thrust lever. The piston in the sequence valve was extended 1 1/4 inches.

The clamshell doors on the No. 1 thrust reverser assembly were in an intermediate position. The aft edges of the doors were separated 14 inches. The deflector doors were rotated outward; the lower door was crushed against the reverser frame assembly.

The No. 2 engine and its thrust reverser assembly were intact. The piston in the directional valve was extended 1 1/8 inches. The thrust reverser followup cam was in the interlock position. The piston in the sequence valve was extended 1 inch. The clamshell doors on the No. 2 engine's thrust reverser assembly were in an intermediate position; the aft edges of the doors were separated 4 1/4 inches. The left deflector door was rotated outward; the right deflector was damaged severely by impact.

The No. 3 engine's assembly remained attached to the engine support assembly. The No. 3 thrust reverser assembly separated from the engine just forward of the rear flange of the fan exhaust case. The piston in the directional valve was extended 1 1/8 inches. The thrust reverser followup cam was in the interlock position. The piston in the sequence valve was extended 13/16 inch. The clamshell doors were separated 14 inches. The deflector doors were rotated outward.

1.13 Medical and Pathological Information

The captain sustained multiple fractures to his legs and ribs, as well as contusions and abrasions. The first officer sustained skull, leg, rib, and spinal fractures, and contusions and lacerations. The second officer sustained multiple spinal fractures and a fractured rib.

One flight attendant, who was seated in seat 6C, sustained lacerations to both legs and abdominal bruises. The flight attendant in seat 8C sustained an acute cervical strain and rib fractures on the right side. The flight attendant in seat 22C sustained contusions to the left arm, left knee, and head and fuel burns to his skin. The flight attendant in seat 22-D sustained multiple contusions, fuel irritation to her right eye, and singed hair on the back of her head.

Passenger injuries included spinal, leg, and rib fractures, lacerations, contusions, and abrasions. The fatally injured passenger died of impact trauma.

During the captain's last FAA physical examination, before the accident, on January 22, 1976, a 4+ urine sugar level was discovered; as a result, a blood glucose tolerance test was performed on January 23. The results of this test are considered abnormal on the basis of a high 1-hour blood glucose level (218 mg/100 ml), a low 3-hour blood glucose level (53 mg/100 ml), and persistent abnormal levels of sugar in the urine. The FAA interpreted these test results as not being indicative of diabetes mellitus, but attributed them to "renal glycosuria or some disturbance in the glucose metabolism." The captain was advised at that time to lose 10 lbs and to eat snack foods between meals. Because these test results suggested a greater-than-normal susceptibility to hypoglycemia (abnormally low blood sugar levels), a 6-hour glucose tolerance test was conducted on the captain at the Safety Board's request in July 1976. These latter test results were not considered abnormal. No blood glucose tolerance tests were conducted on the captain on the day of the accident.

The Cecil-Loeb Textbook of Medicine, 13th edition, 1971, indicates that a blood glucose level of 50 mg/100 ml is a hypoglycemic level. The effects of hypoglycemia include, among other things, subtle mental confusion, slowing of cognitive processes, and diminution of psychomotor ability.

During the 12 hours 50 minutes preceding the accident, the captain's food intake consisted of a sandwich, which he consumed the previous evening, and a cup of coffee which he drank between 0600 and 0630 the morning of the accident. He did not recall if he had eaten during the 40-minute flight from Juneau to Ketchikan.

An audiometer hearing test was conducted on the captain in July 1976, with the following results: A hearing loss of 15 dB at 250 Hz, 500 Hz, and 1,000 Hz was noted for both ears; a 40 dB loss at 2,000 Hz for both ears; a 55 dB loss at 4,000 Hz for both ears; and 20 dB and 35 dB loss in each ear at 8,000 Hz.

According to the FAA's Guide for Aviation Medical Examiners, a hearing loss of 25 dB or greater in the frequency range of 500, 1,000, and 2,000 Hz for either ear is disqualifying for a first-class medical certificate.

The captain received a "whisper" hearing test during his most recent first-class medical examination conducted on January 22, 1976. The whisper method is acceptable for all classes of airman's medical examination.

1.14 Fire

Fire erupted on impact. Two airport fire trucks responded. The primary truck driven by the airport manager went from the fire station toward the accident scene but, because there was no way to get to the peripherial access road from the taxiway, the truck turned and drove around the terminal building and then onto the access road to the LOC-DME antenna. When the airport manager arrived, flames were concentrated primarily in the cabin and aft of the wing, and airline personnel and passengers were attempting to gain access to the cockpit to free the crew. On the access road, the two trucks passed passengers who were walking toward the terminal. The airport manager attempted to drive the firetruck to the aircraft via a cleared path from the west side of the LOC-DME antenna but a 5-foot ditch prevented the truck from using that route. The truck's overhead turret was used briefly, but the extinguishing agent would not reach the aircraft. The truck was then backed up and driven down the incline on the east side of the antenna. Again, the turret was used about 50 to 75 feet from the aircraft; however, after he saw that it was not effective, the airport manager elected to fight the fire with a handline. The handline manned by an Alaska Airlines employee directed protein foam toward the forward cabin and the cockpit to protect the persons who were attempting to free the cockpit crew.

A second firetruck, because of its size and difficulties with its brakes and power steering, could not traverse the same route down to the aircraft as did the firetruck, and consequently it remained near the LOC DME antenna and supplied water to the first firetruck.

The last crewmember was removed from the cockpit about 0840, coincidential with the arrival of the first men from the Ketchikan Fire Department (KFD) who got to the airport via the ferry from the mainland. They were joined later by men from the KFD's fireboat and by KFD personnel. The U.S. Coast Guard delivered a 250-gallon-per-minute portable pump which was placed in a creek and its handline was manned by KFD personnel. About 0930, KFD personnel decided to cease the firefighting effort because fuel was leaking from the aircraft and the supplies of aqueous film forming foam (AFFF) and water were low. Under these conditions, the KFD personnel could not be provided with the protection needed to continue fighting the fire. Estimates varied from 20 minutes to over 45 minutes when the firefighting effort was resumed. Additional lengths of hose were located on the primary truck which permitted the use of additional handlines. Additional supplies of extinguishing agents were delivered by the Coast Guard. The fire was fought using three lines and was extinguished by 1242. Airport personnel continued to cool the wreckage during the afternoon.

The airport manager who was in charge of the firefighting activities was neither trained nor equipped to perform this function. In addition, there were no trained firefighters on the airport. The officers and firemen from the city fire department were not familiar with the airport and were not familiar with the airport firetrucks or the location of equipment stored on the trucks and inside the unlabeled compartments on the trucks. Four suits of proximity clothing necessary to protect the firemen during firefighting activities were stored at the fire station; only one airport employee wore a complete suit and an Alaska Airline employee wore a jacket from a second suit. There was no breathing apparatus on the trucks and the power saw to be used for forced entry into the aircraft was not carried on either truck. The airport manager testified that only protein foam was used from the first firetruck. KFD personnel believed, however, that protein foam and AFFF could have been mixed in the Coast Guard pump.

The airport was operating under an exemption to 14 CFR 139.49 (b)(3) because the combined quantity of water carried by its two fire trucks was less than 3,000 gallons. The airport emergency plan, revised July 1975, had not been reviewed or approved by the FAA. The plan had not been tested.

On April 13 and 14, 1976, the FAA inspected the firefighting capability of the airport and reported the following areas of noncompliance with 14 CFR 139:

14 CFR 139.91:	Lack of self-inspection and maintenance records of the equipment.
14 CFR 139.49 (h) and (i):	No records of the firefighting training received by airport employees.
14 CFR 139.89 (a):	Insufficient number of personnel available during all air carrier operations.
14 CFR 139.31:	The airport operations manual was out of date.
14 CFR 139.55:	The revised emergency plan was not approved by the FAA.

The FAA also reported that the Borough "had taken too lightly" the management of the airport and stressed that the airport manager should be free to manage the operations at the airport.

The FAA reinspected the airport in May 1976, and notified the Borough Manager that all areas of noncompliance had been corrected or were in the process of being corrected to the FAA's satisfaction.

1.15 Survival Aspects

This was a survivable accident. Two flight attendants and about 10 passengers evacuated from the main cabin door. The door sprung open about 18 inches and jammed at impact. One passenger crawled through a hole in the ceiling above his seat and at least three passengers crawled through a hole in the cabin wall behind the left wing. The remaining passengers evacuated from the two overwing exits on the left side. Two flight attendants evacuated through a break near the ventral stairs. The cockpit crew was trapped and they were removed about 20 minutes after the crash.

U.S. Coast Guard passengers and other passengers expedited the evacuation by repeated trips in and out of the aircraft to assist those seriously injured. Helicopters, corpsmen, and medical technicians were provided by the Coast Guard and began arriving at the scene minutes after the accident. The Coast Guard arranged for a large transport aircraft to transport the more seriously injured to Seattle, Washington.

The interior of the aircraft was destroyed by impact and fire. Some passenger seat legs showed evidence of compression buckling. Although the fire consumed most of the seats, passenger and flight attendant reports indicated that 16 seats failed, 9 of which were on the right side--rows 6 through 9 inclusive.

Alaska Airlines' procedure for alerting the flight attendants to prepare for landing is the illumination of the cabin no smoking signs. This is done when the landing gear is lowered. Insufficient time was available for the attendants to check that all tray tables were stowed, that passenger seatbacks were up, and that passenger seatbelts were fastened.

1.16 Tests and Research

1.16.1 Examination of Engine Thrust Reversers' Indicator Light Bulbs

The Safety Board examined the light bulbs from the Nos. 1, 2, and 3 thrust reversers at its laboratory in Washington, D.C. The examination revealed that the filament coils in the No. 1 thrust reverser indicator bulb were stretched and distorted; that the filament coils in the No. 2 thrust reverser indicator bulb were slightly stretched; and that the filament coils in the No. 3 thrust reverser indicator bulb were stretched and distorted.

1.16.2 Aircraft Performance Analysis

At the Safety Board's request, the Boeing Company furnished runway stopping distance data for the B-727 aircraft. The following parameters remained constant for all computations: Gross weight--126,500 lbs, pressure--29.92 hes, temperature--34°F.

It was assumed that the runway was wet and that braking action was poor. The aircraft touched down at 145 kn and with a 3-kn tailwind component. Reverse thrust and brakes were used. Undei these conditions, the stopping distances were computed to be:

Flaps	With Spoilers	Without Spoilers
	(ft)	(ft)
30°	3,090	4,290
40°	3,010	4,180

In addition to these data, the Safety Board also requested that Boeing determine the engine bleed air pressure in the reverser system that would be necessary to stow the reversers at an indicated airspeed of 130 kn. Boeing determined that 55 percent N_1, or approximately 1.4 engine pressure ratio (EPR), would be necessary to stow the reversers at that speed.

1.16.3 Aircraft Descent Profile Calculation

The data obtained from the FDR readout was used to calculate the approximate flightpath of the flight and to calculate the approximate distance between the touchdown point on the runway and the point at which the aircraft left the runway. (See Appendix E.)

The indicated airspeed, pressure altitude, and magnetic heading obtained from the FDR were corrected to yield true airspeed, mean sea level altitudes, and true headings. The true airspeed and altitude rate of change were processed to determine the flightpath angle, which, in turn, was used to calculate the horizontal component of true airspeed. The winds aloft taken at Annette Island at 0400 and the surface wind taken at Ketchikan at 0819 were used to give approximate groundspeeds. These groundspeeds were averaged over time and used to calculate distance traveled over the ground. True headings were averaged to give approximate aircraft direction to determine aircraft coordinates in the horizontal plane as a function of time.

The time assumed for touchdown (09:33) and the time the aircraft was assumed to have left the overrun (09:55) were based on an evaluation of the vertical acceleration trace of the FDR.

The wind component parallel to the runway was considered to be a 4.97 kn-tailwind. The tailwind component was algebraically added to computed TAS to calculate the groundspeed parallel to the runway at 1-second intervals from 09:33 and 09:55. The interpolated groundspeeds were converted to feet per second and an integration of these values indicated that the aircraft traveled about 4,400 feet during this time.

The longitudinal deceleration of the aircraft after touchdown was obtained from the change in groundspeed with respect to time over the interval 09:33 to 09:55. Computations indicated that an average deceleration of 6.82 ft/sec/sec (0.21G) was achieved about 2 seconds after touchdown. This deceleration was maintained for 3 seconds after which the deceleration decreased to an average value of 3.12 ft/sec/sec (0.097G) for the next 7 seconds. During the 6-second period prior to the aircraft's leaving the runway, the average deceleration had increased to 8.51 ft./sec/sec (0.26G).

The accuracy of the computed flight track and distance calculations depends on (1) the accuracy of the FDR measurements for this particular recorder, (2) the accuracy of the readout, (3) the accuracy of the wind information and its relationship to actual conditions, and (4) the accuracy of the assumed times of touchdown and leaving the overrun. Because of the unknown errors, the flight track distance computations must be considered approximations and are presented for comparison with other evidence.

1.17 Additional Information

1.17.1 Alaska Airlines Operations Manual

The following are excerpted from Section 4.600 of Alaska Airlines' Flight Operations Manual, which was applicable at the time of the accident:

"TAKEOFF AND LANDING

* * * *

B. General Altitude Awareness Procedures

The pilot not flying the aircraft will inform the pilot flying the aircraft when:

* * * *

4. During VFR approaches, at one thousand feet above field elevation.

5. During descent to initial approach altitude during IFR approaches, the aircraft is:

   a. One thousand above initial approach altitude,

   b. Over the final approach fix inbound (altimeter and instrument cross checks and flag warnings),

   c. On final approach and a significant deviation in airspeed, rate of descent, or instrument indications is noted.

C. The 2nd Officer will monitor and inform the pilots when a malfunction in altimeters or instruments exists or when an oversight is noted, particularly:

* * * *

2. During descent to assigned altitude (altimeter and heading cross checks should be made), or

3. On the final approach.

Instrument Approach Procedures - Crew Coordination

A. Approach checklist should be completed 5-10 minutes before beginning approach.

B. On all instrument approaches, prior to commencing the approach, the Captain and the First Officer shall review the approach plate and missed approach procedure.

* * * *

C. During the approach the First Officer shall assist the Captain as follows:

   1. Whenever the localizer or glide slope starts moving in from full deflection, call out "Localizer Alive" or "Glide Slope Alive" as applicable.

Upon leaving final fix

* * * *

2. Call "Glide Slope" or "Localizer" when one (1) dot deflection (sic) exists. Call "Airspeed" when more than 5 kts off target and "Sink Rate" if in excess of 1,000 feet per minute.

3. The First Officer shall call out 200 feet above minimums (DH) (MDA), 100 feet above minimums (DH) (MDA), at minimums (DH) (MDA).

4. When reaching DH or MDA advise Captain:

   a. "Runway in sight" will be called out if runway, runway lights, centerline lights, touch down lights, or REIL are recognized. If visual cues associated with the runway approach system, such as ALS, sequence flasher, lead in lights, etc., are sighted but not the runway, then the specific lights or clue sighted should be called out. This can be a cue to the Captain as to when is the proper time to leave his instruments and go visual for the landing.

Flight Operations Bulletin No. 73-7 (9/24/73)

Subject: Fuel Saving Techniques:

"…. An operational analysis indicates that greater savings are possible when fuel economy is practiced on each flight."

"During approach, delay in lowering the gear and flaps as long as practicable."

* * * *

Select the minimum certificated landing flap setting for the runway length and conditions. On the B-727 use 30° flaps when safely possible…."

1.17.2 Thrust Reverser System -- B-727 Aircraft

The reverse thrust system provides means of decelerating the aircraft during the landing roll and, thus, reduces the length of the landing roll. The clamshell-door type thrust reverser provides reversal of thrust by blocking the engine exhaust gas flow and deflecting the gases through openings made by the repositioned deflector doors.

The engine throttle lever or thrust lever must be returned to the "idle" position before the reverse thrust lever can be operated. The initial movement of the thrust reverser lever aft to an interlock position repositions the directional valve. This allows the 13th-stage engine bleed air to pass through the lock actuator and unlock the deflector door truck. The retraction of the lockout actuator releases the thrust reverser actuator rod ports and both pistons within the actuators are driven in the aft direction. Movement of both pistons within the actuator causes simultaneous actuation of the deflector doors and the clamshell doors.

When the reverse thrust lever is repositioned to eliminate reverse thrust, bleed air is routed through the primary port between the clamshell and deflector pistons. Thus, the clamshell doors are pushed toward the stowed position. The sequence valve piston is also repositioned when the clamshell doors have fully retracted. Bleed air is then rerouted to the secondary head ports of the thrust reverser actuators which would then drive the deflector door to the cruise position.

Maximum forward thrust cannot be obtained until the clamshell doors have nearly retracted to the cruise position, at which time the push-pull control will rotate the followup cam to the position which will allow movement of the thrust levers out of the interlock position.

Section 3A-1, page 62 of the Alaskan Airlines B-727-100 Flight Handbook, dated May 15, 1974, contained the following information regarding the use of reverse thrust.

> "Note: Do not move the reverse thrust levers rapidly from high reverse thrust (high RPM) into forward idle, as sudden opening of the reversers will allow the greater-than-idle thrust to accelerate the airplane. This nullifies a portion of the wheel braking and thrust reverse just applied. Reduce reverse thrust (and RPM) gradually to idle reverse before going to normal idle.
>
> "If a thrust reverser operating light fails to extinguish with the reverse thrust lever forward and down, the addition of forward thrust will normally cause the light to go out. If the reverser operating light still fails to extinguish, recycle the affected engine, to reverse, to the 70 knot detent (approximately 70% N_1), and move the reverse thrust levers <u>rapidly</u> forward and down. If the reverser mechanism fails to return to the forward thrust position, as evidenced by the fact that the engine thrust lever cannot be advanced past the interlock position, shut down the engine or operate at idle until ground maintenance can be performed.

"CAUTION: INCOMPLETE CYCLING OF THE REVERSE THRUST MAY CAUSE THE MECHANISM TO 'STALL'. ALWAYS BRING THE REVERSE THRUST LEVERS UP AND BACK TO AT LEAST THE REVERSE INTERLOCK WHEN CYCLING. AT SPEEDS ABOVE 40 KNOTS, THE REVERSER MECHANISM MAY NOT FULLY RETURN TO THE FORWARD THRUST POSITION AT IDLE POWER SETTINGS. SINCE 'STALLING' MAY OCCUR REVERSE THRUST SHOULD NEVER BE USED ON LANDING UNLESS A FULL STOP IS PLANNED. THE FORWARD AND REVERSE INTERLOCKS PREVENT THE USE OF HIGH POWER SETTINGS IF 'STALLING' OCCURS DURING THE REVERSE CYCLE."

In December 1975, an Alaska Airlines captain, who was flying a Boeing 727 on a regularly scheduled flight, made a go-around from runway 11 at the Ketchikan International Airport after landing and applying reverse thrust. The captain stated that a normal approach was made and the touchdown accomplished within the first 1,000 feet of runway at a reference speed of about 120 kns, and with a 6-knot tailwind. He stated that he applied full reverse thrust immediately and applied normal braking. Upon determining that the braking was nil, a successful go-around was initiated from a point about 3,000 feet beyond the runway 11 threshold and at an airspeed of 100 kns.

The captain of the accident aircraft testified that he knew about the successful go-around made by one of their pilots, as described above.

The following data regarding the certification basis and testing of the thrust reversers on a Boeing 727 aircraft was received from the Northwest Region of the FAA:

"The basis of certification for the Model 727-100 4/ airplane was Civil Air Regulation (CAR) 4b dated December 1953 with amendments 4b-1 through 4b-11, provisions of CAR SR-422N, special conditions outlined in attachment "A" of FAA letter dated October 27, 1961, and provisions in FAA letter dated June 12, 1963.

Amendment 4b-11 added CAR 4b.407(a) which states, "Reversing systems intended for ground operation only shall be such that no single failure or malfunctioning of the system under all anticipated conditions of airplane operations will result in unwanted reverse thrust. Failure of structural elements need not be considered if occurrence of such failure is expected to be extremely remote." Additionally, as part of the original certification, Item P-4 of the Type Certificate Board minutes, reverser substantiation was required relative to establishing maximum time in reverse, positive locking mechanisms, effects of inadvertent reversal in flight and the need for reverser system indicating lights.

4/ The thrust reversers on a Model 727-81 are the same as on a Model 727-100.

The following ground tests and flight tests were conducted to substantiate the reverser system and certificate the airworthiness of the system:

1. Endurance Testing of a Production JT8D-1 Thrust Reverser for the 727 series airplane - Boeing Document D6-7812 - The purpose of this static ground test was to determine and verify the structural integrity and functional reliability of the reverser system.

2. Thrust Reversing Operating Characteristics - Boeing Document D6-7772, Section 2.08.51 - The purpose of this ground static test was to demonstrate reverser operating characteristics during normal engine operation and the reverser cockpit control lever compliance.

3. Thrust Reverser Fail Safe Demonstration, Boeing Document D6-7772, Section 2.08.52 - The purpose of this flight testing was to demonstrate compliance with 4b.407(a) in that a failure of the pneumatic system does not result in unwanted reverse thrust under all anticipated conditions of airplane operation.

4. Thrust Reverser Inflight Operation Boeing Document D6-7772, Section 2.08.54 - The purpose of this flight testing was to evaluate the effects of pod and center engine reverser operations on airplane handling characteristics and to develop special flight procedures for handling the emergency situation in the event a reverser deployed during flight.

5. Thrust Reverser Controllability, Boeing Document D6-7772, Section 2.08.55 - The purpose of this ground testing was to establish a thrust reverser operating envelope affecting engine operation and surging. In addition, these tests were conducted to demonstrate airplane controllability in the event of pod engine failure conditions and with airplane aft center of gravity loading.

As far as aircraft performance requirements are concerned, there is no credit allowed for landing distance or other effects. The thrust reverser system for the 727 is on the airplane to be used, as an option, in stopping the airplane during landing or a rejected takeoff.

As can be seen from above, no testing was done to demonstrate the reverser system characteristics to stow specifically during the landing roll out or touch and go flight maneuvers. Consequently, the FAA does not have any data relative to the process of coming out of the reverse mode into the forward thrust mode.

The intent of these regulations is to cause the designer to develop an interlock system that will prevent the application of forward thrust with the power levers if the reversing system is not completely stowed and locked, and, conversely, prevent the application of reverse thrust with the power lever if the reversing system is not completely deployed. There is no requirement to override these features or to stow or deploy the reversing system and apply the desired level of thrust in a minimum time interval.

1.18 New Investigative Techniques

None.

2. ANALYSIS

The crewmembers were certificated, trained, and qualified for the flight according to FAA regulations. All flight crewmembers had adequate rest periods before reporting for duty.

The aircraft was certificated, maintained, and equipped according to FAA regulations. There was no evidence of in-flight fire, structural failure, or flight control or powerplant malfunctions.

During the approach and landing, the crew of Flight 60 encountered low ceilings, low visibility, and a low-velocity tailwind component. The flightcrew had been informed of these weather conditions by the FSS and also had been advised that braking action on runway 11 was poor.

The approach, as flown by the captain, did not conform to either the published approach procedure for an ILS or the carrier's procedure for a visual approach. According to the published instrument procedures, the aircraft should have been configured for landing with the landing gear down at the FAF--about 9.7 nmi from the threshold. The glide slope should have been intercepted at 4,200 feet and an angle of descent of 3.61° established. However, when Flight 60 reached that point on the approach, the aircraft was being flown visually. According to the captain, he preferred to operate visually whenever he could; he indicated that he had more faith in his eyes than he did in the electronic guidance devices provided for his use.

For the existing weather and runway conditions, the Safety Board believes that the captain of Flight 60 should have elected to execute a precision ILS approach. The added stability with better airspeed control should have assured a safe landing at or near the normal touchdown point and at or near the reference airspeed.

Although the ground track of the aircraft did approximate the localizer course, the vertical profile deviated significantly from the published procedures. During the latter portion of the approach, from 11 miles DME, the aircraft descended on an approximate 3.6° profile and stayed between 1,000 and 1,500 feet below the glide slope until it was about 4.75 nmi from the touchdown point. At that time a slight climb was initiated; the aircraft passed through the glide slope, reestablished a descent and maintained a path about 150 feet above the glide slope during the final 3.5 nmi to touchdown.

The indicated airspeed was consistently higher than normal throughout the approach. It varied from 240 kns at 5,000 ft to 145 kns at touchdown. The captain apparently intended to land with 30° flap extension. The reference airspeed based upon the aircraft's weight and the 30° flap configuration was 121 kns. Alaska Airlines, Inc., operating procedures allows an additive correction not to exceed 20 kns to provide a maneuverability margin when headwind and gusty conditions prevail. Although such conditions were not indicated by the reported weather, the captain explained that he added the full 20 kns on the expectation that turbulence would be encountered. Sometime before landing, the first officer extended the flaps to 40°. The reference speed for that configuration was 117 kns.

The captain's techniques resulted in an unstabilized approach. The aircraft crossed the runway 11 threshold about 100 feet above the ground and at an airspeed of about 150 kns, over 30 kns above reference speed. The prevailing tailwind component produced an even higher groundspeed. The excess altitude over the threshold and the high speed resulted in a touchdown according to calculations from flight recorder data and testimony of ground witnesses, about 3,300 feet down the 7,500-foot long runway.

Although the flightcrew could recall only one bounce following a firm landing, ground witnesses and passengers agreed that after the aircraft landed, it skipped or bounced and porpoised, and proceeded down the runway for some distance with only the nose gear on the ground. During that time, braking actions probably would have been ineffective.

After final touchdown the captain's procedures were consistent with an attempt for a full-stop landing; although the evidence shows that the aircraft was decelerating, the captain apparently thought the deceleration rate was unsatisfactory and initiated go-around procedures. It soon became apparent to the captain that he would not be able to go-around because he could not get the engines out of reverse thrust. He again attempted to stop the aircraft by re-extending the spoilers, going back to reverse thrust, and applying the wheel brakes; however by this time insufficient runway remained on which to stop. Examination of the thrust reversers revealed no evidence of preexisting failure or malfunction. Consequently, the Safety Board concludes that the reasons for the unsuccessful attempts to obtain forward thrust was the high speed of the aircraft which produced airloads on the deflector doors which exceeded the pneumatic load capacity of the reverser actuators.

The stretched filaments in the bulbs removed from the thrust reverser lights is evidence that the lights were on at impact, and support the reverse mode in which the clamshell doors and deflector doors were found. Also, the evidence is consistent with the captain's testimony that he reapplied reverse thrust.

If the captain's intention was to land and check the braking action, the procedures he used would have negated his objective. With the high groundspeed at touchdown the wheel brakes initially would slow the aircraft very little. Normally at speeds above 100 kns, the most effective decelerative devices on the aircraft are those which generate aerodynamic drag, such as spoilers, wing flaps, and thrust reversers. At speeds below 100 kns, the wheel brakes become the most effective decelerative device available. From the lower speeds, however, the capability of the aircraft to go-around becomes marginal because of the length of runway required. The Boeing 727 engines take approximately 6 to 8 seconds to accelerate from idle thrust to go-around power. Analyses have shown that, when a go-around is initiated at 100 kns, more than 2,000 feet of runway will be required to accelerate the engines and, in turn, accelerate the aircraft back up to liftoff speed on a dry runway. Additionally, drag produced by slush on the runway can adversely affect the aircraft's acceleration and extend this distance. For these reasons, the Safety Board believes that a landing for the purpose of checking braking action with the subsequent intention to go-around is potentially hazardous under any circumstances.

The captain further erred when he failed to recall, or neglected to heed, the published warnings and verbal advice given against the use of thrust reversers unless a full-stop landing was intended. Although the airplane had sufficient airspeed and available runway length to execute the go-around, the inability to stow the thrust reverser deflector doors precluded successful completion of the maneuver.

The airport manager testified that the runway had been plowed and swept just before Flight 60 landed and that the depth of slush on the runway was between 1/8 and 1/4 inch. The captain testified that runway 11 "...was just wet." Based on the above evidence, the Safety Board concludes that, while braking action was not as efficient as that of a dry runway, braking action was adequate and together with reverse thrust would have arrested the forward progress of a B-727 aircraft which landed at or near Vref speed well before the aircraft reached the departure end of the runway.

Furthermore, had the captain made a precision landing and then visually assessed the runway conditions as unsatisfactory, he could have executed a successful go-around provided that reverse thrust was not used and that the decision to go-around was made within 5 or 10 seconds of touchdown. However, once the captain applied reverse thrust, he was committed to keeping the aircraft on the ground and completing the landing roll out.

In spite of the long and fast touchdown, the Safety Board believes that the aircraft could have been successfully stopped on the runway with normal use of spoilers, reverse thrust, and wheel brakes. Boeing calculations showed that the aircraft could theoretically stop on a wet runway in about 3,010 feet from a touchdown speed of 145 kns. This, however, assumes that dynamic hydroplaning does not occur. The Board did not positively determine whether the aircraft did encounter hydroplaning, but such is not evident from the airspeed measurements on the airplane's flight data recorder, the runway examination, or the inspection of the tires. Computations showed that a deceleration rate of 6.82 feet/sec/sec was achieved during the captain's initial attempt to stop the aircraft and that a rate of 8.51 feet/sec/sec was achieved in the 6 seconds before the aircraft left the overrun. Had these decelerations been continuously maintained after the initial touchdown, the aircraft should have stopped within 4,200 feet.

From the foregoing, it is obvious that the captain's conduct of the approach, landing, and postlanding maneuvers was grossly deficient. Specifically, the captain deviated from normal approach procedures, conducted an unstabilized approach, and failed to correct the high airspeed and altitude before reaching the runway threshold, despite callouts by the first officer. The captain did not recall receiving the report of poor braking action; he did not recall his airspeed or sink rates during the approach and landing, he did not recall seeing the 1,000-foot runway markers; and he believed that the aircraft touched down within 1,500 feet of the threshold, when in fact it touched down approximately 3,200 feet down the runway. He erroneously judged the remaining runway length as inadequate to stop the aircraft; and, finally, he failed to heed published warnings against an attempt to go-around following selection of reverse thrust on landing.

Understandably, after touchdown the rapidity with which the runway was being used up would prompt the captain to apply ground spoilers, thrust reversers, and brakes immediately. Moreover, when the aircraft did not decelerate as expected, the captain probably realized that a very hazardous situation was developing and immediate remedial action was urgently needed; and, confronted with the inability to stop the aircraft effectively, the captain's most obvious alternative was to initiate a go-around. But, in electing to do so, he either failed to realize that he was committed to a full stop landing, or he chose to ignore the fact in the hope that forward thrust would become available.

If the captain believed that a go-around in this situation was possible, his belief may have stemmed from certain other information he had on the subject. Specifically, during his deposition the captain indicated that he was aware of another Alaska Airlines B-727 flightcrew which had recently completed a successful go-around following application of reverse thrust during a landing attempt at Ketchikan. The Safety

Board believes this knowledge may have influenced the captain's decision first to initiate a go-around and, then, to persist in that course of action when he recycled the reverse mechanism and again attempted to gain forward thrust.

Apparently, only after his second unsuccessful attempt to apply forward thrust and only after he had progressed more than three-quarters of the way down the runway, did the captain realize that neither a successful go-around nor a stop on the remaining runway was possible. The Safety Board believes that this captain's judgment and performance in this situation was below that expected of an experienced, qualified airline captain.

Given this conclusion, the question arises--why would a highly experienced and qualified captain deviate from prescribed procedures and exercise faulty judgment to the extent that he did in this case, and why would two other crewmembers fail to take more positive and timely action to alter the course of events?

The captain's expressed reasons for his decisions and actions do provide an explanation, but not justification for them; and although the conclusion that his performance constituted a serious lapse in expected professional conduct is inescapable, such a conclusion warrants consideration of other factors that might be involved.

Preaccident medical evidence suggested a predisposition to hypoglycemia on the part of the captain, and led the Safety Board to consider the possibility that he experienced a hypoglycemic episode during the flight.

If the untoward effects of hypoglycemia upon behavior and judgment were experienced by the captain on the morning of the accident, they could explain the underlying cause for the nonstabilized approach and his apparent misinterpretation of visual and kinesthetic cues during his attempts to stop the aircraft and then to take off.

however, the Board concludes that the available glucose test data are inconclusive, and that, in the absence of positive glucose test results from the day of the accident, a finding that the captain experienced an abnormal hypoglycemic episode cannot be supported. However, based on medical opinion, the Board believes that 13 hours without food could lower the blood sugar level in a healthy person to the degree that his efficiency would be adversely affected. Therefore, the Safety Board believes that the captain exercised poor judgment when he did not insure that he had adequate food intake before starting the flight--particularly in view of his medical test results and the medical advice he had received several months before the accident. Moreover, the Safety Board is concerned that this instance may not be an isolated one in the aviation community.

Flightcrews often maintain irregular schedules, cross one or more time zones, and stop at times and places at which it may be inopportune or difficult to get suitable meals. Under these circumstances they may be inclined to skip meals, or to substitute candy bars, soft drinks, and other "junk foods." In so doing, they may be subjecting themselves to below normal blood sugar levels and the resultant symptoms.

Flightcrews and management should be aware of the importance of maintaining adequate blood sugar levels through a regular, well-balanced food intake. They should recognize that they may be susceptible to the effects of hypoglycemia even though they have not been medically diagnosed as such and, that high-sugar content snacks provide only a temporary remedy for a low blood sugar condition and may have longer term adverse effects, if not supplemented shortly thereafter by a proper balance of nutrients.

Because of the extent of the captain's departure from prescribed procedures during the approach and landing, the Safety Board attempted to determine whether either of the other flight crewmembers alerted or advised the captain that the flight was being conducted in a manner which could compromise safety, or if either recommended a missed approach. The first officer could not remember any events leading to the accident; however, the second officer stated that the first officer called out airspeeds and descent rates after the aircraft descended through 1,000 feet, and that after the landing gear was extended, the first officer remarked, "We're high," and lowered the flaps from 30° to 40°. No other evidence of additional efforts was found.

Admittedly, the accident was not inevitable until some time after the aircraft's touchdown on the runway; however, the Safety Board believes the crewmembers should have recognized the progressively deteriorating situation and should not have passively condoned the continued operation of the aircraft in such a manner.

The Safety Board believes that all flight crewmembers, and most particularly the second-in-command, should be more outspoken in advising the pilot-in-command when they believe that the flight is being conducted in a nonstandard, careless or dangerous manner. Such constructive advice could prompt the pilot-in-command to reassess his procedures. Similarly, pilots-in-command should foster an atmosphere in the cockpit which permits constructive advice and positive recommendations for change where safety may be involved.

The Safety Board has previously recognized the need for improved guidelines regarding the circumstances and manner in which a flight crewmember should take affirmative action 5/, and has urged that copilots

5/ NTSB AAR-72-20; June 1, 1972

strengthen their sense of responsibility in adhering to prescribed procedures and safe practices. 6/ The Board again urges airline management and pilots' organizations to reexamine the relationship between the captain and flight crewmembers with a view toward formulating an effective enunciation of responsibilities in circumstances where the aircraft is being operated unsafely.

A 40-dB loss of hearing at 2,000 Hz is well over the permissible 25-dB. Therefore, the Board considered the possibility that the captain may not have heard the transmission of the FSS that the braking action was poor. (The captain testified that he did not recall hearing this information.) However, the second officer testified that he heard the report of the poor braking action and said that either the captain or the first officer acknowledged it. There is no evidence that the captain had any difficulty hearing other transmissions during the the flight. The fact that the hearing loss was discovered during an examination conducted in July 1976, 3 months after the accident, precludes any conclusion as to the degree of hearing impairment which may have been present at the time of the accident. In view of the testimony of the second officer, the Board concludes that the captain probably was aware of the braking conditions on the runway, and most likely heard the transmission himself, although he had no postaccident recall of it.

The Safety Board believes that a whisper test, while presently acceptable, does not measure adequately a person's hearing over the desired audiofrequency spectrum; whereas, the audiometer method does. Requiring audiometer tests at specified intervals would correct this deficiency.

This was a survivable accident since the decelerative forces were within human tolerance. However, the loss of cabin integrity and the failure of many passenger seats hampered escape and caused injuries.

Although the lack of firefighting capability at the airport did not contribute to the casualties, the conditions that existed on the day of the accident were unacceptable.

The airport manager had the responsibility for directing the firefighting at the airport. He was not prepared to assume command and to direct the initial and secondary fire attacks. He had neither the training and experience, nor the trained personnel to enable him to carry out his duties. The demands placed upon his time for overseeing the day-to-day airport operations did not permit him to implement a viable firefighting training program for airport employees and airport tenants.

6/ NTSB Safety Recommendations A-74-85 and 86, October 8, 1974.

The FAA's inspection of the airport's firefighting capability on April 13 and 14 disclosed five areas of noncompliance with 14 CFR 139. Following its inspection of the airport in May 1976, the FAA notified the Borough manager that all areas of noncompliance had been either corrected or were in the process of being corrected to the FAA's satisfaction.

Regardless of the corrective measures, the fact remains that no on-scene FAA inspection of firefighting equipment and facilities at the airport had been made in over 13 months. The Safety Board concludes that the FAA was remiss in not conducting an on-scene inspection to verify that the equipment was adequate and that trained personnel were available before it issued the exemption to 14 CFR 139.49. Further, more frequent inspection schedules at all certificated airports would serve to alert airport managers and municipal governments that certain minimum airport operating standards are required. Also frequent periodic inspections would provide the FAA with more timely information regarding airport operations.

The Safety Board concludes that the circumstances leading to the accident developed from a poorly planned and poorly executed approach followed by the captain's acceptance of a landing which was too far down the runway and at too high an airspeed. However, even after he touched down, the captain still had two options that could have insured the safety of the flight: (1) He could have applied full power and completed a go-around or, (2) he could have stopped the aircraft by firm and immediate use of the prescribed deceleration methods. The captain's indecision in the execution of either of these options resulted in actions that compromised the effectiveness of his ultimate attempt stop the aircraft.

3. CONCLUSIONS

3.1 Findings

1. There is no evidence of aircraft structure or component failure or malfunction before the aircraft crashed.

2. The flightcrew was aware of the airport and weather conditions at Ketchikan.

3. The weather conditions and runway conditions dictated that a precision approach should have been flown.

4. The approach was not made according to prescribed procedures and was not stabilized. The aircraft was not in the proper position at decision height to assure a safe landing because of excessive airspeed, excessive altitude, and improperly configured flaps and landing gear.

5. The aircraft's altitude was higher-than-normal when it crossed the threshold of runway 11 and its airspeed was excessively high.

6. The captain did not use good judgment when he initiated a go-around after he was committed to full-stop landing following the touchdown.

7. There is no evidence that the first and second officers apprised the captain of his departure from prescribed procedures and safe practices, or that they acted in any way to assure a more professional performance, except for the comment by the first officer, when near the threshold, that they were high after which he lowered the flaps to 40°.

8. After applying reverse thrust shortly after touchdown, the captain was unable to regain forward thrust because the high speed of the aircraft produced higher-than-normal airloads on the thrust deflector doors.

9. Braking action on runway 11 was adequate for stopping the aircraft before it reached the departure end of the runway.

10. Before the accident the FAA had not determined adequately the airport's firefighting capabilities.

11. Postaccident hearing tests conducted on the captain indicated a medically disqualifying hearing loss; however, the evidence was inadequate to conclude that this condition had any bearing on the accident.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the captain's faulty judgment in initiating a go-around after he was committed to a full-stop landing following an excessively long and fast touchdown from an unstabilized approach.

Contributing to the accident was the pilot's unprofessional decision to abandon the precision approach.

4. SAFETY RECOMMENDATIONS

As a result of this accident, the National Transportation Safety Board reiterates its previous recommendations:

A-72-137 ...that the Federal Aviation Administration: "Establish a procedure to require air carrier management to establish and implement a system that would provide a method for continual assessment of the pilot-in-command's performance in executing management's operational control responsibility."

"Furthermore, review and revise where necessary the operations manuals of air carriers to clearly state management's operational control procedures with regard to the pilot-in-command and other crewmembers and the manner in which each crewmember is expected to execute his duty." (NTSB AAR-72-20)

A-72-140 "...that the Air Line Pilots Association and the Allied Pilots Association implement a program within existing professional standards committees to provide an expeditious means for peer groups monitoring and disciplining the very small group of air carrier pilots who may display any unprofessional (including hazardous) traits as exemplified by this accident." (NTSB AAR-72-20)

A-74-85 and 86 ...that the Federal Aviation Administration:

"1. Initiate a movement among the pilots associations to form new professional standards committees and to regenerate old ones. These committees should:

a. Monitor their ranks for any unprofessional performance.

b. Alert those pilots who exhibit unprofessionalism to its dangers and try, by example and constructive criticism of performance required, to instill in them the high standards of the pilot group.

c. Strengthen the copilot's sense of responsibility in adhering to prescribed procedures and safe practices.

d. Circulate the pertinent information contained in accident reports to pilots through professional publications so that members can learn from the experience of others.

2. Develop an air carrier pilot program, similar to the General Aviation Accident Prevention Program (FAA Order 8000.8A) that will emphasize the dangers of unprofessional performance in all phases of flight. The program could be present in seminar form, using audio/visual teaching aids, to call to the pilots' attention all the facets of the problem." (NTSB AAR-74-4)

As a result of this accident, on January 25, 1977, the National Transportation Safety Board recommended that the Federal Aviation Administration:

"Inspect more frequently the crash/fire/rescue capabilities of certificated airports, especially those in Alaska, to assure adequate training of personnel, maintenance and operational readiness of CFR equipment, currency of emergency procedures, and availability of qualified personnel to conduct and to direct CFR activity. (Class II, Priority Followup) (A-76-141)

"Initiate a program for those airports which have no full-time CFR crew, especially those in Alaska, to properly train and equip the personnel that must respond to an aircraft fire. (Class II, Priority Followup) (A-76-142)

"Amend 14 CFR 139 to require that airport personnel who are not professional firefighter but who, because of their supervisory status, must direct CFR operations at airports, be qualified to perform this task. (Class II, Priority Followup) (A-76-143)

"Amend 14 CFR 67 to require that all applicants for first- and second-class medical certificates be administered periodically an audiometric hearing test. (Class II, Priority Followup) (A-77-7)"

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ WEBSTER B. TODD, JR.
Chairman

/s/ KAY BAILEY
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PHILIP A. HOGUE
Member

/s/ WILLIAM R. HALEY
Member

December 22, 1976

APPENDIX A

Investigation and Depositions

1. Investigation

The National Transportation Safety Board was notified of the accident at 1150 e.s.t., April 5, 1976. Investigators were dispatched immediately to Ketchikan.

Working groups were established for structures, systems, powerplants, operations, weather, maintenance records, human factors, witnesses, and flight data recorder. Parties to the investigation were: Alaska Airlines, Inc., Federal Aviation Administration, Air Line Pilots Association, Boeing Company, Pratt & Whitney Aircraft Division, United Aircraft Corp., the Association of Flight Attendants.

2. Depositions

Depositions were taken of selected witnesses in Seattle, Washington, on May 25, 1976.

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APPENDIX B

Crew Information

Captain Richard L. Burke

Captain Richard L. Burke, 55, was hired by Alaska Airlines, Inc., on January 23, 1960. He was upgraded to B-727 captain on September 7, 1973. He held an Air Transport Pilot Certificate No. 846-705 and a flight engineer's reciprocating and turbo-prop jet certificate No. 1547862. He was type-rated in DC-3, CV-230/330/440, L-382, and Boeing 727 aircraft, and held single and multi-engine land commercial privileges. He held a first-class medical certificate dated January 22, 1976, with the limitation, "Holder shall wear glasses for near and distant vision while exercising the privileges of his airman certificate." According to Captain Burke's testimony, he was wearing glasses on his approach to Ketchikan. He had accumulated 19,813 flight-hours, 2,140 of which were in the B-727 aircraft.

First Officer Richard L. Bishop

First Officer Richard L. Bishop, 42, was employed by Alaska Airlines, Inc., on April 26, 1966. He had an Airline Transport Pilot Certificate No. 1632077, with ratings in the B-707 and B-727 aircraft. He held commercial privileges in single-engine land and multi-engine land aircraft including the B-727. He held a second-class medical certificate dated August 7, 1975, with no limitations. He had accumulated 3,193 flight-hours, 1,980 of which were in the B-727 aircraft.

Second Officer Huston Leach

Second Officer Huston Leach, 43, was employed by Alaska Airlines, Inc., on December 5, 1966. He held Airline Transport Pilot Certificate No. 1440840. His first-class medical certificate was dated July 15, 1975, and showed no limitations. He had accumulated 3,454 total flight-hours, 2,641 hours of which were in the B-727 aircraft.

Crew Duty Time

The cockpit crew had performed 5:52 hours of duty during the 24 hours preceding the accident. Of this, 2:21 were flight-hours. Forty-two minutes were flown on the accident flight.

The cockpit crew had 12:45 hours rest during the 24 hours preceding the accident flight.

APPENDIX C

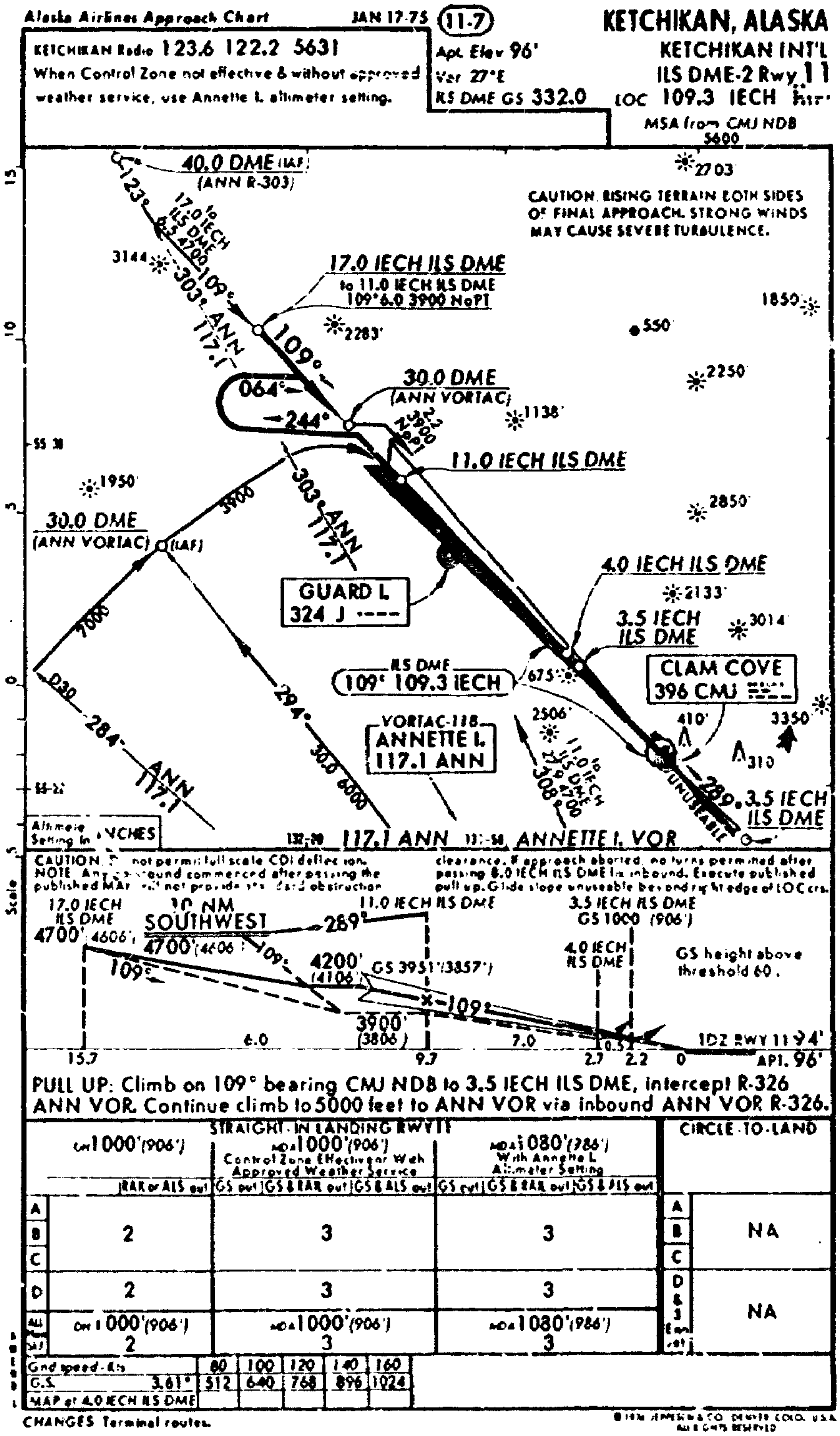
Aircraft Information

The aircraft was a Boeing 727-81, N124AS, manufacturer's serial No. 18821. The aircraft was manufactured March 1965. The aircraft had accumulated 25,360.6 hours total flying time, including 12,969.8 since the last major inspection and 316.7 hours since the last line maintenance check.

The aircraft was equipped with three Pratt & Whitney JT8D-7A engines. Engine serial numbers and times follow:

Engine	Serial No.	Total Time (hrs.)	Time Since Overhaul
No. 1	P654578B	14,910.0	10,583.5
No. 2	P653963B	19,099.0	10,349.6
No. 3	P653494B	16,683.8	16,683.8

APPENDIX D

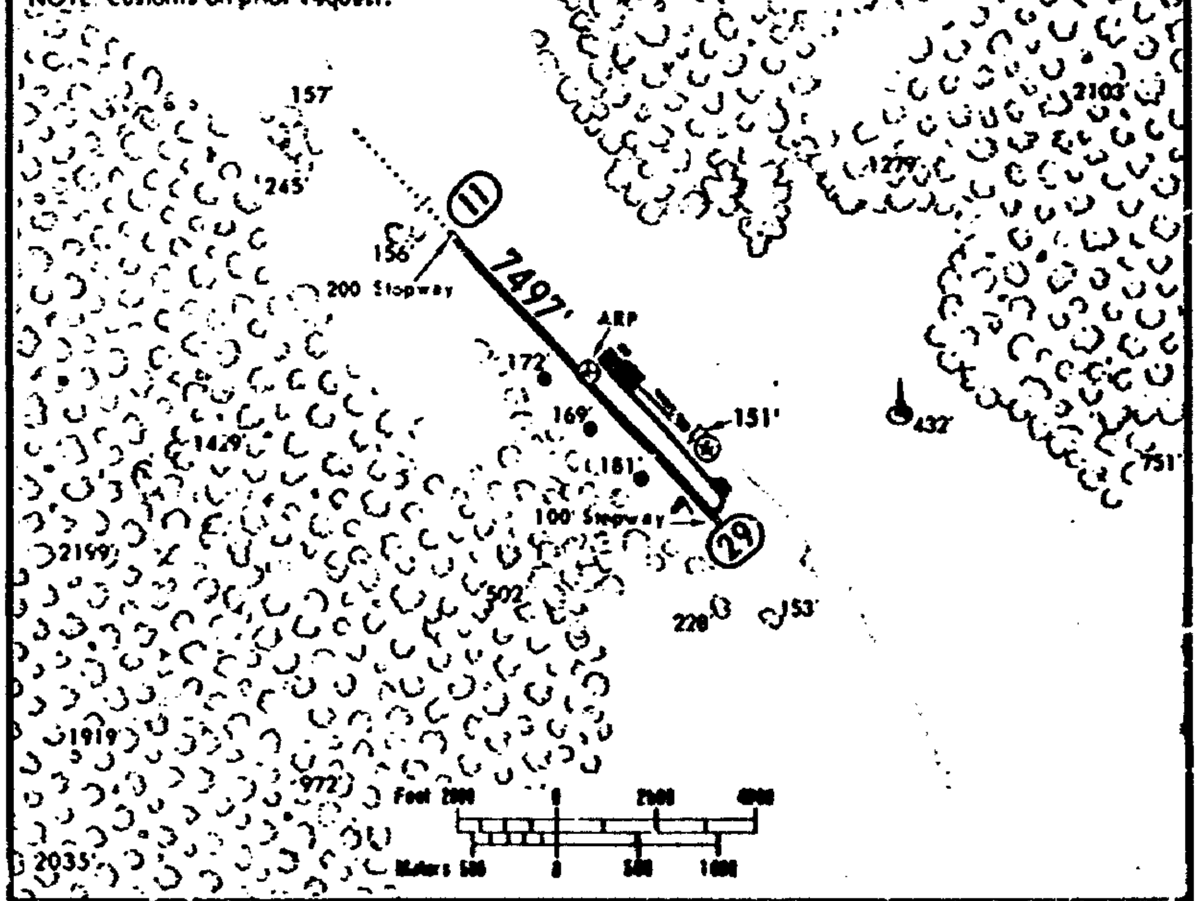


"ILLUSTRATION ONLY - NOT TO BE USED FOR NAVIGATIONAL PURPOSES"

KETCHIKAN, ALASKA
KETCHIKAN INT'L APT.
Elev 88' N55 21.4 W131 42.7
Var 27°E PAKT

(11-1) NOV 5-76 Jeppesen Approach Chart

CAUTION. High surrounding terrain causes highly variable wind direction, velocity and turbulence on arrival and departure routes.
NOTE: Customs on prior request.



ADDITIONAL RUNWAY INFORMATION

RWY		USABLE LENGTHS — LANDING BEYOND — Threshold	Glide Slope	TAKE-OFF	WIDTH
11	HIRL MALSR VASI-L		6497		150'
29	HIRL VASI-L				

	■ TAKE-OFF Rwy 11	Rwy 29	FOR FILING AS ALTERNATE Aut orized Only When Control Zone Effective or With Approved Weather Service
1 & 2 Eng / 3 & 4 Eng	3000 ceiling-2 ■1000 ceiling-2 ■ If performance restrictions of departure procedure can be met	1000 ceiling-2	A B C D: 3000-5

■ IFR departure procedure: Rwy 11, climb on 109° bearing CMJ NDB to 3.5 IECH ILS DME, intercept R-326 ANN VOR, thence via ANN VOR R-326 to the ANN VOR at o hove 5000'.(This departure requires 335'/mile climb . ANN VOR R-326/11.0 DME to clear obstacles in flight path). Rwy 29, northwest-bound, climb on west course IECH LOC to intercept V-317. West and southeast-bound, climb direct to J NDB, thence via 220° bearing from the J NDB to intercept V-307/V-317/V-317W.

CHANGES: Rwy 29 VASI.

"ILLUSTRATION ONLY - NOT TO BE USZD FOR NAVIGATIONAL PURPOSES"

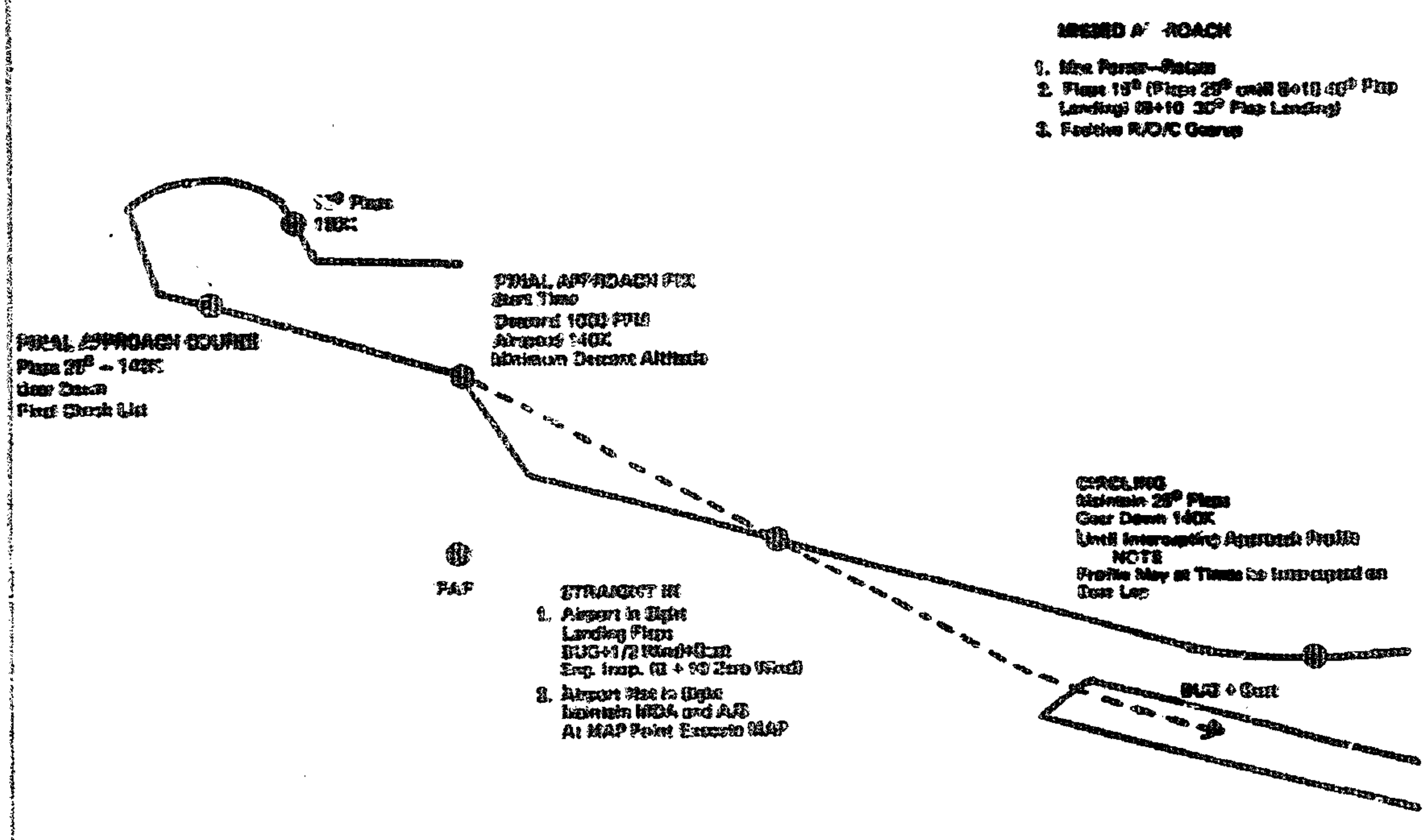
727 — **NON-PRECISION AND MISSED APPROACH** — 727

ADF/Backcourse/VOR/Circling

(Normal and Engine Inoperative)

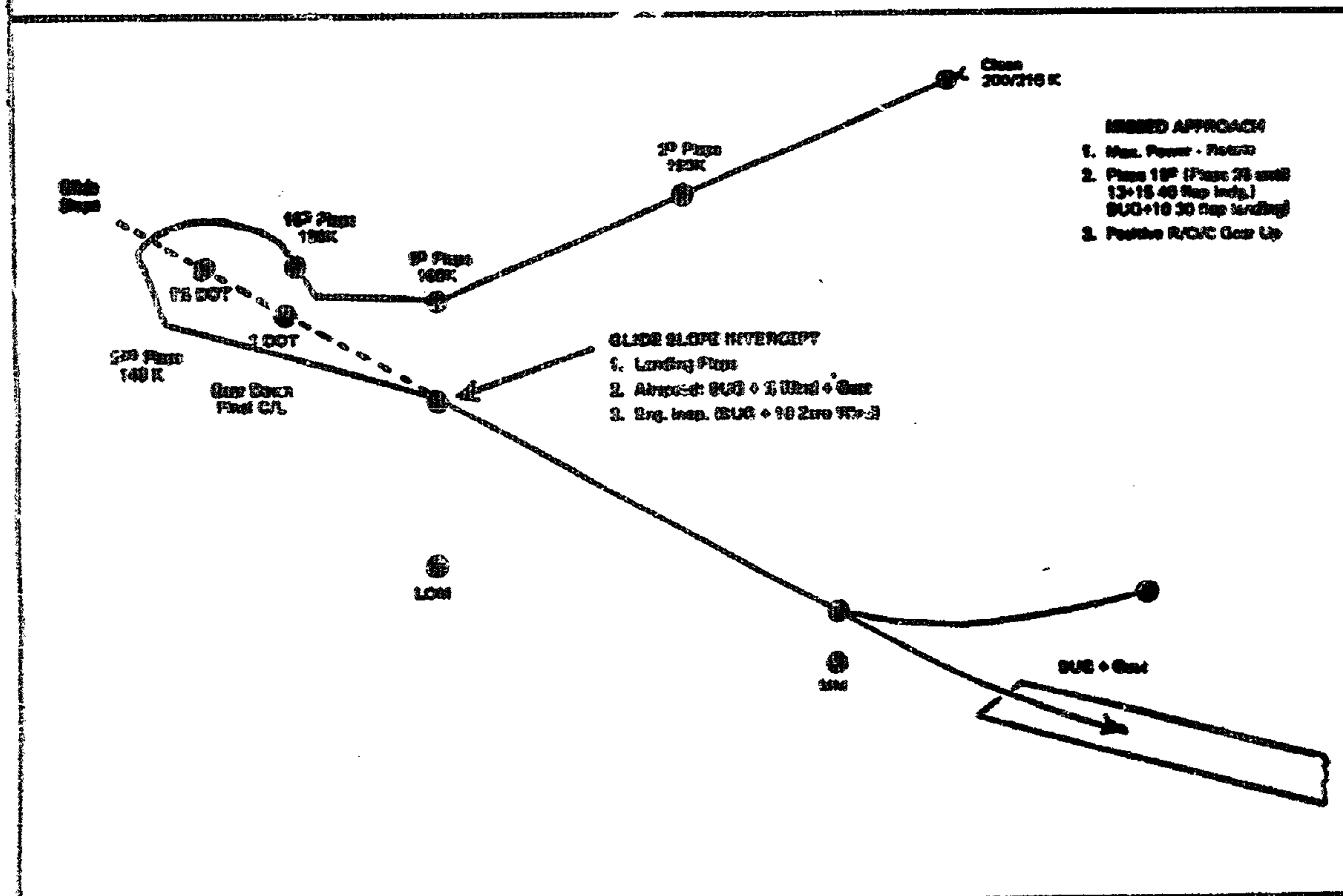
SECTION:	6.100
PAGE:	6
DATE:	9/15/74
SUPERSEDES PAGE DATED:	3/20/73

ALASKA AIRLINES — OPERATIONS TRAINING



727 **ILS AND MISSED APPROACH** 727

(Normal and Engine Inoperative)



OPERATIONS TRAINING

ALASKA AIRLINES

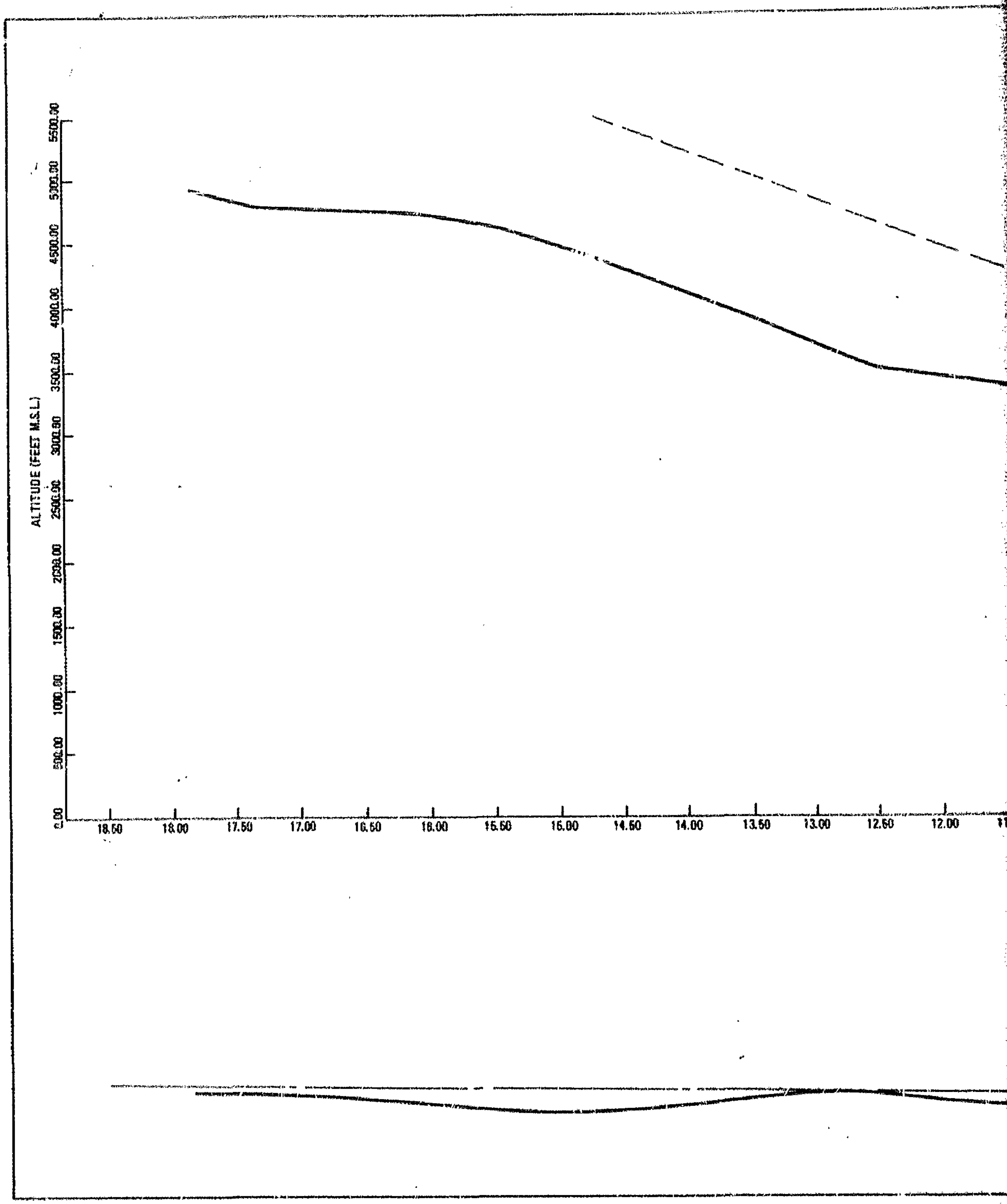
SECTION: 6.100

PAGE: 5

DATE: 3/15/74

SUPERSEDES PAGE DATED: 3/20/70

APPENDIX D



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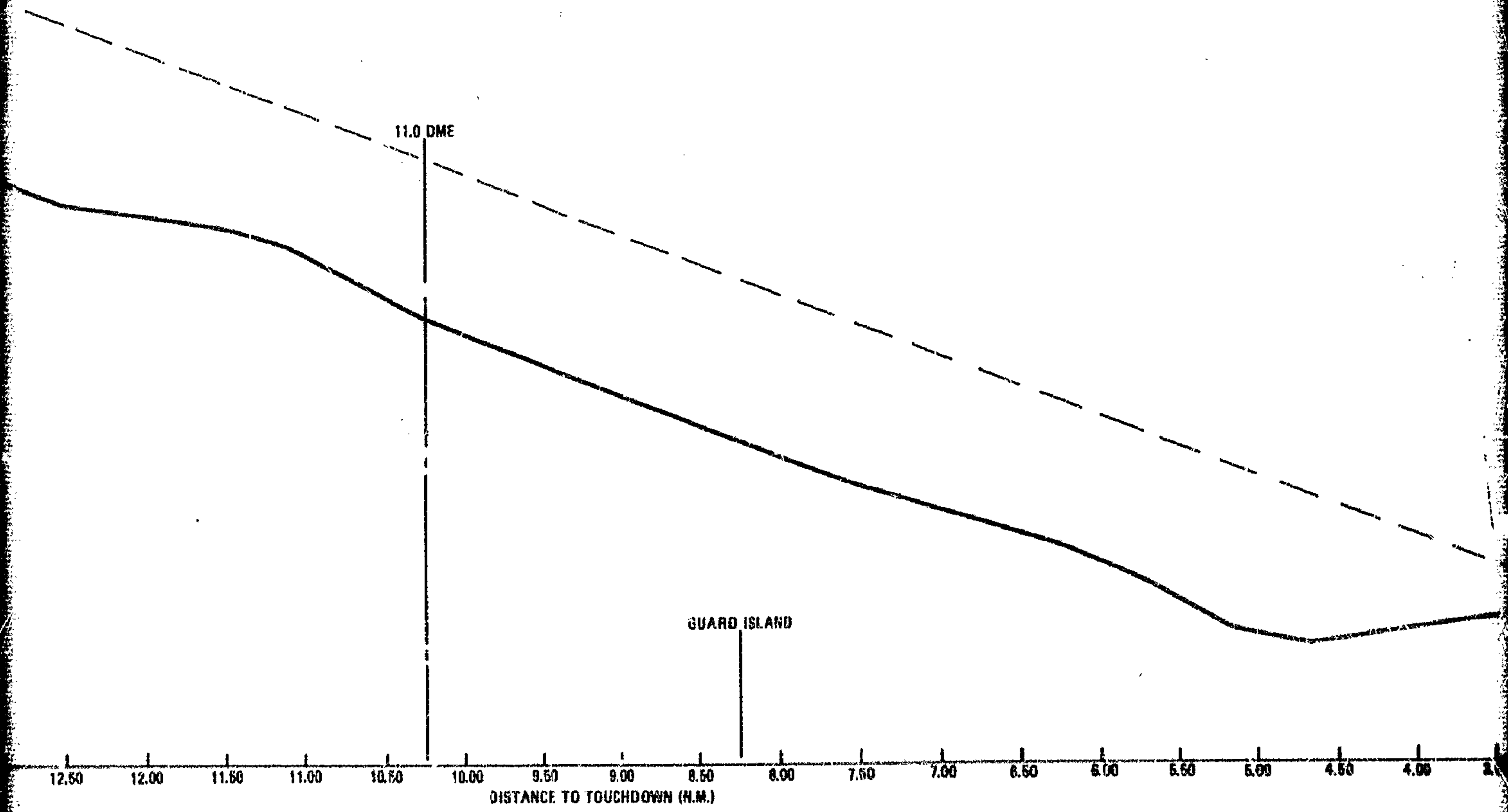
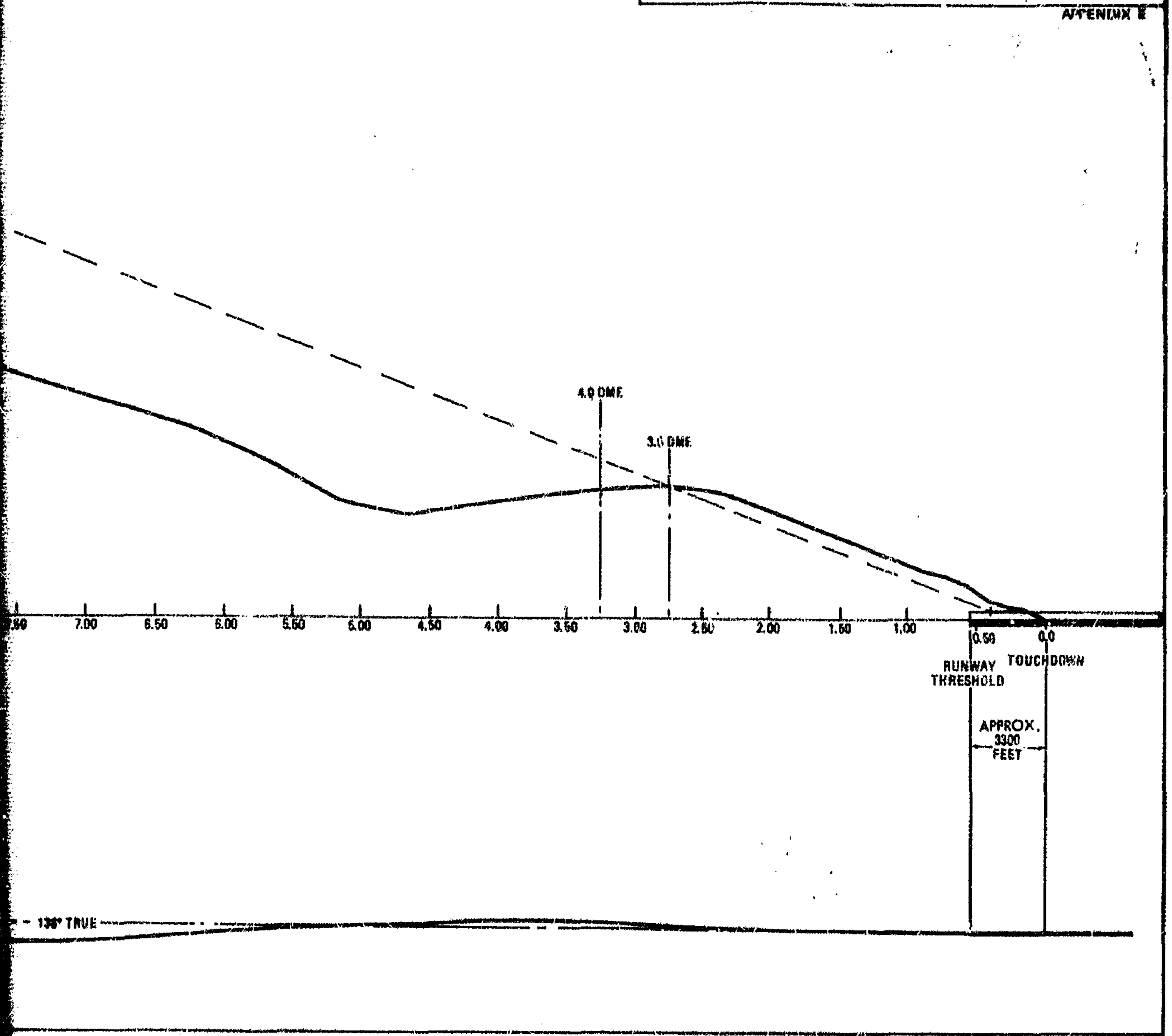


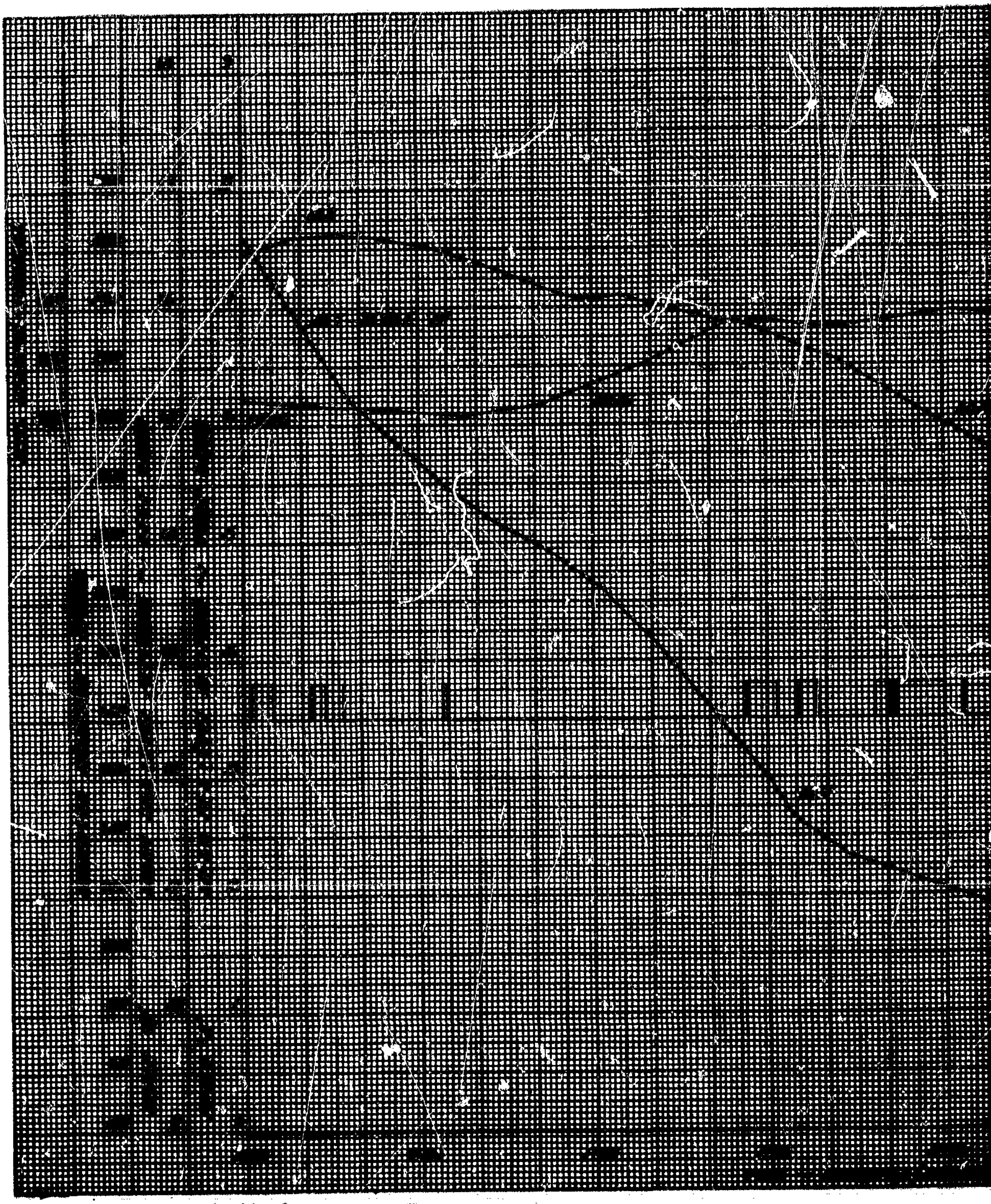
DESCENT PROFILE

GROUND TRACK

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

CALCULATED DESCENT PROFILE & GROUND TRACK BASED ON FDR DATA FROM ALASKA AIRLINES, INC.
BOEING 727-81, N124AS
KETCHIKAN INTERNATIONAL AIRPORT
KETCHIKAN, ALASKA
APRIL 5, 1976





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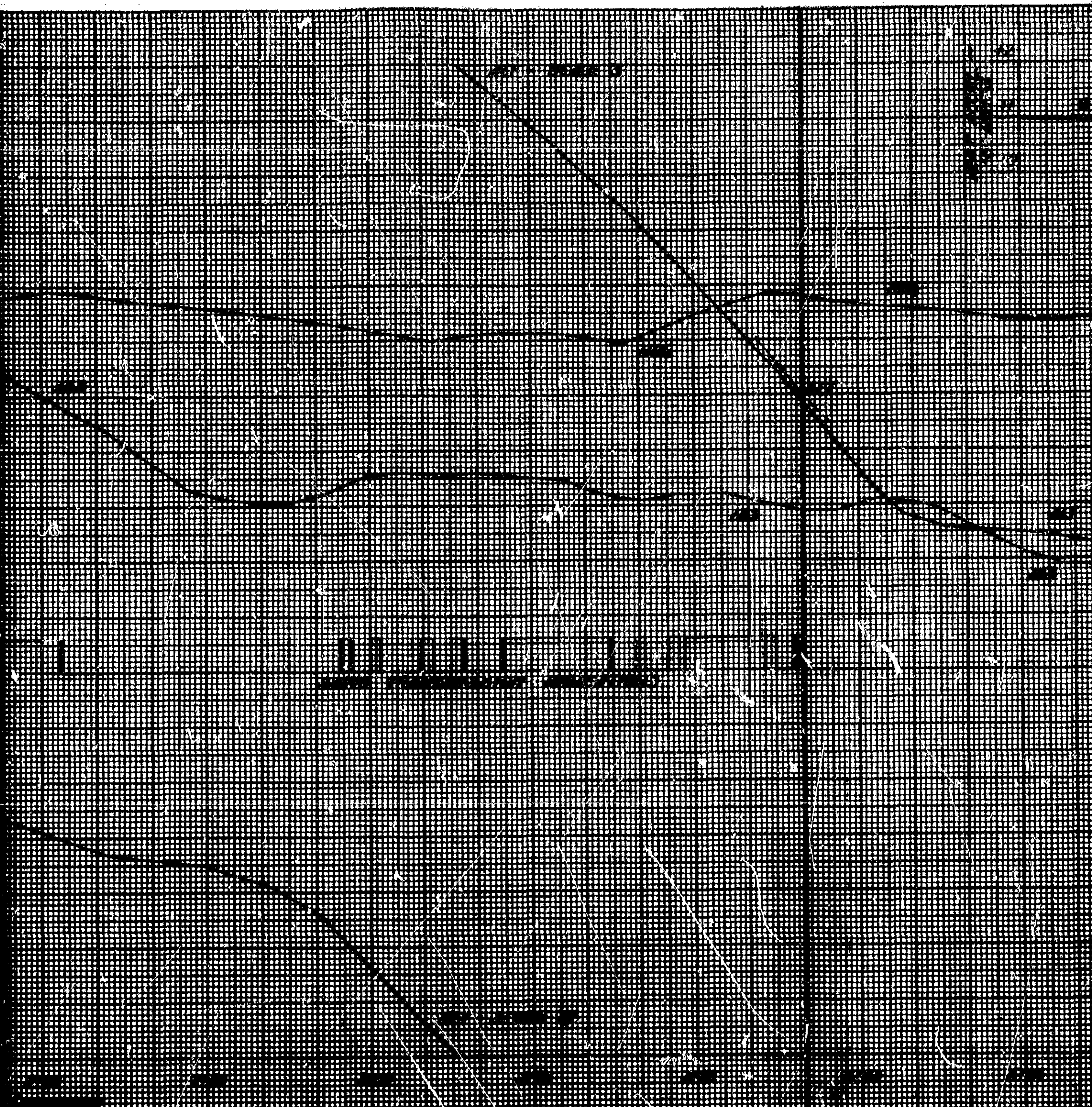

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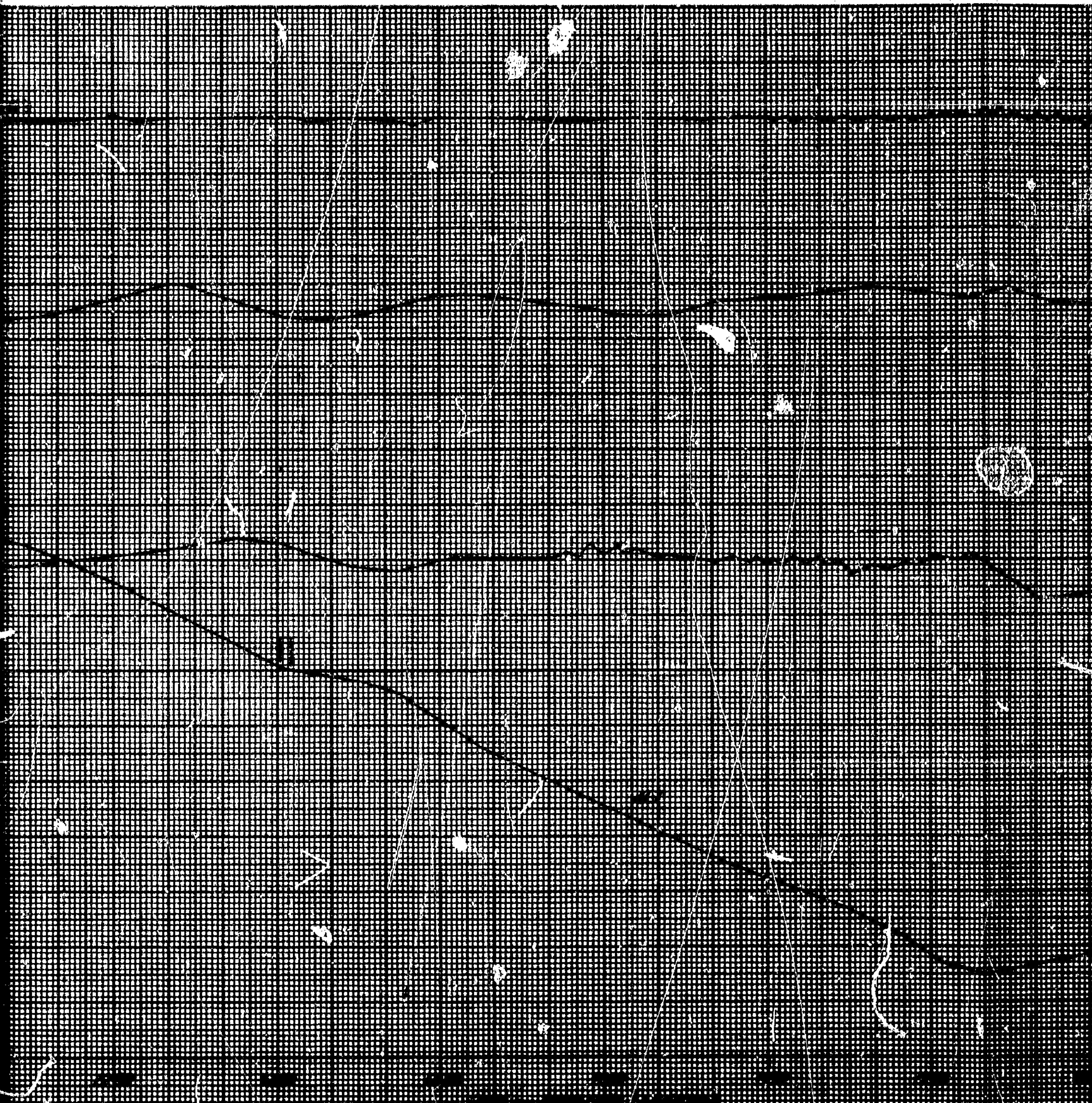

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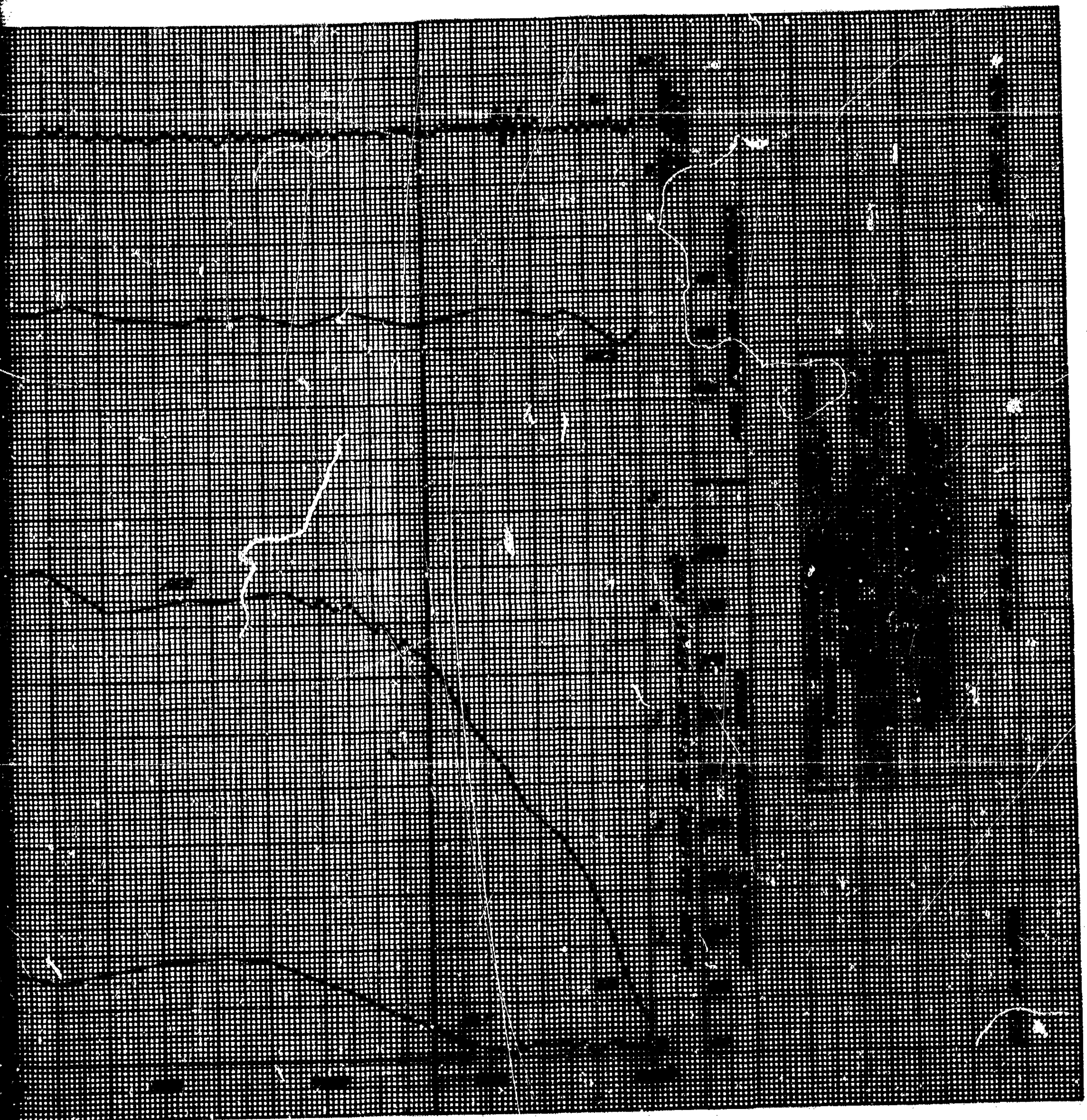

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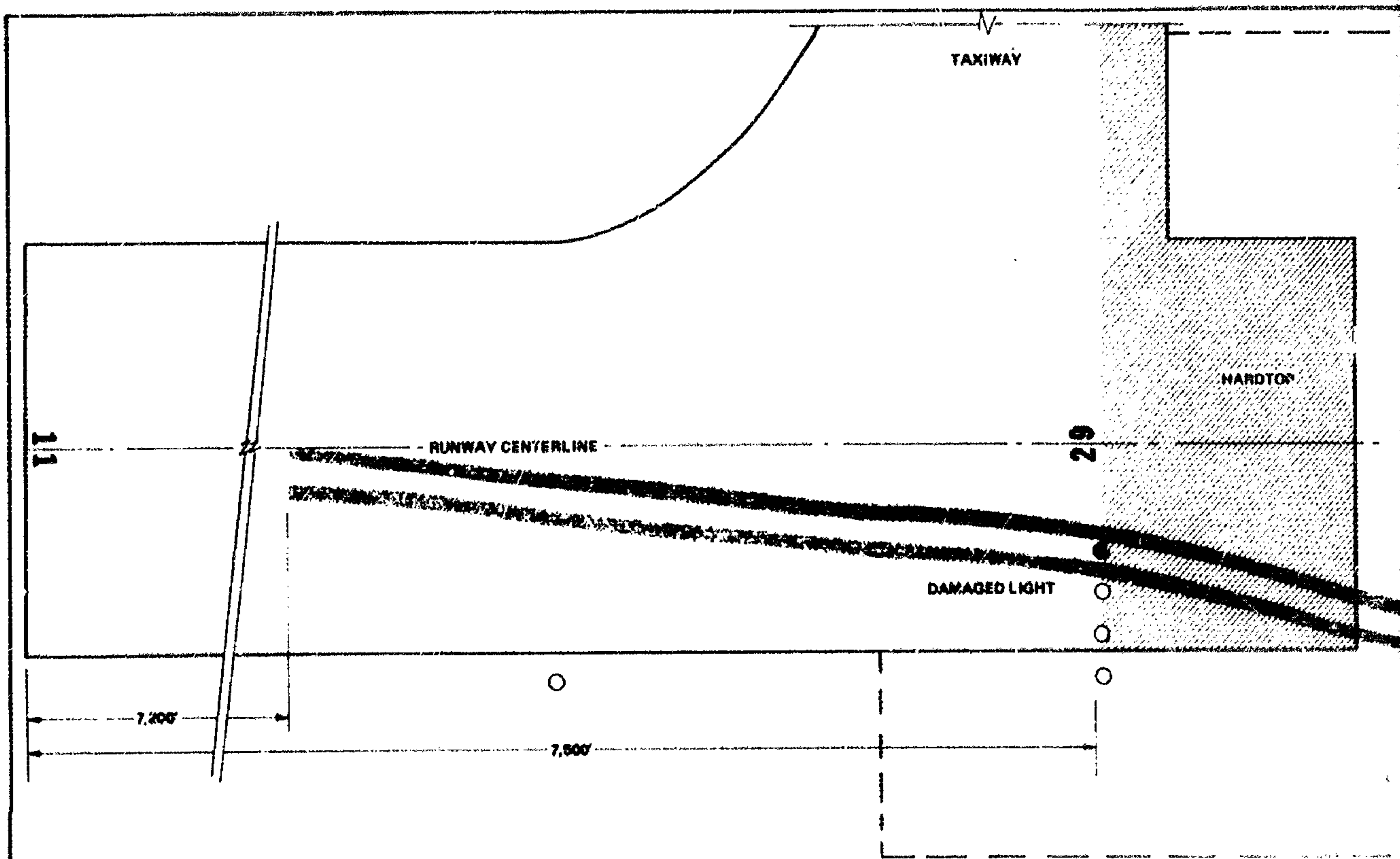

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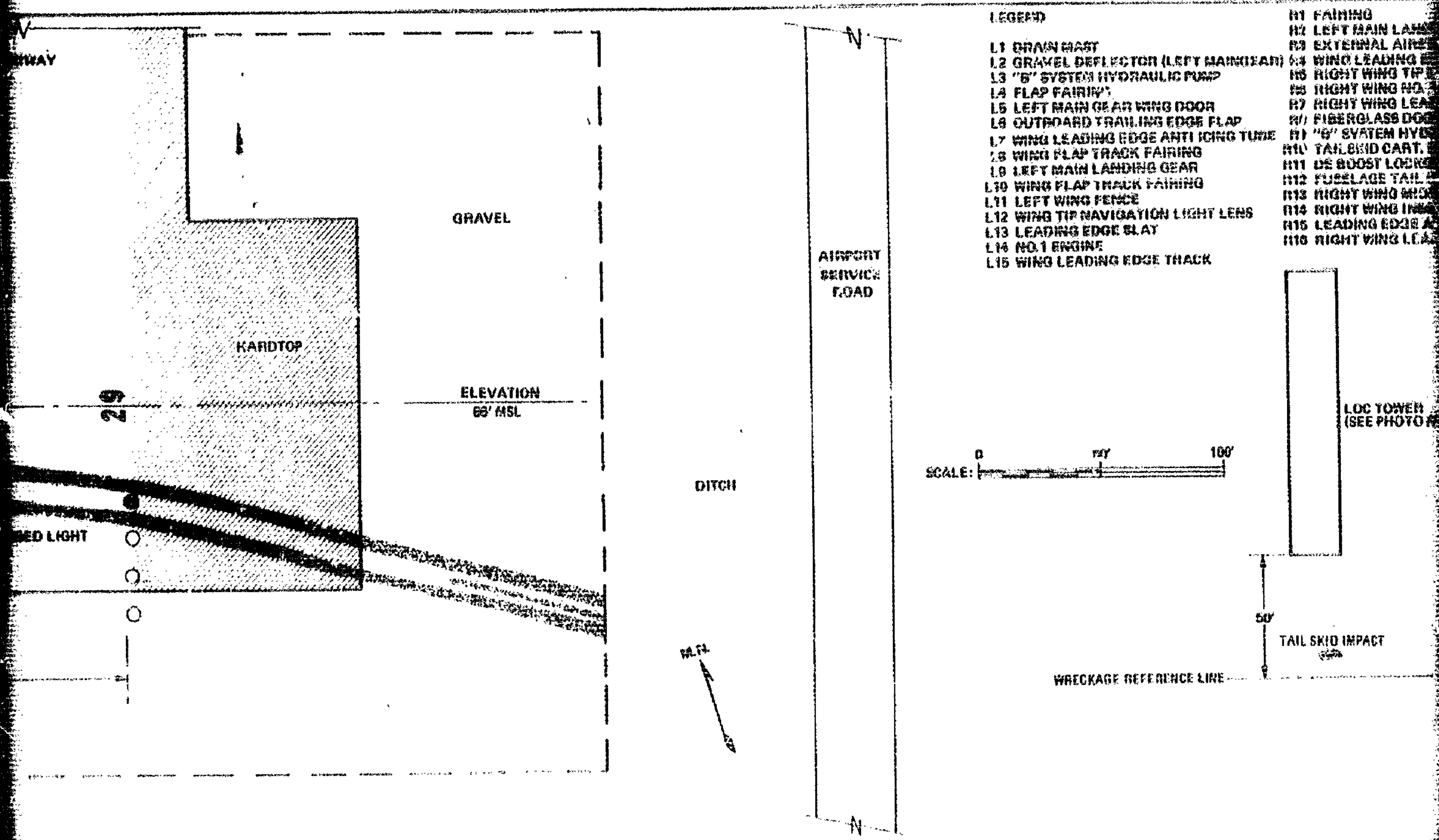
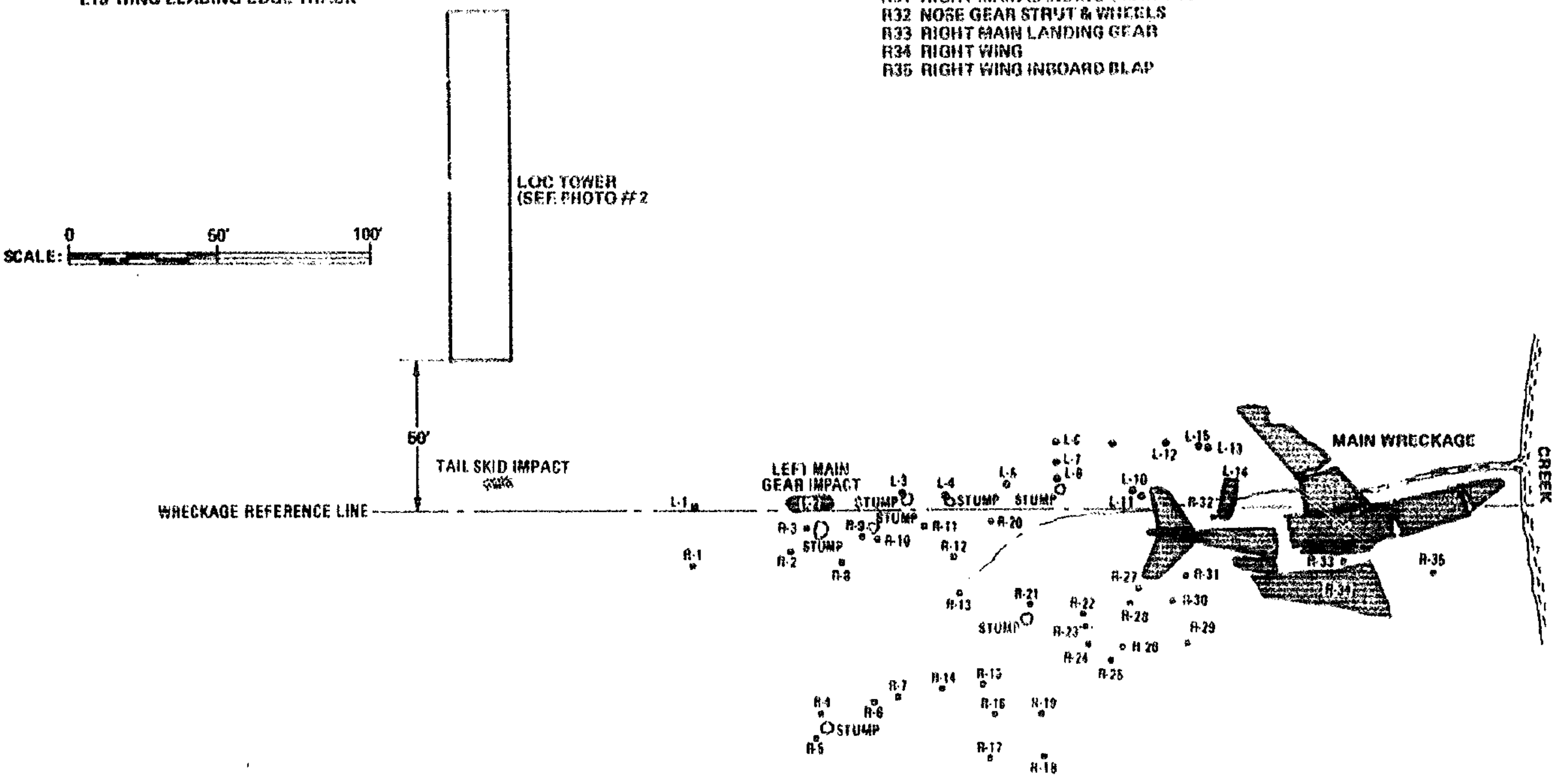


GRAVEL
HARDTOP
ELEVATION
66' MSL
DITCH
AIRPORT SERVICE ROAD
N
N
M.N.
LEGEND
L1 DRAIN MAST
L2 GRAVEL DEFLECTOR (LEFT MAINGEAR)
L3 "B" SYSTEM HYDRAULIC PUMP
L4 FLAP FAIRING
L5 LEFT MAIN GEAR WING DOOR
L6 OUTBOARD TRAILING EDGE FLAP
L7 WING LEADING EDGE ANTI ICING TUBE
L8 WING FLAP TRACK FAIRING
L9 LEFT MAIN LANDING GEAR
L10 WING FLAP TRACK FAIRING
L11 LEFT WING FENCE
L12 WING TIP NAVIGATION LIGHT LENS
L13 LEADING EDGE SLAT
L14 NO.1 ENGINE
L15 WING LEADING EDGE TRACK
R1 FAIRING
R11 DE BOOST LOCK
R12 FUSELAGE TAIL
SCALE: 0 50' 100'
LOC TOWER
50'
TAIL SKID IMPACT
WRECKAGE REFERENCE LINE


LEGEND

L1 DRAIN MAST
L2 GRAVEL DEFLECTOR (LEFT MAINGEAH)
L3 "B" SYSTEM HYDRAULIC PUMP
L4 FLAP FAIRING
L5 LEFT MAIN GEAR WING DOOR
L6 OUTBOARD TRAILING EDGE FLAP
L7 WING LEADING EDGE ANTI ICING TUBE
L8 WING FLAP TRACK FAIRING
L9 LEFT MAIN LANDING GEAR
L10 WING FLAP TRACK FAIRING
L11 LEFT WING FENCE
L12 WING TIP NAVIGATION LIGHT LENS
L13 LEADING EDGE SLAT
L14 NO.1 ENGINE
L15 WING LEADING EDGE TRACK

R1 FAIRING
R2 LEFT MAIN LANDING GEAR DOOR
R3 EXTERNAL AIRSTAIR DOOR
R4 WING LEADING EDGE ANTI ICING DUCT
R5 RIGHT WING TIP NAVIGATION LIGHT LENS
R6 RIGHT WING NO. 8 LEADING EDGE SLAT
R7 RIGHT WING LEADING EDGE ANTI ICING DUCT
R8 FIBERGLASS DOOR
R9 "B" SYSTEM HYDRAULIC PUMP
R10 TAILSKID CART. HOUSING
R11 DE BOOST LOCKOUT VALVE
R12 FUSELAGE TAIL CONE FAIRING
R13 RIGHT WING MIDFLAP & TRACK
R14 RIGHT WING INBOARD FAIRING
R15 LEADING EDGE ACTUATOR PISTON
R16 RIGHT WING LEADING EDGE SLAT
R17 RIGHT WING LEADING EDGE SLAT
R18 FAIRING CONTAINING EMERGENCY LIGHT
R19 LEADING EDGE VENT
R20 STAINLESS HEAT DUCT
R21 FLAP TRACK & TRUNNION, LEADING EDGE FLAP SEGMENT, HYDRAULIC VALVE, FAIRINGS BOTTOM SECTION OF INBOARD SPOILER ACTUATOR
R22 THRUST REVERSER & FLAP DRIVE SHAFT
R23 DEBOOST VALVE
R24 FLAP, TRACK & TRANSMITTER AND FLAP OUTBOARD LIGHT
R25 SECTION OF RIGHT WING FENCE.
R26 LEADING EDGE ACTUATOR HOUSING
R27 MAIN LANDING GEAR INBOARD BEAM WITH JACKSCREW & PIECE OF WAL KI'4G BEAM, WING DOOR & THRUST REVERSER DOOR
R28 SPOILER ACTUATOR
R29 RIGHT WING LEADING EDGE SLAT
R30 RIGHT MAIN LANDING GEAR ACTUATOR
R31 RIGHT MAIN LANDING GEAR DOOR
R32 NOSE GEAR STRUT & WHEELS
R33 RIGHT MAIN LANDING GEAR
R34 RIGHT WING
R35 RIGHT WING INBOARD BLAP



NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

WRECKAGE DISTRIBUTION CHART
ALASKA AIRLINES, INC.
BOEING 727-81, N124AS
KETCHIKAN INTERNATIONAL AIRPORT
KETCHIKAN, ALASKA
APRIL 5, 1975