AIRCRAFT ACCIDENT REPORT

PAN AMERICAN WORLD AIRWAYS, INC.

BOEING 707-321C, N799PA

ELMENDORF AIR FORCE BASE

ANCHORAGE, ALASKA

DECEMBER 26, 1968

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

SA-None

File 1-0045

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2

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TABLE OF CONTENTS

		Page
	Synopsis	1
	Probable Cause	1
1.	Investigation	2
1.1	History of the Flight	2
1.2	Injuries to Persons	5
1.3	Damage to Aircraft	5
1.4	Other Damage	5
1.5	Crew Information	5
1.6	Aircraft Information	5
1.7	Meteorological Information	5
1.8	Aids to Navigation	7
1.9	Communications	7
1.10	Aerodrome and Ground Facilities	7
1.11	Flight Recorders	7
1.12	Wreckage	8
1.13	Fire	9
1.14	Survival Aspects	9
1.15	Tests and Research	9
1.16	Other Information	12
2.	Analysis and Conclusions	13
2.1	Analysis	13
2.2	Conclusions	18
	(a) Findings	18
	(b) Probable Cause	19
3.	Recommendations and Corrective Action	19

Appendices

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SYNOPSIS

Pan American Clipper, N799PA, a Boeing 707-321C, cargo/mail flight bound for Vietnam via Tokyo, Japan, crashed on takeoff from Runway 23, Elmendorf AFB, Anchorage, Alaska, at approximately 0615 A.s.t. 1/ on December 26, 1968. The aircraft was destroyed. The accident was fatal to all three crewmembers, who were the only occupants aboard the aircraft.

The takeoff was made with the flaps in the retracted position. A takeoff aural warning system, which is designed to alert the crew to the fact that the flaps are not in the proper takeoff position, did not activate.

The Board determines that the probable cause of this accident was an attempted takeoff with the flaps in a retracted position. This resulted from a combination of factors: (a) inadequate cockpit checklist and procedures; (b) a warning system inadequacy associated with cold weather operations; (c) ineffective control practices regarding manufacturer's Service Bulletins; and (d) stresses imposed upon the crew by their attempts to meet an air traffic control deadline.

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

1. INVESTIGATION

1.1 History of the Flight

Pan American World Airways, Inc., Flight 799 (PICI), was a regularly scheduled cargo/mail flight from San Francisco, California, to Cam Ranh Bay, Vietnam, with intermediate stops at Tokyo, Japan, and Da Nang, Vietnam. A refueling stop and crew change were also scheduled at Anchorage International Airport, Anchorage, Alaska.

Flight 799 was loaded at San Francisco International Airport, San Francisco, California, and departed on December 25, 1968, at 2254. The flight to Anchorage was routine. However, local weather was below landing minimums at Anchorage International Airport, so the captain elected to land at Elmendorf Air Force Base. He advised company operations at Anchorage International Airport of his decision at 0338, and landed 11 minutes later at Elmendorf AFB. The outbound crewmembers, who were awaiting the aircraft at PAA operations, proceeded to Elmendorf AFB. They arrived at the Air Base in time for the arriving captain to confer briefly with both the captain and the flight engineer. The arriving captain advised them that they had experienced some difficulty with the reverser on the No. 4 engine.

Clearances for international flights such as Flight 799 are issued by Anchorage Air Route Traffic Control Center. The Oceanic Control Coordinator at the center assigns block times of 20 minutes to flights operating at the same flight level. If necessary, flights are required to utilize a constant mach cruise control to maintain this separation en route. Mach control is assigned only as required.

Some aircraft overfly Anchorage, while others make refueling stops; therefore it is necessary to control the departure times of these aircraft to insure that there will not be a conflict with through flights when the Anchorage departures reach cruising altitude. A flightcrew filing a flight plan may be given a void time for the clearance issued, based on their estimated time of departure and other proposed traffic for that route-time envelope. When a void time has been issued and ground delays necessitate a change in the departure time, an extension for the clearance void time must be requested from the Oceanic Control Coordinator.

Flight 799 experienced several delays prior to departure from Elmendorf AFB. Initially, a discrepancy in the computation of mixed fuel density resulted in a requirement for additional fuel. Also, some difficulty was experienced in getting the jet starter unit to provide power for the engine start. Finally, at approximately 0555, the engines were started and the flight departed the ramp at approximately 0602.

Flight 799 had its void time extended six times for various reasons. The final void time, issued by the Oceanic Control Coordinator, was 0615. In this instance, the clearance void time was required to prevent a conflict between Northwest Airlines Flight 901, cruising at Flight Level 310 (FL310), and Flight 799. Flight 799 had also requested FL310 until fuel burnoff would permit an en route climb to FL350. The controller stated that if Flight 799 had failed to make the final void time of 0615, they would have had to delay approximately 45 minutes. The only alternative was to accept a lower cruising altitude which would have resulted in excessive fuel consumption.

Although clearance to Runway 05 was issued initially, the flight requested use of Runway 23 because of the greater effective runway length. 2/ A "follow me" truck was used because the crew was not familiar with the airport and a portion of the lights on one of the taxiways was out. The cockpit voice recorder (CVR) revealed that, when the Elmendorf Tower controller offered to send out the "follow me" truck, the crew was going over the taxi portion of the cockpit checklist. One of the items called out during the reading of this checklist was "wing flaps." Additionally, the CVR revealed that approximately the time the "follow me" truck arrived, a discussion took place between the captain and first officer regarding the flaps. The captain advised that he had raised the flaps. The first officer then remarked, "Oh, okay, let's not forget them." As the taxiing continued to Runway 23, the first officer continued talking with the Oceanic Control Coordinator about extending the void time for their previously issued clearance; the flight engineer was computing burnoff of fuel to determine how quickly they could climb to FL350; and the captain was absorbed with controlling the aircraft on the slippery taxiways and coordinating the efforts of the crew.

Flight 799 arrived at the takeoff end of Runway 23 at approximately 0610 and held, awaiting their turn in sequence. During the next few minutes, MAC 172 landed and MAC 651 departed on Runway 05. Flight 799 was then cleared for, "... right turn on the east-west runway and 180 at the end for a departure to the west; taxi into position and hold." As the aircraft was positioned for takeoff, coordination between the pilots and the Oceanic Control Coordinator was still being accomplished to determine the latest possible departure time which would not conflict with other traffic. This was finally established at 0615, and at 0614:30, the flight was cleared for takeoff.

The crew based their takeoff speed computations on an aircraft flap configuration of 14°. Accordingly, the speeds appearing on the crew takeoff information sheet were as follows:

2/ There are mountains to the east, whereas the terrain to the west is relatively flat.

V_1 148 knots, V_R 154 knots, V_2 168 knots 3/

Engine pressure ratio (EPR) readings were 1.78 static and 1.82 rolling takeoff

The CVR indicated that during the period of time when the flight was awaiting takeoff clearance, the flight engineer challenged the pilots several times, "Gyro compass." They finally acknowledged that this had been checked. It was the last item on the pre-takeoff portion of the cockpit checklist. The captain then told the first officer, "Okay, you got it," and takeoff power was applied. Callouts were made by the captain for air speeds at 120 knots, V_1, and V_R as the attempted takeoff progressed. Shortly after V_R, a noise identified as the stick shaker 4/ was heard on the CVR record. This noise continued throughout the rest of the recording. There were also numerous popping noises heard shortly after the stick shaker noise commenced. The recording ended approximately 59.2 seconds after the first officer called for takeoff power.

Statements were obtained from 41 witnesses who encircled Runway 5-23. However, the majority of the witnesses were located at the southwest end of the runway and in the vicinity of the operations building, which was located approximately 1 mile from the initial impact point. These witnesses indicated that the aircraft had an unusually long takeoff roll prior to becoming airborne. Several also observed what they described as a settling following lift-off. The rate of climb was described as slow, and estimates of the maximum altitude reached ranged from 10 to 20 feet to 150 to 200 feet. Three persons observed flames from the left engines; three saw flames but could not associate their observation with a specific side of the aircraft; and 16 saw flames emanating from the right engines. All described these flames as occurring while the aircraft was airborne and maneuvering in various combinations of noseup and wing-down attitudes. The consensus was that the initial impact was made in a steep right bank, with the nose low, and that a large ground fire broke out immediately.

The right wingtip of the aircraft first contacted the ground at a point just to the left of the extended centerline of Runway 23 at an elevation of approximately 207 feet m.s.l. (61° 16'N. latitude - 149°50'W. longitude). The accident occurred at nighttime at approximately 0615.

3/ V_1 means critical-engine failure speed
V_R means rotation speed
V_2 means takeoff safety speed

4/ The stick shaker provides a means of alerting the pilots to an extreme nose-high attitude or to a flight condition approaching a stall.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others
Fatal	3	0	0
Nonfatal	0	0	0

1.3 Damage to Aircraft

The aircraft was destroyed by ground impact and postimpact fire.

1.4 Other Damage

A small building, which housed the transmitter for the ILS middle marker for Runway 05-23, was destroyed.

1.5 Crew Information

All crewmembers were properly certificated and qualified for their positions. (For details see Appendix A.)

1.6 Aircraft Information

The aircraft was fueled with 13,257 gallons of JP-4. The total fuel on board at the ramp was 124,500 pounds.

Two quarts of oil were added to engines Nos. 1 and 4. In addition, three mechanics assisted in pushing the No. 4 engine reverser to the closed position. The maintenance supervisor then checked the reverser light in the cockpit to make sure it was out. No maintenance was performed on the aircraft, and the records indicate the aircraft was airworthy on its departure from Elmendorf.

The weight and balance was calculated to be within limits at the time of takeoff from Elmendorf. (See Appendix B for details.)

1.7 Meteorological Information

The surface weather observations from Elmendorf were as follows:

0555, partial obscuration, 200 feet scattered, visibility 1¼ miles, ice crystals, fog, temperature 1°F., dew point -3° F., wind calm, altimeter setting 30.01 inches, runway visual range 10 minute average 6,000 feet plus, 3/10 of the sky obscured by fog, patchy ice on Runway 05, runway condition 12, patchy ice on Runway 33, runway condition 10. 5/

5/ Runway braking conditions are expressed in increments from 0 to 25, with 0 being an ice condition and 25 being a dry condition. Numbers 5 to 10 are used to describe a runway with a loose snow condition.

0606, Special, partial obscuration, 200 feet scattered, visibility 2 miles, ice crystals, fog, wind calm, altimeter setting 30.01 inches, 1/10 of the sky obscured by fog.

0617, Local, partial obscuration, 200 feet scattered, 700 feet scattered, visibility 2 miles, ice crystals, fog, temperature 6° F., dew point 2° F., wind 030° 2 knots, altimeter setting 30.02 inches, 2/10 of the sky obscured by fog, magnetic wind direction 360°, patchy ice on Runway 05, runway condition 12, patchy ice on Runway 33, runway condition 10.

The aviation area forecast, issued by the Weather Bureau Forecast Office at Anchorage at 0048, valid 0100 to 1300, was in part as follows:

Alaska south and east of Alaska - Aleutian Range.

Heights above sea level unless noted.

Synopsis. Weak lee side trough southeast Alaska northwestward to Prince William and little change in intensity next 24 hours.

Clouds and weather. Cook Inlet and Susitna Valley. Clear except patches partial obscuration, visibility ¼ mile, fog northern third Cook Inlet.

Icing. No significant icing.

Freezing level at or near surface.

Turbulence. None.

Weather Bureau personnel at Anchorage provided weather documentation to Pan American personnel for delivery to the crew of N799PA. The documentation consisted of the following: terminal forecasts for Misawa, Nagoya, Itazuki, Chitose, Tokyo, Yokota, and Tachikawa, Japan, 500-millibar prognostic chart verifying at 0800, tropopause and vertical wind shear prognostic chart verifying at 0800, and a prognostic significant weather chart verifying at 0800.

The Commander, Detachment 13, 11th Weather Squadron Elmendorf, stated, "Personnel of this detachment provided no forecast data to PAN AM Flight 799 on 26 December 1968 for its departure from Elmendorf AFB, Alaska."

Fog dispersal operations were being conducted at Elmendorf AFB during the morning of December 26, 1968. One cloud seeding operation began at 0252 and ended at 0305. A second seeding began at 0452 and ended at 0517.

Fog dissipation is accomplished at Elmendorf AFB by dispersal of dry ice pellets, ranging in size from granular to 3/8 of an inch, from a WC-130 aircraft at approximately 500 feet. The object of the seeding is to provide a rectangular lane of approximately 3 miles along the approach path and runway. The seeding is generally used at temperatures ranging from +32° F. to -20° F. A vapor pressure differential between the supercooled water droplets and the dry ice results in the water adhering to the ice particles which fall to the ground as very dry snowlike pellets.

The reason for the seeding operations on the morning of December 26, 1968, was because of a 100-foot ceiling. The WC-130 dispensed dry ice at a rate of 15 pounds per nautical mile, making seven lanes at intervals of 2,000 feet between lanes. The seeding aircraft's altitude was 700 feet.

The accident involving Flight 799 occurred in fog and under nighttime conditions.

1.8 Aids to Navigation

Not involved.

1.9 Communications

There were no reported discrepancies in the communications facilities, and radio contact was maintained with the aircraft until just before the accident occurred.

1.10 Aerodrome and Ground Facilities

Elmendorf AFB is situated at the northeast edge of the city limits of Anchorage, Alaska. Runway 5-23, the principal instrument runway, is 10,000 feet long and 200 feet wide, with 1,000 feet of overrun at each end. The runway surface is macadam and the overrun is concrete. The initial 7,000 feet of Runway 23 is a 0.44 percent downhill gradient and the last 3,000 feet is a 0.18 percent uphill gradient. The overall gradient is 0.25 percent downhill. The airport elevation is 212 feet m.s.l.

1.11 Flight Recorders

N799PA was equipped with a Lockheed Air Service Model 109CR flight data recorder and Fairchild Cockpit Voice Recorder (CVR) Model A100, both of which were recovered from the general wreckage area. A readout of the flight data recorder indicated that the highest speed attained by the aircraft was approximately 187 knots at a point approximately

5 seconds before impact. The highest altitude recorded was approximately 310 feet m.s.l. at a point approximately 4 seconds before impact. The heading trace indicated the aircraft was on a more or less constant heading of 235° during the takeoff roll. However, during the last 10 seconds of the recording, excursions on the heading trace changed from approximately 236° to 241° to 230° to 246° to 195°.

The CVR apparently functioned normally throughout the flight, and pertinent portions of the recorded data were reported in preceding parts of this report.

1.12 Wreckage

The right wingtip of N799PA first contacted the snow-covered ground 94 feet left of the extended centerline of Runway 23, at a distance of 2,760 feet from, and at an elevation 32 feet above, the west end of the runway. The aircraft made a 68-foot-long furrow in the snow beyond that point. Right wingtip parts were found in the furrow and for a distance of 350 feet beyond it.

The next ground contact resulted in the formation of a 140-foot furrow which began 3,100 feet from the runway and terminated at a perimeter road.

The main portion of the wreckage was strewn from this road to over 4,600 feet from the runway, and a ground fire pattern also extended from the road to the farthest piece of wreckage. Most of the parts found within the ground fire area exhibited some evidence of soot or fire damage, whereas those found outside the pattern were generally completely free of any such indications.

The aircraft became inverted sometime after the first contact and all major sections which remained intact were found inverted. Parts from the left side of the aircraft were generally found to the right of the centerline of the wreckage throwout. The engines were also found in reverse order with respect to the centerline, with the No. 4 engine 110 feet left, and the No. 1 engine 190 feet right of the centerline.

The aircraft was almost completely destroyed by the ground impact and the ensuing ground fire, and much of the structure could not be identified. The wings and forward fuselage were fragmented, and the only large, intact sections were the aft fuselage and the horizontal stabilizers.

All of the fractures observed were typical of those caused by overload.

The landing flaps were in the retracted position at the time of breakup. This was established by the fact that eight of the ten flap

drivescrews were found with extensions equal to, or near, the extension which would be obtained if the flaps were fully retracted. Also, the jackscrew in the left-hand outboard aileron lockout mechanism was found in a position consistent with a fully locked-out aileron. This mechanism is designed to fully lockout the outboard aileron at a 0° wing flap setting.

The landing gear was found in the extended position.

The elevator screwjack was found in a position that corresponds to 3.5° noseup. This is the proper setting for an aircraft at the weight and center of gravity computed by the crew for a takeoff with 14° of flaps.

Examination of the four aircraft engines revealed no evidence that would indicate there was an overtemperature on the hot section parts. In addition, there was no evidence suggestive of any abnormalities within the powerplants or their accessories, other than those attributed to impact. There was nothing that could be associated with in-flight fire on any of the engines. All four engines showed evidence of rotation at time of impact. Those engine anti-ice valves that were recovered were found to be in the closed position.

1.13 Fire

The aircraft was destroyed by ground impact and the ensuing ground fire. In certain areas, the ground fire continued to flame for several days after the accident because of fuel impregnation of the area. There was no indication of an in-flight fire prior to the aircraft's initial contact with the ground.

The Elmendorf crash crew responded to the alarm and the equipment was on the scene about 3 minutes later. The hoselines were advanced over the snowdrifts and through the wood thickets in the area. The fire was reported as being under control at 0745.

1.14 Survival Aspects

This was a nonsurvivable accident.

1.15 Tests and Research

Flight 799, like other B-707-321C aircraft, had a takeoff warning system that was intended to provide an audible warning signal (horn) when the thrust levers were advanced (through the 42° position of thrust advancement) if flaps, speed brakes, or the stabilizer were not positioned properly for takeoff. No such warning was heard on the CVR tape.

During the early stages of the investigation, it was determined that on January 31, 1967, the Boeing Company had issued Service Bulletin 2384. This bulletin warned that during "cold weather operations" (this term was not defined), the takeoff warning system may not operate within the desired limits because the takeoff engine pressure ratio may be reached before the takeoff warning switch is actuated to arm the system. Accordingly, the bulletin recommended that the actuator setting be adjusted from 42° to 25° of thrust lever advancement.

This bulletin was issued as the result of a review by company engineering analysis personnel and not because of a specific incident or accident.

The Boeing Company, in response to the National Transportation Safety Board request for a definition of "cold weather operations" as set forth in the service bulletin, provided in part the following: "... at the 42° switch setting the horn will sound (nominally) down to temperatures of +33° F. After incorporation of the 25° switch setting the horn will sound (nominally) down to temperatures of -43° F..."

Boeing incorporated this service bulletin into their production aircraft beginning with the 509th 707-720 series aircraft (ship No. 8141) on June 14, 1966. A similar service bulletin was subsequently issued to cover the 727 series aircraft. However, to cover those 508 aircraft previously delivered, Boeing listed in the service bulletin those aircraft that had not received this modification. The subject aircraft, N799PA, was one cited as not having received the modification.

In accordance with individual airline contractual agreements with the aircraft manufacturer, maintenance publications, including service bulletins, must conform to Air Transport Association (ATA) Specification 100. This specification, under the section on service bulletin compliance, states that the manufacturer should provide a "recommended" statement if it feels strongly that the bulletin should be accomplished. The Boeing Company issued Service Bulletin 2384 as a "recommended" statement.

If otherwise, the bulletin should specify "optional based on operator's experience," and one of the following manufacturer statements may be used:

1. (Issuer) considers that the work outlined herein affects the safety of the aircraft.

2. Although the work outlined herein does not affect the immediate safety of the aircraft, (issuer) recommends its accomplishment.

3. (Issuer) considers the work outlined herein desirable but not urgent.

None of the above statements implies mandatory accomplishment of the service bulletin. The Federal Aviation Administration (FAA) is the only organization that can make a service bulletin mandatory. Accordingly, if an aircraft manufacturer feels strongly that a service bulletin should be made mandatory, he can so state to the FAA. However, such a statement was not made in this case.

The overall procedure for processing service bulletins in effect on the date of the accident was that the manufacturer issuing the bulletin should forward copies to each carrier operating 707-720 series aircraft. In the case of Pan American, two bulletins were sent to two documentation groups -- one in Miami and the other in New York. Upon receipt of the bulletins, each of these groups filled out a service disposition form on which was listed a code number designating the engineering group responsible for that particular area covered by the bulletin. Such groups were maintenance, operations, cargo, and communications. Upon receipt of the bulletin by the responsible engineering group, it was routed to the engineering section responsible for that particular component (brakes, flight controls, etc.). One of the engineers within the applicable section reviewed the bulletin and made a determination of the necessity for compliance after coordination with any other interested section, i.e., flight operations, maintenance. Some of the factors considered during this review were the number of times the company aircraft was exposed to the condition specified in the service bulletin and the relationship of this exposure to safety. If the determination was made to comply with the bulletin and the cost was generally under $500, as it was in this instance, an aircraft modification request would be prepared. This form would be submitted through channels to accounting. Accounting would determine if the cost of the modification would be capitalized under the Civil Aeronautics Board Regulations and, if so, would be changed accordingly. If it was determined that the cost could not be capitalized, it would be charged directly as a maintenance expense. In both cases, engineering changes would be issued.

In the event that the engineer (within the applicable section reviewing the bulletin) decided the modification was not necessary, a notation would be made as to the reason for noncompliance, the bulletin would be filed, and no further action taken.

In respect to the processing of the subject Service Bulletin No. 2384, (less than $500 cost), the initial routing was made and the bulletin was reviewed by the operations engineering group. One of the supervisors of an engineering section within this group decided, after coordination with flight operations, that the bulletin was not applicable to Pan American aircraft and no further action was taken. The reason for this decision was not fully documented.

In response to the Safety Board's inquiry concerning reasons for the nonimplementation of the service bulletin, Pan American cited the following:

1. No incident was cited in the bulletin, nor was any indication given as to the specific ambient temperature below which an unmodified aircraft would be deprived of wing flap warning due to rigging of the warning system switch to throttle movement.

2. The FAA did not see fit to issue an Airworthiness Directive requiring compliance with the Boeing Service Bulletin.

3. Other air carrier operators also elected not to comply with this service bulletin at the time it was issued.

Pan American also pointed out that since the significance of this service bulletin is now clearly recognized, Pan American is modifying all affected aircraft.

1.16 Other Information

A. Performance Data

At the request of the Board, the Boeing Company provided certain aircraft performance data relating to the B-707-321C aircraft and the general conditions prevailing at the time of the accident. It was noted that the minimum unstick speed (V_{mu}) was estimated to be 163.5 KIAS 6/ with 0° flaps and with a center of gravity of 25 percent of mean aerodynamic cord (MAC). This is the lowest speed at which a takeoff can be accomplished.

B. Check of Takeoff Warning System

A statement from the flight engineer, who was part of the crew that flew N799PA from San Francisco to Elmendorf on December 26, 1968, indicated that the warning system was functioning properly at the time of the preflight check. This check was the only occasion he had to test the warning system.

In order to determine if the takeoff warning horn was audible to the CVR on other B-707 aircraft, a sample CVR recording was made both while taxiing and in flight. A playback of this tape recording ascertained that the warning horn was readily distinguishable.

6/ KIAS - Knots indicated airspeed.

C. Cold Weather Operating Procedures

A portion from the cold weather operating procedures section of the Pan American aircraft operating manual - B-700, under the caption of taxiing, reads as follows:

> "The wing flaps should be left in the UP position until lineup for take-off. On model 707 aircraft this will reduce the chance of snow or ice being blown onto the flap screws which may freeze the flaps in an extended position. Also, on model 707 aircraft with the flaps extended during high power operation of No. 4 engine during engine starting, chunks of snow may lodge between the fillet flap and the wing trailing edge and prevent the fillet flaps from being fully retracted."

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The investigation disclosed that the causal factors involved in the accident were directly related to the chain of events initiated by the flaps being in the retracted position instead of in the takeoff position (14°). The evidence uncovered in the wreckage and on the CVR tape established that the takeoff was made with the flaps in the retracted position. The airspeeds for rotation and lift-off for this type of aircraft are based in part upon the flaps being at a prescribed takeoff position. Since the takeoff of N799PA was made with the flaps retracted, insufficient airspeed was attained at lift-off to maintain lateral control of the aircraft, and the crash resulted. Thus, any analysis of this accident should consider why the flaps were left in the retracted position during the takeoff.

An examination of a copy of the cockpit checklist used by the Pan American crew indicated that the takeoff flap item appears only on the taxi portion of the checklist. There is no provision on the pre-takeoff portion of the cockpit checklist to remind pilots that the flaps should be lowered. The Safety Board believes that the placing of a flap reminder item further down the checklist, for example, on the takeoff portion of the checklist, would be most helpful to the pilot. In addition, the use of a slide cover type checklist as used by some other air carriers would enable the pilot to see at a glance which items have not been accomplished. This type of checklist is one means of assisting the crew to accomplish the "passed over" items just prior to takeoff, in those situations where the checklist item is not accomplished on the first reading of the list, or the action taken is subsequently altered, as occurred in this accident.

In the case of Flight 799, the first officer apparently lowered the flaps to the takeoff position (14°) during the initial reading of the taxi portion of the cockpit checklist. However, unknown to the first officer, the captain retracted the flaps and the first officer was not aware of this action until the flap item was mentioned during a second reading of the taxi portion of the cockpit checklist. The captain had apparently retracted the flaps in compliance with the company cold weather operating procedures. The flaps remained in the retracted position during a second reading of the taxi portion of the checklist, in spite of a reminder by the first officer not to forget to lower them. Thus, since the taxi portion of the checklist is the only portion of the checklist prior to taking off that contains a reference to wing flaps, any reading of further portions of the checklist would not have alerted the crew as to the position of the flaps.

During the period of time that the crew were going over the cockpit checklist in preparation for the flight, they were busily engaged in taxiing the aircraft and in handling numerous radio communications with various air traffic control facilities concerning their departure. These factors, along with probable apprehension due to operating from an unfamiliar airport during nighttime, undoubtedly consumed much of the crew's attention. In addition, the crew's desire to comply with the various void times that were issued by ATC, based upon the traffic within the system, and their own estimates of their capability of meeting these void times, must have caused a considerable amount of mental stress. The CVR transcript clearly reflects the tension in the cockpit and the over-emphasis on expediency by all concerned in an effort to fit this aircraft in with other aircraft in the Elmendorf area.

The fact that the takeoff warning horn is not heard on the CVR tape can be explained by either a malfunction or failure of the system to activate because of the relatively cold ambient operating conditions. Since the flight engineer from the previous flight stated that the warning system checked out "OK" in San Francisco, it is reasonable to assume that the system also checked "OK" when checked by the crew of Flight 799 at Elmendorf. Thus, in the absence of any evidence of malfunction of the takeoff warning system, it is more likely that the warning horn protection in Flight 799 was not realized because the takeoff EPR setting was achieved prior to the necessary throttle advancement required to activate the system. Thus, the crew of Flight 799 applied engine thrust and began the takeoff roll unaware that the flaps were in the retracted position--an occurrence the takeoff warning system was designed to prevent.

In all probability, the crew did not detect the up-flap condition as they continued their takeoff roll and, subsequently, attempted to rotate the aircraft at the precomputed 14° flap speed of 154 KIAS. A review of the flight recorder and the performance information provided by the

Boeing Company indicated that the aircraft left the ground with some margin above 1 g 7/ stalling speeds and also above V_{mu} speeds, but very close to, or below, stick shaker speed. Analysis of the heading changes for the period immediately preceding lift-off until the right wing made initial contact with the ground, revealed that the aircraft was experiencing a progressively increasing lateral oscillation. Calculations made by the Board indicate the aircraft was in an approximate 90° right bank at the time of initial contact with the ground. This apparent lateral control difficulty was probably the result of the decay of lateral control effectiveness, with the wing operating at or near a stall angle of attack, combined with a loss of outboard ailerons. The outboard ailerons are designed to be locked in the faired position, with 0° of flaps, and to be fully operable when the flaps are extended beyond approximately 23°. These ailerons are normally available during slow-speed flight, such as during takeoff, to provide the pilot with a roll capability similar to that during high-speed flight.

The rapid changes in aircraft attitude near the stall caused momentary compressor stall(s) on one or more of the engines. Testimony of ground witnesses as to the presence of flames in the vicinity of the engines immediately after lift-off indicates that this occurred.

On December 29, 1968, while the field phase of the investigation was still in progress, three Air Force C-141 aircraft crews reported ice build-up, after taxiing to the parking area, following a landing at Elmendorf AFB. Because of the possibility that similar conditions might have existed on the morning of December 26, 1968, the project director of fog dispersal at Elmendorf was asked to comment. In his comment, he compared the weather conditions on the two days as follows:

> "During the period of 0900 to 0923 LST on 29 December, three C-141 aircraft reported ice build-up after taxiing to the parking area following landing. The 0955 LST observation is believed to be representative of the conditions during this period which was as follows:
>
> > Partially obscured with 1/8 mile visibility with fog, temperature was -2°F and dewpoint was -4°F, surface wind was from 040 degrees at 2 knots, and the runway visual range was 17 (10 minute average).
>
> "The very low visibility is a measure of the high concentration of liquid water droplets in the atmosphere. On 26 December, however, at 0455L, three minutes after seeding began ..., you will note that the runway visual range (ten minute average) was 60, a much better visibility than the morning of 29 December 1968. Although this

7/ 1 g - the force of gravity.

observation was taken three minutes after seeding had commenced, this was too early to have been affected by the one lane of dry ice that had been dispensed to the west of the field. The only reason for seeding the morning of 26 December was because of the ceiling at 100 feet.

"Once fall out begins during a seeding operation, the available liquid moisture in the atmosphere is rapidly diminished. Therefore, during the period of 0545 to 0617 on 26 December 1968, approximately 30 to 60 minutes after the completion of seeding operations, as evidenced by the visibility, icing conditions would have been highly improbable. Not only was the visibility better than on the morning of 29 December prior to seeding, but the majority of the water droplets had become ice crystals and fallen to the ground by 0545L."

The Board generally concurs with the project director's analysis of the icing conditions that were prevalent on the morning of December 26, 1968. Thus, we believe that no more than a trace of airframe icing was likely to have been encountered. This assumption can also be supported by the statement of a pilot who departed Elmendorf in a C-141 at 0612 and indicated that there was no ice, snow, or frost on his aircraft's exterior.

The closed position of the engine anti-icing valves that were recovered indicated that engine anti-icing was not being used at the time of impact.

Since there is a reference on the CVR tape to "nacelles" at a point on the pre-taxi portion of the checklist where this item would normally be checked, it can be assumed that anti-ice was considered. Either it was decided not to use engine anti-ice or, if turned on, it was turned off before starting the takeoff roll. In any case, if some engine ice did form prior to the takeoff, there would have been a drop in turbine discharge pressure or engine pressure ratio. This drop would have been reflected on the engine instruments. The absence of any comment on the CVR tape concerning instrument readings and the "routine" callout of the air speeds by the captain during the takeoff roll, indicated that the aircraft was accelerating at the expected rate.

The fact that it was necessary to push the No. 4 engine fan reverser to the closed position while the aircraft was parked at the ramp is not considered to be a causal factor in this accident. The maintenance supervisor who assisted in this operation ascertained that the reverser warning light in the cockpit was out indicating the fan reverser was in the proper stowed position. The outbound flightcrew was aware of the condition of this reverser having discussed the problem with the arriving captain. In addition, the CVR tape revealed nothing that would indicate the crew of Flight 799 had experienced any difficulty with the reverser system.

Still another factor that should be considered is the likelihood of crew fatigue. The crew had flown the San Francisco-Anchorage leg of the same flight on the previous day arriving at Anchorage at approximately 0330 on December 25, 1968. Evidence developed during the investigation revealed nothing that would indicate that the crew's activities during their layover period at Anchorage were other than routine. According to company personnel the crew was awakened at their hotel at 0215 on December 26, 1968, and proceeded from their hotel to the Pan American operations office at the Anchorage International Airport. Upon receipt of information that the inbound flight was landing at Elmendorf Air Force Base they traveled to the Air Base arriving in sufficient time to have a brief discussion with the inbound crew. Additionally, the flight from San Francisco to Anchorage on December 25 was the only trip the captain and flight engineer had flown since December 3rd. The first officer, with the exception of a period of proficiency training from December 18 to 22, had not flown since December 2nd. Thus, in view of the off-duty time provided the crew at Anchorage and the interval between their scheduled flights prior to December 25, the Board is of the opinion that crew fatigue was not a factor in this accident.

The Board believes that this accident occurred because of a combination of circumstances, any one of which in isolation would not have caused the accident. As is often the case, the flightcrew had the final role in the sequence of events leading to the accident. The breakdown in normal procedures for reasons associated with the environment is self-evident. However, the lack of Service Bulletin 2384 incorporation has not gone unnoticed by the Board wherein Boeing, Pan American, and the FAA had differing potential action roles albeit such roles were not mutually exclusive. In this regard, the Board released a special report concerning this accident on May 12, 1969. Boeing could have made the bulletin more definitive. Pan American could have more correctly evaluated the potential hazards involved in their operational environment. The FAA, in theory at least, could have inserted higher priority to the change at the time of initial bulletin review. However, the FAA's role is basically one of providing minimum standards and enforcement thereof. They cannot be expected to be the total protector of the air traveling public and indeed considerable preventive action must be taken elsewhere.

There is a need for each manufacturer to be as definitive as possible in stating the reason for the issuance of every service bulletin. There is a need for each air carrier to review the processing procedures governing acceptance or rejection of such bulletins. Finally, the regulatory process should not be looked upon as a panacea to preclude accidents, but rather just one of several vital ingredients to the accident prevention process.

2.2 Conclusions

(a) Findings

1. The flight crewmembers were properly certificated and qualified for the operation involved.

2. The aircraft was airworthy, and its gross weight and center of gravity were within limits.

3. Weather conditions were such that any airframe or engine icing that would have been encountered would have been in such small amounts that it would not have been a causal factor.

4. There was no indication of a mechanical failure or malfunction of the aircraft structure or powerplants.

5. Evidence conclusively established that the wing flaps were in the retracted position during the takeoff.

6. There is no reference to wing flap on the air carrier's pre-takeoff portion of the cockpit checklist as distinct from the taxi portion.

7. Boeing Service Bulletin 2384 had not been incorporated in N799PA.

8. The takeoff warning horn failed to sound because the takeoff power setting did not require more than 42° throttle advancement.

9. The aircraft was flown in expectation of performance applicable to a 14° flap setting, and lateral control of the aircraft was lost.

10. The aircraft rolled to approximately 90° right bank and the wingtip made initial contact with the ground.

11. The crew was operating in a stressful environment created by lack of familiarity with the airport, adverse weather conditions, darkness, cumulative delays, and a self-imposed time envelope.

12. Boeing Service Bulletin 2384 did not define "cold weather operations."

13. The significance of Service Bulletin 2384 was not fully realized at the time it was processed by Pan American.

(b) Probable Cause

The Board determines that the probable cause of this accident was an attempted takeoff with the flaps in a retracted position. This resulted from a combination of factors: (a) inadequate cockpit checklist and procedures; (b) a warning system inadequacy associated with cold weather operations; (c) ineffective control practices regarding manufacturer's Service Bulletins; and (d) stresses imposed upon the crew by their attempts to meet an air traffic control deadline.

3. RECOMMENDATIONS AND CORRECTIVE ACTION

Based on the Board's findings that (1) the takeoff was attempted with the flaps in the retracted position; and (2) the takeoff warning system did not activate, the Board made the following recommendations to the Federal Aviation Administration (FAA) on May 2, 1969:

1. The provisions of Boeing Service Bulletin No. 2384, which calls for modification of the thrust lever advancement from 42° (or 33°) to 25° travel, be required by issuance of an airworthiness directive to all operators of B-707/720 aircraft.

2. Air carrier cockpit checklists be reviewed in an effort to insure that each list provides a means of reminding the crew, immediately prior to takeoff, that all items critical for safe flight have been accomplished.

The FAA Administrator concurred in the first recommendation by issuing an airworthiness directive on May 28, 1969, that applied to the takeoff aural warning system of all Boeing 707/720 and 727 series aircraft. In response to the second recommendation, reference was made to a Telegraphic Notice that was issued on December 31, 1968, to all operators of Boeing 707/720 aircraft to be alert to the possibility of the takeoff warning system not operating during cold weather conditions. It also recommended that flightcrews double-check proper positioning of flaps, speed brakes, and stabilizer trim during cold weather operations. Inasmuch as the December 31, 1968, Notice pertained only to Boeing 707/720 aircraft, an Air Carrier Operations Alert was issued to the field on February 4, 1969. This alert covered all aircraft provided with takeoff warning systems, and directed principal inspectors to ensure that the operators concerned establish a procedure requiring flightcrews to double-check positioning of wing flaps, speed brakes, and elevator/stabilizer trim during cold weather operations.

The Board, in a followup action, indicated that it was not its intent to relate the application of their second recommendation to specific weather conditions. Instead, the intent was to insure that all items critical for safe flight had been accomplished and checked prior to any takeoff. Accordingly, the Board resubmitted to the FAA the recommendation relating to a review of air carrier cockpit checklists.

A subsequent reply from the FAA stated that instructions were being prepared to their field offices requiring principal operations inspectors to review the aircraft cockpit checklists and associated procedures of their assigned air carriers to assure that the air carrier has a satisfactory means of reminding the flightcrew that all items critical for safe flight have been accomplished immediately prior to takeoff.

Additionally, the Board has issued a special report on May 12, 1969, in which this accident was used as a case history to show how such accidents can be prevented. This special report expressed a need for the processing of safety information in "some form of system safety approach" rather than a fragmented seller-buyer-regulator relationship. The report also stated that the manufacturer, airlines, and the FAA should reexamine their procedures, not limited to but including the processing of service bulletins and make better utilization of existing systems for the exchange of safety information.

After the accident, Pan American revised its procedures for processing service bulletins by adding an additional step when the initial review by the appropriate engineering section results in a determination that the bulletin is not applicable. Under the revised procedure, the bulletin will be brought to the attention of the vice president responsible for the particular area, if the engineering group concludes that no action is necessary.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOHN H. REED
Chairman

/s/ OSCAR M. LAUREL
Member

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

Isabel A. Burgess, Member, did not take part in the adoption of this report.

November 19, 1969.

APPENDIX A

Crew Information

Captain Arthur Moen

Captain Moen, aged 47, was hired on May 15, 1949, and was issued an airline transport pilot rating June 10, 1957. He was designated a captain on B-707 equipment June 9, 1967. He satisfactorily completed his last proficiency check November 24, 1968.

Pilot data furnished by PAA was as follows:

		Hours
a.	Total pilot time	15,207
b.	Total time in B-707	3,969
c.	Total command time in B-707	294
d.	Total time last 30 days	26
e.	Flight time last 48-hour period	4
f.	Duty-free time prior to flight	23
g.	Certificates and ratings - Airline transport pilot certificate No. 522082 with ratings for DC-3, DC-6/7, B-377, B-707/720, and airplane multiengine land.	
h.	Medical data - First-class medical certificate issued November 24, 1968, with no waivers.	

Captain Moen flew a bid trip December 1 to 3, and though he was on standby for various intervals during the month, he was not scheduled for another trip until he and the other members of his crew originated the San Francisco-to-Anchorage leg of Flight PlCl on December 24.

First Officer Johannes D. Markestein

First Officer Markestein, aged 38, was hired on March 8, 1957, and was issued an airline transport pilot rating January 16, 1967. His last proficiency check was satisfactorily completed on December 23, 1968.

Pilot data furnished by PAA was as follows:

		Hours
a.	Total pilot time	9,813
b.	Total time in B-707	2,813
c.	Total time last 30 days	41
d.	Time last 48-hour period	4
e.	Duty-free time prior to flight	23

f. Certificates and ratings -
Airline transport pilot certificate No. 1362156 with ratings for B-707/720, airplane multiengine land with commercial privileges single-engine land.

g. Medical data -
First-class medical certificate issued November 15, 1968, with no waivers.

First Officer Markestein returned from his bid trip December 2, and was not assigned again until the period December 18 to 22, when he received periodic proficiency training. He then originated Flight P1C1 on December 24, 1968, from San Francisco to Anchorage.

Flight Engineer James R. Skellenger

Flight Engineer Skellenger, aged 31, was hired on September 12, 1966, and served as second officer on B-707 equipment until May 1968, when he transferred to flight engineer training. He was issued a flight engineer certificate August 16, 1968, and satisfactorily completed his last proficiency check on that date.

Flight engineer and pilot data furnished by PAA was as follows:

		Hours
a.	Total pilot time	3,032
b.	Total time in B-707	1,376
c.	Total flight engineer time in B-707	138
d.	Total time last 30 days	4
e.	Flight time last 48-hour period	4
f.	Duty-free time prior to flight	23

g. Certificates and ratings -
Flight engineer certificate No. 1866882 with a rating for turbojet; commercial pilot certificate No. 1671252 with ratings single-engine land, instrument; navigator certificate No. 1736580.

Flight Engineer Skellenger was on vacation from November 9 to December 3, and was not assigned a trip upon return to duty until Flight P1C1 on December 24.

This crew had not flown together previously. However, both the captain and first officer had operated out of Anchorage International twice before.

APPENDIX B

Weight and Balance

The takeoff gross weight is computed by adding the aircraft basic operating weight, fuel, and cargo. The basic operating weight for Flight 799 included:

Aircraft empty weight	128,920 pounds
Configuration equipment weight	4,600
Operating variables weight	820
Basic operating weight	134,340 pounds

The computations for the takeoff gross weight were as follows:

Basic operating weight	134,340 pounds
Fuel 1/	123,500
Cargo	73,020
Takeoff gross weight	330,860 pounds

The maximum allowable gross weight for takeoff on Runway 23 was 330,950 pounds. Examination of pallet weights on the individual manifests revealed that the computed cargo weight should have been 73,180 pounds, which indicates that the aircraft weighed 331,020 pounds. Although this technically exceeds the allowable takeoff gross weight by 70 pounds, that figure can be reduced to 56 pounds by using a more accurate conversion factor from kilograms to pounds. Another variable which would affect the actual weight of the aircraft was the standard 1,000-pound allowance for taxi fuel. This figure is predicated on a fleet-wide nominal average taxi time of 15 minutes with an average fuel flow of 1,000 pounds/hour/engine. Since Flight 799 was operating on the ground for 20 minutes, at an optimum fuel flow of approximately 1,065 pounds/hour, it is presumed that approximately 1,420 pounds of fuel was burned and the actual takeoff gross weight was probably 330,600 pounds.

The aircraft center of gravity was computed to be 25.3 percent of the mean aerodynamic chord. This was within the allowable limits of approximately 20.1 and 27.2 percent.

The cargo, consisting mostly of mail and food packages, was largely consumed by ground fire, and no attempt was made to verify the weights as listed on the cargo manifest.

1/ Does not include 1,000 pounds of fuel for taxi.

APPENDIX C

INVESTIGATION AND HEARING

1. Investigation

The Board received notification of the accident at approximately 1140 e.s.t. on December 26, 1968, from the Federal Aviation Administration. An investigating team was immediately dispatched to the scene of the accident. Working Groups were established for Operations, Systems, Powerplants, Structures and Flight Data Recorder. Interested Parties included: the Federal Aviation Administration; Pan American World Airways, Inc.; the Boeing Company; Air Line Pilots Association; Pratt & Whitney Aircraft Division of United Aircraft Corporation; Flight Engineers International Association; and the Military Airlift Command of the U. S. Air Force.

The on-scene investigation was completed on January 5, 1969.

Subsequent to the on-scene investigation one of the Board's meteorologists and the Cockpit Voice Recorder Specialist prepared reports covering their respective areas.

2. Hearing

There was no public hearing.

3. Preliminary Reports

An Interim Report of Investigation summarizing the facts disclosed by the investigation was published as a special report on May 12, 1969.

NATIONAL TRANSPORTATION SAFETY BOARD

DEPARTMENT OF TRANSPORTATION

WASHINGTON, D.C.--20591

Safety Information

For Release:

SB 69-35
(202) 382-7273

AM Newspapers
Monday, May 12, 1969
Office of the Chairman

The National Transportation Safety Board today released a special report, which it described as the "anatomy of an air carrier accident," in order to show how such accidents can be prevented. At the same time, the Board released a safety recommendation to the Federal Aviation Administration proposing specific actions aimed at preventing similar accidents from the same causal factors.

The accident case history, used as an example by the Safety Board, involved the fatal takeoff crash of a Pan American 707 cargo flight which occurred at Elmendorf Air Force Base, Anchorage, Alaska, on December 26, 1968. The crew of three was killed, and the cargo and aircraft were destroyed.

Safety Board investigators at the accident site determined that the 707 became airborne near the southwest end of Runway 23 and that during takeoff the aircraft maneuvered in various noseup and wingdown attitudes before crashing in a steep right bank, nose-low position. They found the landing gear in the extended position, but examination of the wing flap drive screws established the fact that the flaps were in the retracted position at the time of the aircraft's breakup, thus providing the first clue in the chain of causal factors.

Corroborative evidence on the retracted flap position was obtained by Safety Board investigators from the cockpit voice

(over)

recorder (CVR) which revealed that the crew had lowered the wing flaps while going over the taxiing portion of the cockpit checklist, but had subsequently retracted them while taxiing to the takeoff position. There was no evidence on the voice tape, which records all sounds in the cockpit, to indicate that the wing flaps were again extended after this retraction or prior to the takeoff.

The next step by Safety Board investigators was to find out why the takeoff warning system, which is on all 707-720 aircraft, had not alerted the flightcrew to the fact that the flaps were not extended for takeoff. This system provides a warning horn signal when the throttles are advanced for takeoff if flaps, speed brakes, or stabilizer are not in proper takeoff positions. A playback of the CVR tape revealed that no such warning was recorded.

Next, in their study of the takeoff warning system, the Board's investigators learned that the Boeing Company had issued a Service Bulletin, No. 2384, on January 31, 1967, alerting 707-720 operators that during "cold weather operations" the warning system might not operate within the desired limits.

To overcome such a possibility, the Boeing Bulletin recommended certain corrective measures which involved lowering the warning actuator setting under what it called "certain cold weather conditions." In fact, the device could not be predictably effective below +34°F. In any event, Pan American elected not to accept the Boeing recommendation, so, at the time of the accident, with a temperature of 16°F., the takeoff warning horn did not sound.

The Safety Board's next investigative step was to try to find out why Pan American had decided the modification, which cost less than $500, was not necessary. It was learned that copies of Safety Bulletin 2384 were forwarded by Boeing to appropriate operations engineering offices within Pan American, but all that could be determined was that one of the supervisors of an engineering section within this group decided that the bulletin was not applicable to Pan American aircraft, and no further action was taken. This decision could not be documented.

Pan American later explained to the Safety Board that it had not accepted the recommended modifications because (1) Boeing cited no incidents involving the takeoff warning system and its bulletin gave no specific temperature below which an unmodified aircraft would be deprived of the takeoff warning system; (2) the FAA had not issued an airworthiness directive making the change mandatory; and (3) other air carrier operators had elected not to comply with the bulletin.

The Safety Board agrees with Pan American that the Boeing Service Bulletin was something less than precise; in any event, it obviously failed to impart a sense of urgency to the carriers to whom it was addressed. On the second point, the Board said that Pan American's failure to take action because the FAA had not issued an airworthiness directive indicated an abdication of the carrier's independent responsibility for the safety of its operation. The FAA's airworthiness directives, and other safety regulations, should be looked upon as minimum required safety standards only, and standards that the industry should constantly try to better, the Board said.

Pan American informed the Safety Board that now that the significance of Boeing Service Bulletin 2384 is clearly understood and recognized, they are modifying all affected Pan American aircraft. The Board added that many of the other carriers that had also failed to accept the recommended modifications are now complying.

"It is apparent from the anatomy of this accident," the Board said, "that Boeing could have made the bulletin more definitive; Pan American could have more correctly evaluated the potential hazards involved in their operational environment; and the FAA, in theory at least, could have inserted higher priority to the change at the time of initial bulletin review." However, the Board pointed out that the FAA's role is basically one of providing minimum standards and enforcement thereof. "They cannot be expected to be the total protector of the air traveling public and indeed considerable preventive action must be taken elsewhere," the Board stated.

What is needed in the processing of safety information is "some form of system safety approach" rather than "a fragmented seller-buyer-regulator relationship." The Board said that the manufacturer, airlines and the FAA should reexamine their procedures, not limited to but including the processing of service bulletins and make better utilization of existing systems for the exchange of safety information. Within the airline segment of the industry, this could be achieved by upgrading the safety function so that one top official, or one principal office, would have direct responsibility for final evaulation and action on all matters involving safety.

"Until this is accomplished," the Board concluded, "the accident prevention efforts of the aviation community remain less effective than they should be."

# # # # #

AIRCRAFT ACCIDENT SPECIAL REPORT

THE ANATOMY OF AN AIR CARRIER ACCIDENT

PAN AMERICAN WORLD AIRWAYS, INC.

BOEING 707-321C, N790PA

ELMENDORF AIR FORCE BASE

ANCHORAGE, ALASKA

DECEMBER 26, 1968

Adopted: May 2, 1969

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D. C. 20591

AIRCRAFT ACCIDENT SPECIAL REPORT

PAN AMERICAN WORLD AIRWAYS, INC.

BOEING 707-321C, N799PA

ELMENDORF AIR FORCE BASE

ANCHORAGE, ALASKA

DECEMBER 26, 1968

FOREWORD

This report has been prepared from information obtained during the investigation of an accident involving a Pan American World Airways, Inc., B-707-321C, N799PA, at Elmendorf AFB, Anchorage, Alaska, on December 26, 1968.

The purpose of this report is to demonstrate graphically how human stress, an inadequate procedure, management practices, and a mechanical system deficiency combine to cause a fatal accident. It is published to alert the aviation industry to the need for a system safety approach to accident prevention.

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D. C. 20591

NATIONAL TRANSPORTATION SAFETY BOARD

AIRCRAFT ACCIDENT SPECIAL REPORT

ADOPTED: May 2, 1969

Pan American World Airways, Inc.,
Boeing 707-321C, N799PA,
Elmendorf Air Force Base,
Anchorage, Alaska,
December 26, 1968

Pan American Clipper, N799PA, a Boeing 707-321C, cargo/mail flight bound for Vietnam via Tokyo, Japan, crashed on takeoff from Runway 23, Elmendorf AFB, Anchorage, Alaska, at approximately 0615 A.s.t. 1/ on December 26, 1968. The aircraft was destroyed. The accident was fatal to all three crewmembers, who were the only occupants aboard the aircraft.

Shortly after notification of the accident, an investigative team was sent to Anchorage to determine the facts, conditions, and circumstances surrounding the accident. Immediately upon arrival in Anchorage, the team began its investigative activities by interviewing witnesses and examining the accident site and relevant records.

The interviews with the witnesses revealed that the aircraft, which was taking off to the southwest, became airborne at or near the southwest

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

end of the runway. Immediately after becoming airborne, a burst of flames was observed emanating from the area of the engines on both sides of the aircraft. During this period of time, the aircraft was observed to reach an estimated maximum altitude of approximately 200 feet and to maneuver in various combinations of noseup and wingdown attitudes. Eventually, the aircraft was seen to crash in a steep, right-bank and nose-low attitude.

Examination of the wreckage at the accident site disclosed that the right wingtip of the aircraft made initial contact with the ground (snow) at a point just to the left of the extended centerline of Runway 23. This occurred at a distance of approximately 2,700 feet from, and at an elevation of 32 feet above, the southwest end of the 10,000-foot runway. The aircraft became inverted some time after the initial ground contact, and the major sections of the aircraft that were still intact were found inverted. Examination of the wing flap drive screws established the fact that landing flaps were in the retracted position at the time of the aircraft's breakup. The landing gear was found in the extended position.

Examination of all four engines showed evidence of rotation at the time of ground impact. There was no indication of operational distress such as overtemperature, bulging of nozzle guide vanes, or of heat erosion of the vanes or turbine blades on any of the engines.

While some members of the investigative team were interviewing witnesses and studying the accident site, other members were delving into the operational aspects of the flight.

The weather, as recorded 1 minute after the accident, was as follows: Partial obscuration, ceiling 200 feet broken, 700 feet broken, visibility 2 miles, ice crystals and fog, temperature 6°F., dew point 2°F., wind from 030° at 2 knots, altimeter 30.02 inches.

The cockpit voice recorder (CVR) tape was retrieved in good condition. A playback of this tape revealed that the crew had lowered the wing flaps while going over the taxiing portion of the cockpit checklist, but had subsequently retracted them while taxiing to the takeoff position. There is no evidence on the tape to indicate that the wing flaps were extended subsequent to this retraction or prior to the takeoff. It was also evident that the crew, during the period between their arrival at the aircraft and the takeoff, was experiencing extreme stress because of various operational factors involved. Some of these factors were as follows:

1. Delay on departure from the ramp area at the time estimated by the crew.
2. Departure from an unfamiliar airport (a "follow me" jeep was provided) under conditions of darkness and with taxiing conditions of reduced braking effectiveness.
3. Crew request to depart from Runway 23 (due to gross weight) when flight had been cleared initially to Runway 05.
4. Repeated communication with air traffic control facilities relating to possible departure within the time limits assigned by oceanic control. (International flights are assigned a void time for the clearance issued, based on the estimated

time of departure which was changed several times by the crew and traffic conditions.)

Additionally, the CVR tape indicated a callout of airspeed at 120 knots, V_1, and V_R as the aircraft rolled down the runway. A short interval after the callout of V_R, there was the sound of the stick shaker (a safety feature to alert pilots to an extreme nose-high takeoff attitude or to a flight condition approaching a stall). Following the sound of the stick shaker were some popping sounds which were associated with engine compressor stalls by personnel familiar with the sound of jet engines.

Clipper 799, like other B-707-321C aircraft, had a takeoff warning system that was intended to provide a horn audible warning signal when the thrust levers were advanced, if flaps, speed brakes, or the stabilizer were not positioned properly for takeoff. No such warning was heard on the CVR tape.

During the early stages of the investigation, it was determined that on January 31, 1967, the Boeing Company had issued Service Bulletin 2384. This bulletin warned that during "cold weather operations" (this term was not defined), the takeoff warning system may not operate within the desired limits because the takeoff engine pressure ratio may be reached before the takeoff warning switch is actuated to arm the system. Accordingly, the bulletin recommended that the actuator setting be adjusted from 42° to 25° of thrust lever advancement.

This bulletin was issued as the result of a review by company engineering analysis personnel and not because of a specific incident or accident.

The Boeing Company, in response to a National Transportation Safety Board request for a definition of "cold weather operations" as set forth in the service bulletin, provided in part the following: "... at the 42° switch setting the horn will sound (nominally) down to temperatures of / 33°F. After incorporation of the 25° switch setting the horn will sound (nominally) down to temperatures of - 43°F..."

Boeing incorporated this service bulletin into their production aircraft beginning with the 509th 707-720 series aircraft (ship #8141) on June 14, 1966. A similar service bulletin was subsequently issued to cover the 727 series aircraft. However, to cover those 508 aircraft previously delivered, Boeing listed in the service bulletin those aircraft that had not received this modification. The subject aircraft, N799PA, was one of the aircraft cited as not having received the modification.

In accordance with individual airline contractual agreements with the aircraft manufacturer, maintenance publications, including service bulletins, must conform to Air Transport Association (ATA) Specification [illegible]. This specification, under the section on service bulletin compliance, [illegible] that the manufacturer should provide a "recommended" statement if [illegible] strongly that the bulletin should be accomplished. The Boeing Company issued Service Bulletin 2384 as a "recommended" statement.

If otherwise, the bulletin should specify "optional based on operator's experience," and one of the following manufacturer statements may [illegible]:

1. (Issuer) considers that the work outlined herein affects the safety of the aircraft.

2. Although the work outlined herein does not affect the immediate safety of the aircraft, (issuer) recommends its accomplishment.

3. (Issuer) considers the work outlined herein desirable but not urgent.

None of the above statements implies mandatory accomplishment of the service bulletin. The Federal Aviation Administration (FAA) is the only organization that can make a service bulletin mandatory. Accordingly, if an aircraft manufacturer feels strongly that a service bulletin should be made mandatory, he can so state to the FAA. However, such a statement is rarely made and was not made in this case.

The overall procedure for processing service bulletins in effect on the date of the accident was, for the manufacturer issuing the bulletin, to forward copies to each carrier operating 707-720 series aircraft. In the case of Pan American, two bulletins were sent to two documentation groups -- one in Miami and the other in New York. Upon receipt of the bulletins, each of these groups filled out a service disposition form on which was listed a code number designating the engineering group responsible for that particular area covered by the bulletin. Such groups were maintenance, operations, cargo, and communications. Upon receipt of the bulletin by the responsible engineering group, it was routed to the engineering section responsible for that particular component (brakes, flight controls, etc.). One of the engineers within the applicable section reviewed the bulletin and made a determination of the necessity for compliance

after coordination with any other interested section, i.e., flight operations, maintenance. Some of the factors considered during this review were the number of times the company aircraft was exposed to the condition specified in the service bulletin and the relationship of this exposure to safety. If the determination was made to comply with the bulletin and the cost was generally under $500, as it was in this instance, an aircraft modification request would be prepared. This form would be submitted through channels to accounting. Accounting would determine if the cost of the modification would be capitalized under the Civil Aeronautics Board Regulations and, if so, would be charged accordingly. If it was determined that the cost could not be capitalized, it would be charged directly as a maintenance expense. In both cases, engineering changes would be issued.

In the event that the engineer (within the applicable section reviewing the bulletin) decided the modification was not necessary, a notation would be made as to the reason for noncompliance, the bulletin would be filed, and no further action taken.

In respect to the processing of the subject Service Bulletin No. 2486, over than $500 cost, the initial routing was made and the bulletin was reviewed by the operations engineering group. One of the supervisors of an engineering section within this group decided, after coordination with flight operations, that the bulletin was not applicable to Pan American aircraft and no further action was taken. The reason for this decision was not fully documented.

After the Elmendorf accident, Pan American revised its procedures for processing service bulletins by adding an additional step when the initial review by the appropriate engineering section results in a determination that the bulletin is not applicable. Under the revised procedure, the bulletin will be brought to the attention of the vice president responsible for the particular area, if the engineering group concludes that no action is necessary.

In response to the Safety Board's inquiry concerning reasons for the nonimplementation of the service bulletin, Pan American cited the following:

1. No incident was cited in the bulletin, nor was any indication given as to the specific ambient temperature below which an unmodified aircraft would be deprived of wing flap warning due to rigging of the warning system switch to throttle movement.
2. The FAA did not see fit to issue an Airworthiness Directive requiring compliance with the Boeing Service Bulletin.
3. Other air carrier operators also elected not to comply with this service bulletin at the time it was issued.

Pan American also pointed out that since the significance of this service bulletin is now clearly recognized, Pan American is modifying all affected aircraft.

An examination of a copy of the cockpit checklist used by the Pan American crew indicated that the takeoff flap item appears only on the

taxi portion of the checklist. There is no provision on the takeoff portion of the checklist to remind pilots that the flaps should be lowered. The Safety Board believes that the placing of a flap reminder item further down the checklist, as for example, on the takeoff portion of the checklist, would be most helpful to the pilot. In addition, the use of a slide cover type checklist as used by some other air carriers would enable the pilot to see at a glance which items have not been accomplished. This type of checklist is one means of assisting the crew to accomplish the "passed over" items just prior to takeoff, in those situations where the checklist item is not accomplished on the first reading of the list, or the action taken is subsequently altered, as occurred in the Pan American crash.

In conclusion, the Board believes that there is much to be learned from this accident beyond the simple mechanics of the ill-fated takeoff. Whereas this accident contains an element of crew "error," it is obvious that the possibility of such "error" was considered by the manufacturer and found to be within the normal range of human performance. Otherwise, there would have been no justification to install the takeoff (flap) warning system in the first place. The numerous operational stresses present in this case are typical components of a "human error" accident.

Accordingly, in a safety recommendation to the Federal Aviation Administration dated May 2, 1969, the Board outlined specific actions which would tend to eliminate or to reduce the possibility of similar incidents. A copy of this recommendation is attached to this report.

It is apparent that Boeing, Pan American, and the FAA had differing potential action roles in connection with Service Bulletin 2384, albeit such roles were not mutually exclusive. Boeing could have made the bulletin more definitive. Pan American could have more correctly evaluated the potential hazards involved in their operational environment. The FAA, in theory at least, could have inserted higher priority to the change at the time of initial bulletin review. However, the FAA's role is basically one of providing minimum standards and enforcement thereof. They cannot be expected to be the total protector of the air traveling public and indeed considerable preventive action must be taken elsewhere.

There is a need for each manufacturer to be as definitive as possible in stating the reason for the issuance of every service bulletin. There is a need for each air carrier to review the processing procedures governing acceptance or rejection of such bulletins. Finally, the regulatory process should not be looked upon as a panacea to preclude accidents, but rather just one of several vital ingredients to the accident prevention process.

In essence, some form of system safety approach is required -- not in a fragmented seller-buyer-regulator relationship. For in the final analysis, the problem is a general one, not just involving the Boeing Company or Pan American or the FAA but the entire aviation industry. A fundamental rule must still be that there is no substitute for sound, inquisitive engineering judgment. And whereas the air carrier community does a very creditable job, there is always room for improvement.

In summary, the Board believes that this accident illustrates a requirement for improved utilization of existing systems for exchange of safety information among all air carriers, aircraft and component manufacturers, and Government agencies. Until this is accomplished, the accident prevention efforts of the aviation community remain less effective than they should be.

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

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

May 2, 1969

OFFICE OF
THE CHAIRMAN

The Honorable John H. Shaffer,
Administrator,
Federal Aviation Administration,
Department of Transportation,
Washington, D. C. 20590.

Dear Mr. Shaffer:

Investigation of a recent Pan American Airways, B-707-321C, aircraft accident that occurred at Elmendorf Air Force Base, Anchorage, Alaska, December 26, 1968, revealed two areas that need safety attention.

The investigation disclosed the following: (1) The takeoff was attempted with the flaps in the retracted position; and (2) the takeoff warning system did not activate.

The B-707-321C aircraft is equipped with a takeoff warning system that is intended to provide an audible warning signal when the thrust levers are advanced if (1) flaps, (2) speed brakes, or (3) the stabilizer are not properly positioned for takeoff. No such warning can be heard on a playback of the cockpit voice recorder (CVR) tape that was recovered from the aircraft involved in the accident.

Boeing Service Bulletin No. 2384, January 31, 1967, called attention to the fact that, during cold weather operation, the takeoff exhaust pressure ratio (EPR) may be reached before the takeoff warning switch is activated. This Service Bulletin recommended a modification to the takeoff warning switch setting for cold weather operation (the Bulletin did not define "cold weather"). This modification has not been incorporated in Pan American's maintenance program; consequently, the aircraft involved in the accident had not been modified.

Immediately following the accident, the outside air temperature at Anchorage was recorded as +6° F.

The Boeing Company has furnished us with information which shows that, with the takeoff warning switch set at 42° (as was the setting of the aircraft involved in the accident), the horn will sound (nominally) down to temperatures of +33° F. After incorporation of the 25° switch setting, the horn will sound (nominally) down to temperatures of -43° F. Accordingly, the Board considers that the unmodified takeoff warning switch setting did not provide the protection intended for operating with the ambient temperatures which existed at the time of the accident.

A playback of the CVR tape revealed that the second item on the taxi portion of the checklist called out by the crew was for flaps to be set for takeoff (14°). This was accomplished. However, while taxiing to the takeoff position the crew retracted the flaps. There is no evidence on the tape to indicate that the wing flaps were extended subsequent to this retraction or prior to the takeoff.

An examination of a copy of the cockpit checklist used by the crew indicates that the takeoff flap item appears only on the taxi portion of the checklist. There is no provision on the takeoff portion of the checklist to remind pilots that the flaps should be lowered. This lack of a flap reminder item on the takeoff portion of the checklist does not assist the crew in avoiding a situation where items critical for safe flight may be overlooked.

Pan American uses a plain card-type checklist. Some carriers use a two-position sliding cover for each item on the checklist. If this type of checklist is used properly, the sliding cover is not moved to mask an item until the required action is accomplished physically. The Board believes that the two-position slide-type checklist is one effective means of assuring that appropriate action has been accomplished on all items before takeoff.

In view of the above, the Board submits the following recommendations:

1. The provisions of Boeing Service Bulletin No. 2384, which calls for modification of the thrust lever advancement from 42° (or 33°) to 25° travel, be required by issuance of an airworthiness directive to all operators of B-707/720 aircraft.

2. Air carrier cockpit checklists be reviewed in an effort to insure that each list provides a means of reminding the crew, immediately prior to takeoff, that all items critical for safe flight have been accomplished.

Our personnel have discussed the aforementioned problem areas with representatives of your Flight Standards Service.

Our Bureau of Aviation Safety is available to provide you with additional information or assistance.

Sincerely yours,

Joseph J. O'Connell, Jr.,
Chairman