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AIRCRAFT ACCIDENT REPORT

AIRCRAFT POOL LEASING CORPORATION, LOCKHEED SUPER CONSTELLATION, L-1049H, N6917C MIAMI, FLORIDA

DECEMBER 15,1973

ADOPTED: SEPTEMBER 11, 1974

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D.C. 20591
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15. Supplementary Notes

This report does not contain any new recommendations.

16. Abstract

At 2353 e.s.t. on December 15, 1973, an Aircraft Pool Leasing Corporation's Lockheed Super Constellation L-1049H, which was operating as a cargo carrier, crashed after takeoff from runway 9L of the Miami International Airport, Miami, Florida. The aircraft struck the ground 1.25 miles east of the airport and destroyed several homes, automobiles, and other property. The aircraft's occupants--three crewmembers--and six persons on the ground were killed. Two others were injured slightly. The aircraft was destroyed by impact and fire.

The National Transportation Safety Board determines that the probable cause of this accident was overrotation of the aircraft at lift-off resulting in flight in the aerodynamic region of reversed command, near the stall regime, and at too low an altitude to effect recovery. The reason for the aircraft's entering this adverse flight condition could not be determined. Factors which may have contributed to the accident include: (a) Improper cargo loading, (b) a rearward movement of unsecured cargo resulting in a center of gravity shift aft of the allowable limit, and (c) deficient crew coordination.

As the result of this accident, the Safety Board has made several recommendations to the Administrator of the Federal Aviation Administration.

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L-1049H, N6917C
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SYNOPSIS

At 2353 e.s.t. on December 15, 1973, an Aircraft Pool Leasing Corporation's Lockheed Super Constellation L-1049H, which was operating as a cargo carrier, crashed after takeoff from runway 9L of the Miami International Airport, Miami, Florida. The aircraft struck the ground 1.25 miles east of the airport and destroyed several homes, automobiles, and other property. The aircraft's occupants — three crewmembers -- and six persons on the ground were killed. Two others were injured slightly. The aircraft was destroyed by impact and fire.

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As the result of this accident, the Safety Board has made several recommendations to the Administrator of the Federal Aviation Administration (FAA).

1. INVESTIGATION

1.1 History of the Flight

On December 15, 1973, Aircraft Pool Leasing Corporation's Lockheed Super Constellation L-1049H, N6917C, was on a nonscheduled cargo flight from Miami International Airport, Miami, Florida, to Maiquitia Airport, Caracas, Venezuela. The cargo load consisted of Christmas trees from Canada; there were no passengers.

On the evening of December 14, 1973, N6917C was taxied to the loading ramp of a freight company in the northwest area of the airport. At 0700, 1/ December 15, 1973, loading began and was completed at 1230. The freight loading supervisor stated that the main cabin was completely filled with trees. Bundles of trees were also loaded into the forward and aft belly compartments.

At 1329:20, Miami International Flight Service Station (IFSS) received an instrument flight rules (IFR) flight plan for N6917C. The proposed departure time, as filed with Miami Air Route Traffic Control Center (ARTCC) was 1415. This time was subsequently amended by the crew to 2200, because of the need to replace the aircraft's batteries, which were missing when the flight engineer made his routine walk-around checks.

After replacement batteries were purchased, charged, and installed in the aircraft, the three-member crew began preparing for departure.

At 2256, after overcoming some difficulty starting the engines, the flight contacted Miami Ground Control (GC) and requested taxi clearance. N6917C was cleared to taxi to runway 9L and an en route clearance was given to the crew at 2307. The aircraft proceeded to the ramp area adjacent to runway 9L and remained there until 2322. The crew then advised the tower that they would like to return to the ramp and requested that their flight plan be held as they expected a delay of only 15 to 20 minutes. A witness at the freight terminal stated that when the aircraft returned, the crew requested some assistance because they couldn't properly close the crew compartment door. Something was stuck in the door roller track. The witness stated, "I got a screwdriver out of my car and gave it to somebody who took it up to the copilot, and whatever it was that was lodged in the roller, he got it out."

At 2341:45, the crew reestablished radio contact with Miami GC, and the flight was cleared to taxi back to runway 9L. Witnesses stated that as the aircraft taxied from the runup ramp, the No. 1 engine stopped; however, it was restarted immediately.

At 2350:30, the flight advised the local controller that the flight was ready to roll. The controller asked if the flight was ". . . going from the intersection." The flight replied, "Seven Charlie affirmative." The flight was cleared for takeoff on runway 9L and advised of, ". . . traffic 4 miles out for the runway." At 2351, the crew acknowledged, "One seven, Charlie."

Upon clearance, a rolling takeoff was started. According to tower controllers, the aircraft became airborne abruptly 4,800 feet from the start of the takeoff, and it assumed an unusually nose-high attitude.

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

According to two of the controllers, N6917C's attitude was 20° to 30° noseup shortly after the aircraft became airborne.

The controllers agreed that the aircraft attained a maximum altitude of 100 to 120 feet as it continued its climbout. They also agreed that the landing gear was down until the aircraft passed the end of the runway. It then appeared to retract. As the flight continued eastward, controllers lost visual contact with it because of a hangar that obstructed their view. The hangar is about 120 feet high. The tower cab supervisor recalled that the aircraft was losing altitude as it disappeared behind the hangar.

At 2352:55, the local controller cleared N6917C to contact Miami departure control and 10 seconds later, the flight acknowledged, "One seven Charlie."

At 2353:25, a two-word transmission, "One Charlie," was heard on the local frequency of 118.3 MHz. At 2353:35, an aircraft on final approach to runway 9L reported to the tower that "some kind of smoke ball went up." Tower controllers also observed a flash and a ball of smoke at about the same time.

The aircraft crashed 1.25 miles east of the airport. After striking high tension wires and a tree, the aircraft crashed into a parking lot, after which it collided with several homes and other property before stopping.

The weather was clear and the visibility was 10 miles. Many persons observed the aircraft at various places along the flightpath. Most of the witnesses interviewed were aeronautically qualified with either pilot or maintenance backgrounds, or both. Many of them were located north and east of the takeoff runway and adjacent to it. The majority of witnesses stated that the aircraft did not exceed an altitude of 100 to 200 feet and that most of the time it maintained an extremely nose-high attitude. Some witnesses stated that the aircraft was flying very slowly, ". . . near a stall." Eleven witnesses stated that the engines were either not producing full power or were malfunctioning in some manner. Most witnesses who were in a position to observe the aircraft in its final moments of flight, stated that the left wing was down and that the tail was very low; some of these reported that engine sound decreased or ceased just before impact.

One witness, with an aircraft maintenance background, stated: "The aircraft continued down the runway and then it appeared to me that the power was reduced, and I thought the captain was going to abort, but he did not. Power was again applied, and the aircraft broke ground about even with Eastern's 1011 hangar. It raised to about 100 feet. Not any more than 100 feet was reached, if that. I believe about the time he

reached the airport fence his anti-collision light on top of the fuselage was in full view to me, indicating that the aircraft had dropped its tail and was in a severe nose-up position. At the same time, it started to sink. It started to raise momentarily as if it were going to recover and then sank out of sight. . . ."

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other
Fatal	3	0	6
Nonfatal	0	0	2
None	0	0	

1.3 Damage to Aircraft

The aircraft was destroyed by impact and postimpact fire.

1.4 Other Damage

Four homes, seven automobiles, and a motorcycle were destroyed by impact and fire. Several homes were damaged slightly.

1.5 Crew Information

The captain and the first officer were certificated properly for the flight. The captain was qualified in the aircraft. The first officer did not satisfy the second-in-command qualifications in 14 CFR 61.55. The flight engineer lacked recency of experience in the aircraft and obtained a first-class medical certificate by withholding information concerning his past medical history. (See Appendix B.)

1.6 Aircraft Information

The aircraft was certificated and maintained according to Federal Aviation Administration (FAA) requirements. (See Appendix C.)

The L-1049H is certified for a maximum takeoff weight of 142,100 pounds, a maximum allowable landing weight of 114,500 pounds, and a maximum zero fuel weight of 109,500 pounds. The center of gravity (c.g.) limits are between 18 percent and 32 percent mean aerodynamic chord (MAC). On July 5, 1973, N6917C was recertified with a basic empty weight of 72,542 pounds at a c.g. of 13.9 percent MAC.

The aircraft was loaded with 666 bundles of Christmas trees. Reportedly, 621 bundles were loaded in the cabin, 15 in the forward baggage compartment, and 30 in the aft baggage compartment. The bundles did not contain the same number of trees and, therefore, were not the same size and weight. According to the freight loading supervisor, those bundles loaded into the main cargo Compartment through the rear cargo loading

door were stacked longitudinally from the forward bulkhead to the rear of the aircraft. The trees were stacked from wall to wall and from floor to ceiling, without leaving a passageway to the rear of the aircraft. The loading supervisor testified that the butt ends of the trees faced the foward end of the airplane, and additional trees were overlapped until the tree bundles reached the ceiling. This loading pattern continued to the rear of the aircraft until the aircraft was completely filled. One witness reported that a small area directly opposite the door was left unloaded. The methods of securing cargo prescribed in 14 CFR 91.203 were not used, and the loading supervisor did not receive any guidance with regard to load distribution. He stated that the original intent was to load all of the trees on hand into the aircraft. When it was apparent that this could not be done, he was told to put as many on as possible.

The lack of a weight and balance manifest hampered efforts to determine the correct weight and distribution of the load aboard N6917C. Based on the Canadian export declaration, the average weight of each bundle was 33.5 pounds. Therefore, the total cargo weight was about 22,311 pounds. Randomly selected tree bundles at the accident scene weighed an average of 42 pounds per bundle. An average weight of 42 pounds would have resulted in a total cargo weight of 27,972 pounds. The average weight of the bundles that were not loaded aboard the aircraft was 51 pounds per bundle. These trees, however, had been wet down after the aircraft had been loaded. An average weight of 51 pounds would have resulted in a total cargo weight of 33,966 pounds.

N6917 was fueled with 3,300 gallons of 115/145 octane aviation gasoline. According to the flight engineer's log, which was recovered from the wreckage, there were 1,500 gallons in the Nos. 1 and 4 main tanks, and 650 gallons in the Nos. 2 and 3 main tanks. Based on these figures, N6917C was carrying 4,300 gallons of fuel at takeoff.

Based on the available information, the Lockheed California Company calculated the aircraft's weight and c.g. for the various tree-bundle weights. It was assumed that the bundles were uniformly distributed throughout the aircraft. The table that follows shows the results of those calculations.

Average Weight Per Bundle (lbs.)	Cargo Load (lbs.)	c.g. MAC (percent)	Take Off Gross Weight (lbs.)
33	21,978	26.3	122,536
42	27,972	28.1	128,530
51	33,966	29.7	134,524

The effect of an aft shift of the cargo on the aircraft's c.g. was also calculated. For each inch average shift of the total load the effect would be:

0.14 percent MAC for 51-pound bundles
0.12 percent MAC for 42-pound bundles
0.10 percent MAC for 33-pound bundles

A document recovered from the cockpit showed two figures, apparently in the captain's handwriting: A V_1 of 103 kn. and a V_2 of 118 Kn. These figures correspond to a takeoff gross weight of between 130,000 pounds and 132,500 pounds, respectively.

A freelance copilot, who flies regularly in the Miami area and who had flown N6917C, said that restraining straps or cargo nets are not generally used to secure cargo. He also stated that generally the c.g. determinations are made by "guesstimate" and accordingly, the pilots who fly the cargoliners use the full runway length for takeoff. They normally accelerate the aircraft slowly and make shallow liftoff rotations and climbouts to prevent load shifts.

According to information obtained during the inquiry from airmen who had flown N6917C, the landing gear safety solenoid had to be overridden manually in order to raise the gear handle. They also stated that the throttle friction locks on the pilot's quadrant and on the flight engineer's panel were defective and would not hold the throttles properly.

1.7 Meteorological Information

The surface weather observation recorded by the National Weather Service at Miami International Airport immediately following the accident was as follows:

2356 - Clear, visibility-10 miles, temperature-67%. , dew point-57°F., wind-180° at 5 kn., altimeter setting-30.00 in.

1.8 Aids to Navigation

Not applicable

1.9 Communications

No difficulty was reported with communications between the flight and air traffic control.

1.10 Aerodrome and Ground Facilities

The Miami International Airport is located 9 miles NW of Miami at geographic coordinates 25° 47' 35"N. latitude and 80° 17' 10" W. longitude. The airport elevation is 9 feet, and has three paved runways. Runway 9L/27R, which is 10,500 feet long and 200 feet wide, is the longest of the three. The full length of the runway is grooved for 90 feet on each side of the centerline. High intensity runway lights serve the runway.

1.11 Flight Recorders

No flight data or cockpit voice recorders were installed in this aircraft nor were they required.

1.12 Aircraft Wreckage

1.12.1 Structures

The wreckage was distributed in a residential area on NW 30th Street between NW 32nd and NW 31st Avenues. The wreckage was confined to an area about 530 feet long and 60 feet wide. (See Appendix D.) Gouge marks showed that the left wing and the left horizontal stabilizer struck the ground simultaneously; they were consistent with a left wing-down attitude of about 40° and a fuselage attitude of about 25° noseup.

There was no evidence of in-flight structural failure, fire, or explosion.

All structural separation resulted from the impact; there was no evidence of in-flight malfunction or failure of the primary structure or of any of the flight control surfaces or systems.

The forward fuselage between FS-122 and FS-481 was separated from the aft main fuselage section. This section included the captain's, first officer's and flight engineer's seats. All of the seats were attached to the floor structure. The captain's and first officer's seats were twisted to the left and in a forward direction. This entire fuselage section was not damaged by fire.

Each of the four engines had separated from its attaching structure. The left and right wings had separated from the fuselage; both were partially consumed by the ground fire. The left main landing gear had separated from its wing attaching structure, and the right main gear was retracted and attached to the remaining portion of the right wing. Some cargo was still inside this section of the fuselage, and no cargo tie-down ropes, nets, or webbing were found.

One flap panel from the right wing was recovered. The flap panel was still attached to the wing-to-fuselage filet area. The panel was wrinkled and had been damaged by heat; the flap was partially extended. The distance between the forward panel of the flap roller slide and centerline of the flap roller bolt was 33.25 in. This measurement was set on a similar model aircraft; the setting corresponded to a takeoff position of 60-percent flap extension.

1.12.2 Systems

The windshield area was removed during rescue operations; therefore, controls, switches, and some instrument readings may have been altered.

The damaged elevator flight control boost unit was in the manual position, but the cockpit lever was in the boost "on" position. The elevator flight control boost unit is operated by cables which had failed as the result of tension overloads. The unit was examined extensively on and off the aircraft. There was no evidence of a preimpact failure or malfunction.

The hydraulic cross-over valve control switch was in the normal position. Hydraulic pressure for both primary and secondary systems was indicated by gauge readings. The bulb for primary hydraulic pressure warning contained a stretched filament.

The rudder boost was located in the tail wreckage. It was mounted in position and cables and hydraulic lines were attached. There were no apparent leaks in the hydraulic lines or fittings.

The engine start switch was found in the No. 2 engine position and the propeller reversing light bulb filament for the No. 2 propeller was stretched.

There was no evidence of a Pitot-static system failure or malfunction. The pitot tube at the lower right side of the fuselage was undamaged, and the inlet was clear.

1.12.3 Powerplants

The remains of the *4* engine assemblies shared no evidence of inflight fire. Disassembly and inspection of the examinable accessories and components of the four engines disclosed no preexisting discrepancies. Examination of the four engines showed that: **(1)** The removed spark plugs were in normal condition and evidenced minimal wear; (2) the walls of the removed cylinders throughout the area of piston travel were comparatively smooth; **(3)** the exposed pistons did not bear any indications of distress or markings suggestive of engine overspeed; *(4)* the intake and exhaust valves and valve seats were in good condition with no indications of burning or pitting noted. Borescope examination of the remaining intact cylinders confirmed similar observations.

Cylinder removal also demonstrated that: **(1)** The internal articulating components of the parer section were intact and were not damaged; **(2)** the piston rings moved freely within their respective grooves, except where the individual pistons were heat damaged.

Examination of the supercharger sections of the four engines revealed that: **(1)** The power recovery turbine crank-shaft drive gear coupling for the Nos. 1, 2, and *4* engines was broken in a typical torsion mode at the drive splines, while the No. 3 engine drive gear coupling was intact; *(2)* the power recovery turbines did not indicate any preexisting

distress; and (3) the internal operating components of the No. 2 and No. 3 engines' supercharger were intact, and the impeller clutches functioned normally.

The leading edges of most of the blades of each propeller exhibited rotational gouge and scrape marks at random locations. Most of the blade-bending pattern was in a forward direction. Impact markings shaved that the propeller blades were symnetrically positioned on the low pitch stop (14°) on impact. The racks located within the electric head of the Nos. 1, 3, and 4 engines constant speed control assemblies (propeller governor) were in the takeoff position. The rack position of the No. 2 engine constant speed control assembly could not be determined because of separation of the gear and pinion assembly. No mechanical discrepancies or indications of contamination were found within these assemblies.

The low pitch stop assembly of the No. 2 propeller was functionally tested. At an applied pressure of 800 psi, the piston did not move. Normally, the piston moves at 290 psi. Leakage of the assembly was 5 oz/min, whereas maximum allowable leakage is 2 oz/min. It was found that an "0" ring (Manufacturer's Part No. 79413) was worn completely away at one location with the remainder of the "0" ring uniformly worn to a threadlike size.

1.13 Medical and Pathological Information

Post-mortem examination of the six persons who were killed on the ground revealed that they died of severe burns and smoke inhalation. Four of these victims were pronounced dead at the scene, another died the following morning, and the sixth victim died 3 days after the accident.

Post-mortem examinations of the crewmembers revealed that they died instantly because of severe impact trauma. No evidence of an incapacitating disease was found during the examination. However, during the investigation of their medical backgrounds, it was discovered that the flight engineer had a history of alcoholism. He had been a resident of various rehabilitation centers, including one where he was medically diagnosed as a "severe chronic alcoholic" and as having "alcohol epilepsy." He had a history of convulsions beginning in 1966. This information was not made known to the FAA Aviation Medical Examiners (AME's) when the applicant applied for his medical certificate.

The flight engineer's November 16, 1973, First-class Medical Certificate was issued by an AME in Miami, Florida, who had previously issued him Second-class Medical Certificates on November 9, 1970, and on January 22, 1973. Between these dates, the flight engineer attempted to renew his medical certificate in The Netherlands on December 3, 1971.

According to the AME in The Netherlands, who mote a letter to the FAA Aeromedical Certification Branch, at Oklahoma City, Oklahoma, the

flight engineer's hearing and vision were inadequate. Additionally, the AME wrote that the flight engineer was not mentally fit, or was ". . . under the influence of drugs or alcohol." He marked him abnormal in the psychiatric block of the examination form. He then gave the flight engineer a letter of denial because he could not issue the Second-Class Medical Certificate for which the flight engineer had applied.

The AME said that he had presigned the medical certificate before denial and that later he found that the certificate, the letter of denial, and the AME file copy of the application had disappeared.

The completed Second-class Medical Certificate, dated December 3, 1971, was found among the flight engineer's belongings.

The FAA replied to the doctor in The Netherlands on January 10, 1972, and stated that the computer had been "flagged" for subsequent applications submitted by the flight engineer. However, there was no further correspondence relative to this matter in the flight engineer's file.

Toxiaological studies performed on the crewmembers revealed the following levels of carboxyhemoglobin (COW): Captain's chest blood-23 percent carboxyhemoglobin (COHb), femoral vein blood-21 percent, first officer's heart blood-slight trace, flight engineer's heart blood-trace. The captain, reportedly, was a heavy cigarette smoker. He had also been around operating aircraft all day.

Reference to medical publications indicates that a 21 to 23 percent level of COHb in the blood could adversely affect a person's vision, coordination, and central nervous system functions, including judgment. Additionally, the flight engineer's blood contained .58 mg. percent of meprobamate, a tranquilizing drug. The Physicians' Desk Reference to Pharmaceutical Specialties and Biologicals mentions, in part, the following regarding meprobamate: ". . . 0.5-2.0 mg. percent represents the usual blood level range of meprobamate after therapeutic doses." FAA publication AC 91.11-1, "Guide to Drug Hazards in Aviation Medicine," indicates that meprobamate may have the following undesirable effects in aviation: "Tremulousness, muscular relaxation, sleepiness, nausea, depression, allergic reactions, leukopenia, thrombocytophenia, intolerance to alcohol, withdrawal symptoms."

1.14 Fire

At 2355, the Miami tower notified the airport fire watch officer that an aircraft was down about 1 mile east of runway 9L. At 2356, the City of Miami Fire Department received a call that an aircraft had crashed and was on fire. Firefighting equipment arrived on the scene at 0001.

The rescue personnel used power saws and hydraulically operated "jaws" to gain access to the cockpit area so that the bodies of three crewmembers could be removed. According to rescue personnel, the three crewmembers were found in their seats with their seatbelts fastened.

1.15 Survival Aspects

This was a nonsurvivable accident.

1.16 Tests and Research

The Lockheed California Company prepared a performance study for the Safety Board using as a basic reference the FAA-approved Flight Manual and Lockheed aerodynamic data. The calculations were based on a gross weight of 134,520 pounds, a takeoff roll of 4,800 feet, wing flaps in the takeoff position, and the existing atmospheric conditions. In addition, Lockheed assumed an angle of attack of 11°, the angle at which stall buffet would start. The Lockheed study states, in part:

> "For the assumed weight, the 1049H Flight Manual gives a takeoff safety speed V_2 equal to 121 KCAS, and a minimum control speed with one engine inoperative (propeller windmilling) equal to 91 KCAS. The calculated flightpaths assume takeoff at V_2, accelerating to V_2+6 KCAS at 50 feet height above the runway, and climbout from 50 feet height at V_2+6 KCAS. For the assumed N6917C angle of attack of 11° an airspeed of 100 KCAS results. This 100 KCAS flight, on the back side of the power and thrust curve, results in about 35 percent less excess thrust available for climb than would have been available at the climb speed of V_2+6 KCAS."

According to Lockheed calculations, the 4,800-feet ground roll would have required only 9,800 brake horsepower (bhp). Theoretically, use of maximum takeoff power (13,384 bhp) would have resulted in a 2,200-foot ground roll.

Flight on the backside of the power curve refers to the regime of flight speeds below the speed for minimum required power setting. Any decrease in speed below this point results in an increase in the power required. Therefore, a higher power setting is required to maintain a lower airspeed, while holding altitude. The regime of flight on the backside of the power curve is also called the region of reversed command, to distinguish it from normal command (the front side of the power curve), where a decrease in airspeed results in a corresponding decrease in power required.

During the public hearing, a Lockheed representative stated that, "The aft center of gravity limit is reasonably close to the neutral point." He defined neutral stability as a c.g. location rearward of the allowable c.g. aft limit where "the motion of the aircraft would not react

significantly to a motion displacing the aircraft. If you went further behind there would be a tendency for the nose to continue down or to continue up, as the case might be." He also indicated that at an aft c.g. location of 37 to 38 percent MAC, "the aircraft would probably need more elevator control than is available under that situation."

The aircraft stalls at an angle of attack between 14° and 16°. Stall buffet may occur between angles of 9° and 13°.

Hamilton Standard was requested to provide estimated blade angles based on the ambient conditions prevailing at the time of the accident. These computations were based on the type of powerplants that were on N6917C. Estimated blade angles with the propeller operating at takeoff power and at the below listed airspeeds were:

AIRSPEED	BLADE ANGLE (degrees)
90	18.2
102	18.7
118	19.4

1.17 Other Information

The aircraft was owned by Aircraft Pool Leasing Corporation located in Miami, Florida. It was certificated and maintained under the provisions of 14 CFR 91, Subpart D.

Initial contract negotiations for the flight were conducted between the freight forwarding agent and the flightcrew, and between the forwarding agent and the aircraft owner. These agreements indicated that the forwarding agent was the operator. However, the lease between the forwarding agent and the owner was rejected by representatives of the forwarding agent, andawaiver was drawn up and signed by a representative of the aircraft owner. This waiver indicated that the aircraft owner was the operator.

In view of the questions surrounding the validity of these contracts, and the potential safety implications, the Safety Board made recommendations to the Administrator. (Appendix E)

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The'aircraft was certificated and maintained according to FAA regulations; however, the following maintenance discrepancies had not been corrected: The landing gear safety solenoid, the throttle friction

locks, and the leaking low-pitch stop assembly of the No. 2 propeller. All applicable airworthiness directives had been complied with.

There was no evidence of an in-flight fire or explosion, structural failure, flight control malfunction, or systems failure. Although the elevator boost unit was in the manual or boost "off" position in the wreckage, the position was consistent with the impact damage it sustained. In addition, the boost lever in the cockpit was in the "on" position.

The primary hydraulic system's low-pressure warning light had a stretched filament, which suggests that it was illuminated at impact. It was probably triggered when the left wing struck the first building and destroyed the primary system engine pumps and lines. Hydraulic pressure gaugesreflectedthat there had been system pressure before impact. Since the landing gear was retracted after lift-off, the secondary system was operable. Since it automatically backs up the primary, if the primary system had failed, the functioning secondary system would have powered the controls. Thus, the elevator control boost unit did not malfunction because of hydraulic power loss. In addition, teardown and testing revealed there was no evidence of a preimpact malfunction nor did maintenance records indicate a history of elevator control problems. On the basis of these findings, hydraulic system failures were discounted as a causal factor.

Examination and testing of the engines, propellers, and their pertinent accessories and components showed that they were operating normally at impact. The blades of the four propellers were found on the low pitch stop, There are three possible explanations for this finding: (1) Extremely low airspeed at impact; (2) the engines were not operating and the propellers were windmilling on the low pitch stop; (3) the engines were operating with the engine power levers pulled back to the "Idle" position.

Based on witnesses' observations, the damage pattern of the propellers, and the symmetrical blade angles at impact, the power levers must have been retarded just before impact. This is further substantiated by the fact that even at low airspeeds, the propeller blade angles should be at 18°, or higher, at takeoff power settings.

The leak found in the low-pitch stop assembly of the No. 2 propeller indicates that this propeller could not have been placed into the reverse position. Since the stretched filament of the associated reversing light bulb suggests that this light was illuminated, the light was probably triggered during the impact sequence.

Since there is no physical evidence of engine problems, the variations in engine sounds are attributed to power management procedures or

creeping throttles. Therefore, the mechanical condition of the engines and propellers was not related to the direct cause of the accident.

The consensus of the witnesses' statements was that the aircraft rotated abruptly to an unusually high pitch attitude and that the short duration level flight after takeoff was essentially flown in a similar attitude and at a slow speed.

Performance data indicate that with the aircraft flying in the incipient portion of reverse command, there would have been no difficulty in climbing. Instead, N6917C ceased to climb after it reached an altitude of about 120 feet. Therefore, the observed attitude of the airplane and its performance during its short flight lead directly to the conclusion that it was flying deeply in the area of reversed command and near the stall regime. In this area, drag at relatively low speeds is significantly higher than drag at higher speeds during normal takeoff. As a result, a point may be reached at which power available is less than the power required to overcome the drag and maintain level flight. To fly out of this area, drag must be reduced by changing pitch attitude, power must be added, altitude must be sacrificed, or a combination of these corrections must occur. Under some conditions, these corrections cannot be made, or are not practical, and a descent or a stall may be imminent. Such is believed to have occurred in the case of N6917C.

The Safety Board was unable to determine the reason or reasons for the aircraft's entering this adverse flight condition. However, the inquiry disclosed several areas, any one or any combination of which would have led to this situation. Those which appear to be most pertinent are:

1. Improper loading or cargo shift, or both.

2. Deficient crew coordination.

1. Improper Cargo Loading and/or Cargo Shift

The possibility that the cargo may have been improperly loaded and, consequently, shifted, thereby causing the aircraft to initally assume and maintain a critical attitude behind the power curve was investigated in detail. Considerable credence was given to the estimated gross weight based on the captain's V_1 and V_2 calculations. This gross weight -- between 130,000 and 132,500 pounds -- falls midway between the gross weights calculated based on average cargo bundle weights of 42 and 51 pounds. Therefore, the performance data that were based on a gross weight of 134,524 pounds provide a reasonable basis for a discussion of the c.g. aspects.

Most of the evidence concerning the aircraft's loading was inconclusive, and in some cases, contradictory. Although the performance data

were based on a uniform distribution of the tree bundles, it is more likely that the density of the load increased toward the rear of the aircraft, when it became apparent that closer stacking of the bundles was needed to accommodate all of them. Therefore, the actual c.g. may have been aft of the calculated c.g. of 29.7 percent MAC, which was based on a uniform distribution of 51-pound bundles. Possibly, N6917C was misloaded to the degree that its c.g. was at or beyond the aft c.g. before taxiing out. This fact alone would help explain the abrupt, nose-high rotation.

Although it could not be determined to what extent the load may have shifted during the takeoff acceleration, the witness' statement which indicated that a small area near the aft cargo door was left unloaded, suggests that there was at least some room for a cargo shift. Therefore, the Safety Board concludes that accelerative forces, in combination with a vibrating metal floor, could only have had an aggravating effect on the c.g. location of the compressible and unsecured cargo. Even if the c.g. was 29.7 percent MAC, an average cargo shift of only 16 inches would be needed to reach the gear-down aft c.g. limit of 32 percent MAC. A 60-inch shift would be needed to reach an aft c.g. of 38 percent MAC where flight would be extremely critical since there would not be sufficient elevator control available. Between the latter c.g. and the aft c.g. limit lies the neutral point, a c.g. position where the airplane would exhibit neutral static stability.

Based on the observed performance of the aircraft and the circumstances surrounding the loading of the cargo, the Safety Board believes that a critical aft c.g. may have contributed to the accident.

2. ~~Deficient Crew~~ Coordination

Deficient crew coordination pertains to the flight management of the aircraft as related to the overall control of the flight by the captain, the manipulation of the various flight and powerplant controls, and the combination of both of these with the possible actions of one or more partially incapacitated or unqualified crewmembers.

Possibly, the flaps were retracted prematurely, causing the aircraft to rotate to a high angle of attack to compensate for the lift which was lost by the retracting flaps. The factor that rules against in-flight flap retraction was the observation that a steeper-than-normal attitude started at ground level rather than at some point in flight.

If the takeoff was started with the flaps retracted, a 4,800-foot ground roll at normal takeoff power could have accelerated the aircraft to a velocity high enough to compensate for lift loss by a no-flap configuration. When airborne without the added drag of flaps, a well-balanced aircraft could have accelerated easily in a normal climbout. These factors rule out a no-flap takeoff. Further, the flaps were found in the takeoff position.

Loss of power because of throttle mismanagement is also a possible contributing factor. Unintentional reduction of power to the extent that flight could not be maintained could have resulted from incapacitation of the flight engineer. Power reduction could also occur subtly if the crewmembers failed to monitor the throttle friction lock.

A factor that could have caused the crewmembers' attention to be misdirected was the necessity to override the landing gear safety solenoid manually in order to retract the gear. This operation required *two* hands, since the gear handle is on the aft, lower part of the center pedestal, and the solenoid is recessed inside a hole on the lower right side of the center pedestal. An inexperienced and unqualified first officer might have needed assistance to retract the gear.

Witnesses reported that the landing gear was raised late in the takeoff and the landing gear was found in the full "up" position in the wreckage. The flight engineer would have had difficulty reaching either the gear handle or the solenoid. Therefore, the captain or the first officer could have been occupied raising the landing gear during the critical initial portion of the flight. This fact, coupled with the loose throttle friction, may have set the stage for the throttles to creep back during the takeoff.

In each of the preceding situations, the captain's unexplainable high COHb level, the physiological condition of the flight engineer, and the inexperience of the first officer may have complicated events at a critical time and, therefore, contributed to the accident.

2.2 Conclusions

a. Findings

1. The aircraft was certificated and maintained in accordance with 14 CFR 91; however, there were some discrepancies that had not been corrected.

2. There was no evidence of preimpact structural or flight control failure, fire, or powerplant failure.

3. The captain and the first officer were certificated properly; however, only the captain was qualified for the flight.

4. The first officer did not meet the requirements of 14 CFR 91.213.

5. The flight engineer lacked recency of experience as required by 14 CFR 91.211 and was not medically qualified for the flight.

6. The captain's blood contained sufficient COHb to have adversely influenced his vision, coordination, and judgment.

7. The flight engineer's blood contained sufficient meprobamate to have caused detrimental effects on his performance.

8. The landing gear safety solenoid had to be depressed manually in order to raise the gear handle, and the throttle friction lock on the pilot's quadrant and at the flight engineer's station would not secure the throttles adequately.

9. The wing flaps were in the takeoff position at the time of the crash.

10. The gross weight of the airplane was below the maximum allowable weight of 142,100 pounds.

11. Cargo restraining devices were not used.

12. Based on available aircraft loading information, the center of gravity could have been at or aft of the aft limit when loading was completed.

13. There was no evidence that the cargo was so tightly packed that it could not shift.

14. The aircraft exhibited critical stability characteristics, as evidenced by the abrupt rotation at lift-off.

15. The aircraft was rotated and flown in the area of reverse command, near the stall regime.

b. Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was overrotation of the aircraft at lift-off. resulting in flight in the aerodynamic region of reversed command, near the stall regime, and at too low an altitude to effect recovery. The reason for the aircraft's entering this adverse flight condition could not be determined. Factors which may have contributed to the accident included: (a) Improper cargo loading, (b) a rearward movement of unsecured cargo resulting in a center of gravity shift aft of the allowable limit, and (c) deficient crew coordination.

3. RECOMMENDATIONS

As a result of the accident, the Safety Board on September 11, 1974, issued Safety Recommendations A-74-62 through A-74-64 to the Administrator, FAA. On October 2, 1974, the Safety Board issued to the Administrator, FAA, an additional recommendation, A-74-84. Copies of these recommendations are included in Appendix E.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JOHN H. REED
Chairman

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

/s/ WILLIAM R. HALEY
Member

FRANCIS H. McADAMS, Member, did not participate in the adoption of this report.

September 11, 1974

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The Board was notified of the accident at 0017 on December 16, 1973, and an investigation team went immediately to the scene. Working groups were established for operations, weather, air traffic control, witnesses, structures, systems, powerplants, human factors, and maintenance records.

Parties to the investigation included the Federal Aviation Administration, the Lockheed California Company, and the Dade County Aviation Department. A representative of Aircraft Pool Leasing Corporation later joined the powerplants group.

2. Public Hearing

A public hearing was held at the Everglades Hotel, Miami, Florida, February 5 through February 7, 1974. Parties to the hearing were: the Federal Aviation Administration, Dade County Aviation Department, Aircraft Pool Leasing Corporation, and Paulssen and Guice, Ltd.

APPENDIX B

CREW INFORMATION

Captain William C. Fox

Captain William C. Fox, 48, held FAA Transport Pilot Certificate No. 1055729, airplane multiengine land, commercial privileges airplane single engine land, Douglas DC-3/4, Convair 240/340/440, and Lockheed Constellation. Mr. Fox also held an instrument and flight instructor certificate that was issued on December 4, 1970, and superseded an airman certificate issued July 1967. The latest rating expired December 31, 1972. His first-class medical certificate was issued on November November 16, 1973. The certificate noted that the holder shall wear correcting glasses while exercising the privileges of his airman's certificate. (A pair of half-frame glasses with corrective lenses was found in the left section of the pilot compartment, and another pair of corrective lens glasses was found in the captain's flight kit.)

His logbook shaved 11,550 flight-hours, including 7,355 hours as pilot-in-command. His total flying time in Lockheed Co'nstellation type aircraft was 1,087.9 hours.

Captain Fox was a freelance pilot. His actual rest period before the flight could not be determined. He arrived at the airport at about 0700 on the day of the accident, and most of his time during the morning and afternoon was spent waiting for the aircraft to be loaded and prepared for flight.

First Officer Jeffrey H. Flanders

First Officer Jeffrey H. Flanders, 30, held Commercial Pilot Certificate No. 1734038 with ratings for airplane single and multiengine land and sea and instruments. He also held a flight instructor certificate with ratings for airplanes and instruments. His first-class medical certificate, with no limitations, was issued January 24, 1973.

His estimated total flying time was 2,500 hours, including 1,050 hours of flight instruction time and 650 hours of seaplane flying. Mr. Flanders was a freelance pilot.

There was no record that he had Lockheed Constellation experience before the accident. An air carrier employment application, dated January 16, 1973, revealed that Mr. Flanders had listed 5 hours of "Prop Four Engine Total Flight Time," flown in a Sikorsky SV44A. Following the accident, a friend of Mr. Flanders said that Mr. Flanders and Captain Fox had spent some time in the aircraft (N6917C) for familiarization on the night before the accident.

Mr. Flanders reportedly departed his residence on December 15, 1973, at approximately 0700.

Flight Engineer Arthur A. Kimball

Flight Engineer Arthur A. Kimball, 59, held Flight Engineer Certificate No. 1139732 with ratings for reciprocating engine aircraft. The certificate was issued February 24, 1969. Mr. Kimball's flight logbook showed that this certificate was a renewal and that the original license had been issued in 1949. He held a first-class medical certificate with the limitation that the holaer shall wear correcting glasses while exercising the privileges of his airman's certificate. The last entry in his logbook was made on February 26, 1973; however, the flight times had not been totaled since March 1966. At that time his total flight time was 6,044 hours.

Mr. Kimball's flight log summary started in 1954 and recorded flight time each year to 1961. There was no record for the years 1962 and 1963. The summary was not completed beyond June 1966, although title headings were entered for the years 1967 and 1969. There were no entries from October 27, 1966, to August 2, 1967, and from December 24, 1970, to December 14, 1972. Flights recorded in Lockheed Constellation aircraft were made on December 9, 10, and 11, 1969, and totaled 11 hours, 55 minutes. The memoranda section of the flight logbook recorded a Lockheed Constellation flight to South America on September 3, 1970, for a total trip time of 71 hours 30 minutes.

He arrived at the airport at about 0700 on the day of the accident.

APPENDIX C

AIRCRAFT INFORMATION

Aircraft N6917C, a Lockheed Super Constellation L1049H, Serial No. 4815, was manufactured by Lockheed Corporation, Burbank, California, in 1957, under FAA Aircraft Specification 6A5. A Certificate of Airworthiness Form ACA-136a, was issued by the FAA on April 8, 1957, to Lockheed Aircraft Corporation, the registered Owner.

On April 11, 1957, a Standard Certificate of Airworthiness, Form ACA-1362, was issued by the FAA LA-223/32, to Flying Tiger Line, Inc.

In September 1967, the aircraft was placed in storage in Kingman, Arizona, where it remained until February 10, 1970.

On January 26, 1970, Mr F. George Areces, President, Trademark Leasors, Inc., San Juan, Puerto Rico, submitted an application for the registration of N6917C.

On June 30, 1970, the FAA Aircraft Registration Eligibility, Identification, and Activity Report indicated that the aircraft was owned by North Slope Supply Company, Inc.

On September 10, 1970, a weight and balance certification was accomplished on the aircraft for Aerofletes Internacionales, S.A. "AFISA". The registration at that time was for HP 526 which is a Republic of Panama registration and is the first indication of a registration change from U. S. registry.

In July 1971, Trademark Leasors, Inc., Rio Piedras, Puerto Rico, Mailing Address-Aerofletes Internacionales, Aptdo 6270, Zona 5, submitted an Application for Certificate of Airworthiness to the Government of Panama for HP 526. The application was approved by the Republic of Panama on July 18, 1971. Aircraft HP-526 (N6917C) remained under the Panamanian registry until the owner, Mr F. George Areces, sold the aircraft to Aircraft Pool Leasing Corporation, P. 0. Box 176, MIAD, Miami, Florida 33148, on July 6, 1973. The conveyance was filed with the FAA Aircraft Registry on July 12, 1973, and was recorded on July 30, 1973,.

The last major inspection was a combined annual and 100-hour recertification which was performed on August 16, 1973, at Aeroborne Enterprises, Inc., Opa Locka, Florida. The inspection was performed in accordance with 14 CFR 91, Subpart D.

At the time of the inspection, the aircraft had accumulated 28,905 hours, of which 3,800:15 hours were flown since overhaul. During this inspection, the altimeter and static system checks were accomplished as required by 14 CFR 91.170.