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File 1-0016

AIRCRAFT ACCIDENT REPORT

Adopted: February 26, 1968

AIRLIFT INTERNATIONAL, INC.

DOUGLAS DC-7C, N2282

TACHIKAWA AIR BASE, TOKYO, JAPAN

SEPTEMBER 12, 1966

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

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SYNOPSIS

On September 12, 1966, at approximately 2201 (Japan local time), Airlift International, Inc., Material Airlift Command Freight Flight 184/12, a Douglas DC-7C, N2282, initiated takeoff from Runway 01 at Tachikawa Air Base, Japan. The flight was carrying 27,484 pounds of cargo and was bound for Wake Island. The takeoff was aborted following unsuccessful attempts to rotate the aircraft. However, efforts to stop the aircraft were unsuccessful and it overran the runway, went through a perimeter fence, and came to rest in a field approximately 700 feet north of the airport.

Two of the four crewmembers were injured. The aircraft was damaged substantially by impact and was partially destroyed by subsequent fire.

The Board determines that the probable cause of this accident was improper cargo loading which resulted in the inability of the aircraft to be rotated for takeoff under existing conditions.

1. INVESTIGATION

1.1 History of the Flight

On September 12, 1966, Airlift International, Inc., Douglas DC-7C, N2282, was scheduled to operate as Military Airlift Command Freight Flight 184/12 from Tachikawa Air Base, Tokyo, Japan, nonstop to Wake Island. Departure was scheduled for 2000. 1/

The aircraft was loaded with 27,484 pounds of cargo during the afternoon under the supervision of the United States Air Force (USAF) Military Ramp Service. 2/ An aircraft weight and balance form was computed by a dispatching agent for the carrier which showed the aircraft weight and load distribution to be within allowable takeoff limitations. In preparation for the flight the captain reviewed weight and balance and other dispatching documentation and the crew inspected the appearance of the cargo load and tiedowns. No unusual conditions were noted.

At approximately 2145 the flight was cleared to taxi for takeoff on Runway 01. After receiving an Instrument Flight Rules clearance to Wake Island, the flight reported to the tower that they were ready for takeoff and requested the use of the paved runway overrun area. This request was approved by the tower and at 2201 the aircraft commenced its takeoff run. At approximately 2202, the aircraft, failing to become airborne ran beyond the runway, through the airport perimeter fence and into a

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1/ All times herein are local Japan time based on the 24-hour clock.

2/ Procedures and documentation relating to cargo loading and the weight and balance of the aircraft will be found in Section 1.6A, Loading Information.

cultivated field. The landing gear failed and the aircraft slid to a stop about 1,700 feet from the end of Runway 01. Fire broke out during the latter portion of the crash sequence.

Statements were obtained from the crew regarding the takeoff roll and subsequent accident. It was stated that during the takeoff roll, aircraft performance and acceleration were normal up to the point where V_2 speed (121 knots IAS) was obtained. Full back pressure on the elevator control yoke at this point failed to rotate the aircraft. Aircraft acceleration continued to 128 knots IAS and when full back pressure on the control column still failed to effect rotation, the captain alerted the crew that they were, ". . . not going to make it." He then retarded the throttles fully and applied maximum braking. The captain stated that he started to apply propeller reversing, but discontinued this action when he saw that the aircraft was rapidly approching the perimeter fence.

Witnesses who observed the aircraft during the takeoff roll reported no abnormal conditions until the aircraft failed to become airborne and crashed through the perimeter fence. About the same time the tower controllers observed a ball of fire off the north end of Runway 01 and activated the crash circuits.

The accident occurred during the hours of darkness.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others
Fatal	0	0	0
Nonfatal	2	0	0
None	2	0	

1.3 Damage to Aircraft

The aircraft was damaged by the impact sequence after the landing gear failed and was partially destroyed by subsequent fire.

1.4 Other Damage

Cargo aboard the aircraft was damaged by fire. However, except for the small portion of the cargo in compartment "N" which was destroyed, all other cargo remained identifiable by weight and location. The perimeter fence at the north end of Runway 01 was destroyed as were various garden crops in fields along the aircraft ground swath.

1.5 Crew Information

The crewmembers were properly certificated and qualified for the flight. For detailed information in this regard see Appendix A.

1.6 Aircraft Information

The aircraft was properly certificated and had been maintained in accordance with FAA requirements. For detailed aircraft information see Appendix A.

1.6A Aircraft Loading Information

At the accident scene cargo was identified as to its location aboard the aircraft. This cargo was then removed to a hangar where it was weighed and placed in a manner duplicating its position within the fuselage. The small amount of cargo that was in compartment "N" and destroyed by fire was identified by process of elimination from the recovered cargo, and its weight then determined from the cargo manifest. From this information the actual weight and balance of the aircraft at takeoff was recomputed.

It was determined that the aircraft takeoff gross weight was 136,309 pounds (maximum allowable takeoff gross weight was 140,435 pounds) which included 27,484 pounds of cargo and 32,140 pounds of 115/145 aviation fuel. The center of gravity (c.g.) based on these weights and locations was found to be 15.2 percent Mean Aerodynamic Chord (MAC). The acceptable takeoff c.g. limits were 18.8 percent MAC to 32.5 percent MAC.

The weight and balance data given to the crew by the dispatching agent showed the c.g. to be 22.3 percent MAC.

Because of these differences the method of loading cargo and the weight and balance computation procedures utilized by the Military Airlift Command and Airlift International [3/] at Tachikawa Air Base were examined in detail.

Provisions of the appropriate Military Air Transport Service (MATS) contract with commercial air carriers relating to aircraft loading responsibilities are as follows:

> "The contractor shall be responsible for the safe loading of his aircraft (passenger or cargo flights) in accordance with applicable Civil Air Regulations. In the event cargo flights are loaded by Government personnel, the contractor's representative or a crewmember will be responsible for providing the MATS traffic representative at the originating station with a MATS Form 55 (or the contractor's equivalent form) showing the

3/ Slick Airways, Inc., a subsidiary of Airlift International, was the designated dispatching agent for Airlift International at Tachikawa Air Base.

planned load breakdown, six hours (four hours for cargo aircraft carrying palletized loads) in advance of trip departure. The Government loading supervisor will annotate the form to show the actual load placed aboard the aircraft by compartment and total weight. The contractor's representative or crewmember shall be responsible for proper weight and balance load planning, shall make a visual check of the load after loading is completed and indicate approval of loading by signing the MATS Form 55 or equivalent form. The Government shall be responsible for the accuracy entered on the form by the loading supervisor."

In accordance with this contract and other pertinent considerations the following loading flow pattern procedures were utilized:

Step One

The agent for the carrier submits a cargo load request in triplicate on either a Military Air Traffic Service (MATS) Form 55 or an Airlift International standard weight and balance form, to Military Cargo Traffic Control. This request stipulates the desired total cargo load and further indicates the maximum load per station or compartment.

Step Two

Military Cargo Traffic Control signs the request, returns one copy to the agent, retains one copy in their files, and forwards one copy to Military Ramp Service.

Step Three

Military Ramp Service forwards the load request to the Military Freight Warehouse where the cargo is prepared for the airlift. The load request form is retained by the warehouse and the cargo is forwarded to the loading ramp. Attached to each piece of cargo is a tag that identifies the item and gives its weight.

Step Four

Military Ramp Service receives the cargo from the warehouse and loads the aircraft. The loading is performed by civilians under the direction of a Military Ramp Service load master. The load master is subordinate to a Ramp Service loading supervisor who oversees the overall activities relative to the loading of civil aircraft.

At this point a new MATS Form 55 is prepared by the load master showing the actual cargo weights placed in each aircraft compartment as well as the total cargo weight placed aboard the aircraft. This form is then submitted to Military Cargo Traffic Control.

Step Five

The agent for the carrier obtains a copy of the new MATS Form 55 from Military Cargo Traffic Control.

Step Six

The agent for the carrier prepares a weight and balance form utilizing the cargo weights shown on the new MATS Form 55.

Step Seven

The flight crew examines the completed weight and balance form to insure that the data relating to the aircraft gross weight and computed c.g. are within proper limitations. The weight and balance form is then placed with other pertinent trip papers.

In this case, preparation of the desired load request and the aircraft weight and balance form was carried out by a civilian agent for the carrier. That agent stated that he utilized the weights listed on the MATS Form 55 received from Military Cargo Traffic Control to compute the weight and balance and that the resultant c.g. was almost, "center." However, his copy of this form could not be located during the investigation. The agent stated that it most likely had been thrown away with other scratch papers with which he had been working.

The MATS Form 55 on file with the Military Cargo Traffic Control showed that the cargo weights listed by compartments on this form did not coincide with the weights which the agent stated that he received and subsequently utilized in preparing the weight and balance form. A recomputed c.g. using the figures found on the MATS Form 55 was determined to be 18.2 percent MAC which also was forward of the allowable limit (18.8 percent MAC). The three separate computations involved were as follows:

CARGO WEIGHTS BY AIRCRAFT COMPARTMENT

Compt.	Used by Agent For Flight's Weight & Balance	Listed on MATS Form 55 On File with Military Cargo Traffic Control	Determined by Investigation
A	3577	3577	4713
C	3590	3590	4726
E	2124	4700	3942
G	4989	4989	4232
H	3200	3200	2443
J	3180	3180	3180
L	4700	2124	2124
N	2124	2124	2124
Total Cabin Load	27,484 pounds	27,484 pounds	27,484 pounds
c.g. percent	22.3%	18.2%	15.2%

The loading of N2282 was done by local civilian cargo loaders working under the supervision of the military load master. The loaders were well experienced in the physical task of loading and unloading aircraft. The military load master who supervised the loading of N2282 was an airman with a total of seven months service and had not loaded a DC-7 type aircraft prior to the subject one and was not trained in the use of weight and balance forms or computers. While N2282 was being loaded, the Ramp Service Loading supervisor was personally engaged in loading two other aircraft and did not give specific attention to N2282.

1.7 Meteorological Information

The USAF surface weather observation for Tachikawa Air Base taken at 2203 was in part: ceiling 300 feet variable overcast, visibility 1-1/8 miles in haze, ground fog and smoke, temperature 73F., dewpoint 71F., wind 350 degrees 6 knots, altimeter setting 29.65 inches, ceiling 200 feet variable to 400 feet.

1.8 Aids to Navigation

Navigational aids were not involved in this accident.

1.9 Communications

Not applicable.

1.10 Aerodrome and Ground Facilities

Tachikawa Air Base is located about 22 miles northwest of Tokyo, Japan, and on the edge of the city of Tachikawa. Runway 1-19 is 5,021 feet long and 150 feet wide with paved overruns of 797.2 feet at the north end and 875.1 feet at the south end. N2282 started its takeoff roll from a position approximately 600 feet in the south overrun area.

Runway examination after the accident revealed black rubber tire marks from heavy braking commencing at a point 4,882 feet from the threshold of Runway 1 and extending almost continuously through the entire north overrun area.

1.11 Flight Recorders

The aircraft was not equipped with a flight data recorder or with a cockpit voice recorder and neither was required.

1.12 Wreckage

Investigation at the scene of the accident revealed that the aircraft came to a stop approximately 1,700 feet from the end of Runway 01. The nose gear and two main landing gears were separated from the aircraft during the impact sequence. Both tires from each main landing gear were blown and all four tires exhibited severe abrasion and scuffing around the ruptured areas. The fuselage and interior cabin was burned extensively aft of the wing with most of the damage occurring to the rear cabin section. The No. 3 engine separated from the wing on impact and came to rest under the right horizontal stabilizer.

Examination of all four powerplants revealed no evidence of any failure, malfunction, or operating distress prior to impact.

Flight control system examination revealed no evidence of pre-impact failure or distress. The control surface gust locks were found in the normal flight (unlocked) position. The gust locks disclosed no evidence of any abnormal binding or friction that would have restricted full flight control surface movement. The flaps and elevator trim tab were found positioned for takeoff.

Functional testing of the pitot static system and both the pilot's and copilot's airspeed indicators revealed no abnormalities or discrepancies that would have precluded accurate airspeed indications.

1.13 Fire

The aft fuselage and right wing were destroyed by post impact fire, which was started by the No. 3 engine when it came to rest under the empennage section.

1.14 Survival Aspects

There were no fatalities and only the navigator received serious injuries. The copilot and flight engineer left the aircraft through the copilot's side window exit. They then opened the cockpit door, and with the assistance of the captain inside the aircraft, extricated the navigator who was pinned in his compartment. The captain then followed the navigator out of the aircraft.

1.15 Tests and Research

The weight and balance computations were checked with Douglas Aircraft Corporation (DAC) who confirmed the method and accuracy of the computations.

Although DAC had no actual flight test data relative to aircraft rotation under the conditions found in the investigation (c.g. 15.2 percent MAC), it was their opinion that with takeoff trim set properly, the aircraft should have been able to rotate at V_2 speed with a stick force approximately 15 pounds higher than normal. However, it was emphasized by DAC that the opinion expressed was based on extrapolations of performance data from the DC-6 aircraft and that actual flight test data for the DC-7C relating to rotational capabilities under these conditions were not available.

To examine further all of the ramifications concerned with rotation capabilities of the DC-7C under the weight and c.g. conditions presented in this accident, expert opinion was obtained from an FAA test pilot familiar with the flight characteristics of the DC-4, DC-6, and DC-7 aircraft. He reported, that based on his flight test experience, he was convinced that N2282 could not be rotated under the given conditions because of the ground

effect on the nose-down pitching moment. He further reported that the assumption that elevator power required for nosewheel lift-off varies linearly with the c.g. is not valid when an extreme forward (beyond limits) condition is encountered.

The Board also reviewed a similar incident [4/] where a DC-7C takeoff was aborted when the aircraft failed to respond to rotational control pressure at and above V_2 speed. It was noted in this case that the aircraft's takeoff gross weight was 118,482 pounds with the c.g. at 15 percent MAC. The forward c.g. limit for this aircraft was 17 percent MAC. Thus, the loading conditions found for N2282 were more critical than those found for the DC-7C involved in the Pan American incident in that the c.g. was 1.6 percent farther forward and the takeoff gross weight was approximately 18,000 pounds greater. Both of these factors would more adversely affect the aircraft's rotational capabilities.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The investigation of this accident disclosed no evidence of any failure or malfunction of the aircraft, its systems or components. The aircraft and crew were properly certificated.

It was determined that the weight and location of the cargo loaded aboard this aircraft resulted in a takeoff c.g. of 15.2 percent MAC; well forward of the appropriate c.g. limit of 18.8 percent MAC. While it was DAC's opinion that aircraft rotation may have been possible, other evidence

4/ Pan American World Airways, DC-7C, N5735PA, Dover Air Force Base, Delaware, July 18, 1961.

such as flight test experience and a similar DC-7C mishap where aircraft rotation could not be effected on takeoff because of improper loading is more forceful to the contrary. Therefore, the Board concludes that the crew was unable to rotate the aircraft because of the improper loading and resultant adverse c.g. condition.

The flight crew received a weight and balance form completed by the station agent showing both the takeoff gross weight and c.g. to be well within acceptable limits. Their preflight inspection of the aircraft, cargo, and cargo tiedowns revealed nothing unusual. Therefore, with a properly operating aircraft during takeoff, the crew would have passed the safe abort point (V_1 speed: 108 knots IAS) and would not have had the opportunity to discover the c.g. imbalance until aircraft rotation was attempted. When in fact this did occur and the takeoff was aborted, there was insufficient stop distance remaining on the runway even with the employment of maximum braking.

It is concluded that; (1) the aircraft was loaded improperly by the Military Ramp Service; (2) that incorrect cargo weights were entered on the MATS Form 55 by the load master; and (3) that inaccurate weight and balance information was used by the agent in computing the weight and balance form that was given to the crew.

A review of the procedures utilized and the degree of supervision exercised in loading this aircraft revealed deficiencies which directly led to the improper loading. The most obvious deficiency was the utilization of a load master who was neither experienced in the loading

requirements of DC-7 aircraft, nor familiar with general weight and balance techniques. It was shown that the copy of the load request, which lists a breakdown of the maximum load per compartment based on the total load requested, does not accompany the cargo from the warehouse to the ramp. Had this document been available to the load master during loading, at least a minimal amount of loading guidance would have been provided. The Ramp Service loading supervisor who normally oversees the loading of civil aircraft was engaged in other loading duties and therefore could not exercise any supervision or guidance over this operation. The end result was that the load master not only loaded N2282 improperly, but also prepared a MATS Form 55 that was totally inaccurate as compared to the actual cargo weight found aboard the aircraft. For example, the weight listed for compartments A, C, and E were 3,577, 3,590, and 4,700 pounds, respectively. The actual weights found in these forward compartments were 4,713, 4,726 and 3,942 pounds, respectively, or a total gross error of 3,430 pounds (see Page 9).

Further, a comparison of the weights listed on this MATS Form 55 and the cargo weights shown on the weight and balance form of the carrier, prepared by the agent, disclosed an interchange of weights between compartments E and L (see Page 9). The weights listed on the MATS Form 55 showed 4,700 pounds in compartment E and 2,124 pounds in compartment L. A computation of the weight and balance from this form and the weight listed thereon, results in a takeoff c.g. of 18.2 percent MAC which is beyond acceptable limits. The cargo weights used by the agent for the carrier as listed on the weight and balance form shows 2,124 pounds in compartment E and 4,700

pounds in compartment L and resulted in an acceptable takeoff c.g. computation of 22.3 percent MAC. Because the weights were obtained by the agent from the MATS Form 55 on file with Military Cargo Traffic Control, the Board can only assume that the interchange error occurred during his transposition of weights from the MATS Form 55 to the weight and balance form. If this error had not been made, a proper weight and balance computation by the agent would have revealed the c.g. of 18.2 percent MAC which is slightly out of limits. Had this happened, it is most probable that the agent would have initiated corrective action and possibly the aircraft misloading would have been detected.

It is concluded that the pilot properly accepted the weight and balance form as a factual representation of the load distribution aboard the aircraft and that the misloading situation would not have been apparent to the crew during the preflight inspection.

2.2 Conclusions

(a) Findings

1. The flight crew was properly certificated and qualified for the operation involved.
2. Weather was not a factor in this accident.
3. The aircraft was currently certificated and airworthy.
4. The aircraft cargo was loaded improperly by the military group charged with that responsibility.
5. The MATS Form 55 did not accurately list the cargo weights as loaded on the aircraft.

6. The agent for the carrier did not utilize the cargo weights as listed on the MATS Form 55 in computing the weight and balance form.

7. The weight and balance sheet presented to the flight crew was not a correct representation of the cargo distribution aboard the aircraft.

8. Computation of the aircraft's weight and balance, utilizing cargo weights and distribution determined during the investigation, disclosed that the takeoff c.g. was well forward of the allowable limit.

9. There was no evidence of any failure or malfunction of the aircraft, its systems or components that would have mechanically impaired its ability to rotate.

10. N2282 could not be rotated at the runway speed attained due to the forward c.g. position.

(b) Probable Cause

The Board determines that the probable cause of this accident was improper cargo loading which resulted in the inability of the aircraft to be rotated for takeoff under existing conditions.

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

APPENDIX A

Crew Information

Captain Clarence L. Pope, age 46, held airline transport pilot certificate No. 416728, with ratings in the C-46, AW-650, DC-6/7 aircraft, commercial privileges for single-engine land aircraft, and a flight instructor rating. Captain Pope had a total of 15,906 flight hours. He had 1,782 flight hours in DC-7C aircraft of which 496 hours were as pilot-in-command. His FAA first-class medical certificate was dated August 2, 1966, with no limitations. Captain Pope's last proficiency check in DC-7C aircraft was completed on February 23, 1966.

First Officer Wesley A. Diedrick, age 39, held commercial pilot certificate No. 1328955, with airplane single and multiengine land, instrument and flight instructor ratings. He had a total of 6,282 flight hours of which 760 hours were in the DC-7. First Officer Diedrick held an FAA first-class medical certificate dated March 22, 1966, with no limitations. His last proficiency check in DC-7C aircraft was completed on May 29, 1966.

Flight Engineer James A Huff, age 30, held flight engineer certificate No. 1690129 with reciprocating engine rating. He had a total of 221 flight hours, all in DC-7 aircraft. His last proficiency check in DC-7 aircraft was completed on May 29, 1966. Flight Engineer Huff held an FAA first-class medical certificate dated March 7, 1966, with no limitations.

Navigator David A. Steinberg, age 31, held flight navigator certificate No. 1676672. He had a total of 2,650 flight hours of which 405 hours were in DC-7 aircraft. Navigator Steinberg held an FAA second-class medical certificate dated February 16, 1966, with no limitations. His last proficiency check was completed on June 12, 1966.

All of the crewmembers received approximately 14 hours rest time prior to this flight.

Aircraft Information

N2282, a Douglas DC-7C, serial No. 45128, was manufactured in 1957 and at the time of the accident had accumulated a total of 16,054 flight hours with 3,184 flight hours since overhaul. The aircraft was configured as a cargo model and did not have provisions for passengers. Inspection of the maintenance records for N2282 disclosed that the aircraft and powerplants had been maintained in accordance with FAA and company requirements.

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