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C I V I L A E R O N A U T I C S B O A R D
ACCIDENT INVESTIGATION REPORT

Adopted: July 25, 1951 Released: August 3, 1951

THE FLYING TIGER LINE, INC. - DENVER, COLORADO, JULY 30, 1950

The Accident

A C-46F aircraft, N-67960, operated by The Flying Tiger Line, a cargo carrier, crashed immediately following take-off from Stapleton Air Field, Denver, Colorado, at 0330,[1/] July 30, 1950. No one was injured, but the aircraft was destroyed.

History of the Flight

The flight departed from Newark, New Jersey, at 1331, July 29, 1950. Stops were made at Cleveland, Ohio; Detroit, Michigan; Chicago, Illinois; and Des Moines, Iowa, for the purpose of loading and unloading cargo and for the routine servicing of the aircraft. It proceeded in a routine manner, arriving at Denver at 0224 without incident. At Denver, another crew was assigned, consisting of Captain Douglas K. Robins and Copilot Cleo Monte Treft.

Before the new crew departed, Denver cargo was unloaded, additional cargo was added for the remainder of the flight to Los Angeles, and the aircraft was serviced with fuel and oil. At 0322, the flight taxied from the loading ramp as Captain Robins received clearance from the control tower to proceed to the end of Runway 12 for take-off. On board, in addition to the crew of two, were two non-revenue passengers, 14,682 pounds

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1/ All times referred to herein are Mountain Standard and based on the 24-hour clock.

of cargo, 656 gallons of fuel, and 50 gallons of oil. Total aircraft weight was 48,268 pounds. This was 268 pounds more than the 48,000 pound maximum permitted for take-off.

There was a ceiling of broken clouds at 12,000 feet, visibility was 40 miles, the wind was from the south-southeast at five miles per hour, temperature was 59 degrees, and the altimeter setting was 29.96. The published elevation for Stapleton Air Field is 5,325 feet ASL; however the density altitude for Stapleton at that time is computed to have been 6,500 feet. Wind decreased to two miles per hour during the taxi out for takeoff; and in response to the flight's request, the tower approved Runway 17 for takeoff. This runway is 6,980 feet long.

The crew performed their "before takeoff check", found all components of the aircraft to operate normally, and then, at 0329, rolled onto the runway for takeoff. From the tower, the aircraft appeared to accelerate slowly and to take an excessively long period of time to become airborne. The pilots stated that the engines operated normally, developing 45-inch hg. of manifold pressure and 2700 RPM (revolutions per minute), but air speed increased slowly. Between 90 and 100 miles per hour, and just before the end of the runway was reached, the aircraft was pulled off the runway by Captain Robins as he applied back pressure on the control column.

After take-off, the highest air speed attained was between 100 and 105 miles per hour. The landing gear control was placed in the "up" position when the flight became airborne, and a climb was made to about 100 feet. During the climb, the aircraft shuddered severely. Altitude was lost, and the aircraft struck an obstruction light on the top of a 40-foot electric light pole which was 1,910 feet south of the end of the runway. The

aircraft struck three more poles, then touched ground and skidded for 350 feet. It came to a full stop 2,791 feet from the south end, and in line with Runway 17.

The crash landing was made in an alley way of a residential district located between Stapleton Air Field and the Lowry Air Force Base, which is located 1-1/4 miles south of Stapleton. In addition to striking the electric light poles, the aircraft knocked down several fences, a small tool shed, and collided into two parked automobiles. Crash and fire equipment which was dispatched from both the Stapleton and Lowry Airports and the city of Denver arrived promptly. Partly as a result of their precautionary action, no fire occurred.

Investigation

It was found that the left main gear touched ground 250 feet from the point where the aircraft came to rest. An impression of the tail wheel 350 feet from the wreckage was also found. These ground markings showed that the landing gear had not completely retracted when the aircraft was in flight. Wing flaps were in the "up" position, and according to the crew, they had not been used for takeoff. With the exception of the tips of the right wing, right stabilizer, and right elevator which were torn off when the aircraft struck the electric light poles, the wreckage remained in one piece; however, there was considerable crash damage in the form of crushing and tearing of the aircraft structure. The fuselage was nearly broken in two just aft of the main cabin door.

An examination of the cockpit showed that the landing gear control had been placed in the "up" position. Fuel valves and electrical switches had been turned off by the crew to prevent fire. No reliable information

could be obtained as to the settings of any of the trim tabs since the flight control cables were broken, permitting the controls in the cockpit to move independently of their surfaces. The fuel tanks had been drained under supervision of a Civil Aeronautics Board investigator, and it was not possible to obtain a sample of fuel because of contamination of the fuel supply by chemicals and water poured on the wreckage to prevent fire. The center of gravity of the aircraft at the time of take-off was within limits according to the flight manifest, but could not be otherwise determined, since the cargo had shifted forward as a result of the crash landing.

No items were found in any of the aircraft records which were material to the accident. Other than minor irregularities, nothing was found in the examination of the power plants and propellers which could have resulted in a substantial loss of power of either engine. The air speed and manifold pressure indicators, when tested, were found within accepted limits. The left tachometer generator was damaged to such an extent that it could not be checked. The right one was found within accepted limits. The brakes for both the right and left wheels were examined and the clearances were found to be within accepted limits with no indication of heat.

All cargo was removed from the aircraft and weighed. The total weight was found to be 14,682 pounds, or 276 pounds more than the amount entered on the weight manifest for the flight. It was impossible to establish definitely the weight of the gasoline and oil in the tanks.

However, if we accept the weights shown in the manifest, that is, 4,122 pounds of gasoline and 375 pounds of oil, the aircraft weighed at least 48,268 pounds when it was taxied from the loading ramp. If there is deducted from this amount 96 pounds for 16 gallons of fuel allowed for engine warm-up and taxi, the aircraft was overloaded by at least 172 pounds at the time of takeoff.

Take-offs from Stapleton on Runway 17 require flight over the Denver residential area located between Stapleton and the Lowry Air Force Base. From Runway 8-right, which is 8,500 feet long, the flight path following take-off is over open fields. The same is true of Runway 12, which is 7,010 feet long, and to which the flight was originally cleared by the tower for take-off. At the time of the accident there was no rule or regulation which required the use of Runway 8-right or Runway 12 under calm wind conditions.

Runway 17 was examined after the accident and found to have a relatively smooth and even surface. There was a very slight rise in the surface at the intersections with Runway 8-left and Runway 8-right. These rises, however, were not considered sufficient to cause any particular difficulty in takeoffs or landings.

Both the pilot and copilot[2/] were qualified to fly the C-46. The captain had a total of over 8,000 flying hours of which 479 were in the

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2/ For complete flight history of the two crew members, see Supplemental Data.

C-46F, and the copilot had a total of well over 6,000 flying hours of which 74 were in the C-46F. Both pilots received training in the Air Forces, and had obtained considerable experience in transport flying prior to their employment by the company. Captain Robins had made many take-offs from Stapleton in C-46 aircraft loaded to 48,000 pounds. He testified that N-67960 was consistently slower in accelerating and taking off than other aircraft of the same type that he had flown.

Analysis

Information contained in the CAA-approved flight manual for this model aircraft shows that, under the weight conditions previously described and at the density altitude of 6,500 feet which existed at the Stapleton Air Field at the time of take-off, the aircraft should have attained an altitude of 50 feet and an air speed of 92½ miles per hour after traversing a distance of approximately 5,850 feet from the start of its take-off run. Runway 17 at Stapleton has a slight uphill gradient, the south end being 40 feet higher than the north end. This gradient would normally lengthen the take-off run by 320 feet, assuming that the aircraft became airborne at 95 miles per hour and the gradient was uniform. However, since the aircraft accelerated to an air speed of only 90 to 100 miles per hour and was pulled off the ground just before it reached the end of the 6,980-foot runway, it is apparent on the basis of these figures that the take-off performance was subnormal due to an increase over the normal drag in the take-off configuration, or to a loss of thrust horsepower, or to a combination of the two.

The possibility of dragging brakes decreasing the acceleration during the take-off run is eliminated, since the investigation disclosed that

the brake clearances were adequate and no indication of heat was found on the brake drums.

A second possibility of increased drag is found in the pilot's testimony that N-67960 was consistently slower in accelerating and taking off than other aircraft of the same type which he had flown. However, no specific cause for this sluggishness was found.

A third possible cause for increased drag is suggested by the testimony of two eye-witnesses, that the pilot attempted to take off at too low an air speed and, as a result, did not obtain the best performance from the aircraft. One of these witnesses testified that he observed two attempted take-offs before the one which resulted in the aircraft becoming airborne. However, the statements of the pilots and other observers do not entirely support these witnesses. The tower controller said only that the aircraft passed in front of him in an unusually tail low attitude; and the slight rise of runway level at the intersections of Runway 17 with Runways 8-left and 8-right may have resulted in a slight lifting of the aircraft which created an optical illusion of an attempted take-off. However, it is apparent that an unusually tail low attitude during the take-off run will result in increased drag and increased distance required for take-off.

There is no evidence to indicate any loss of thrust horsepower due either to the propellers not being in low pitch position or to the malfunctioning of the power-plants. An examination of the engines and propellers disclosed no defects which could have resulted in any substantial loss of power and the crew members stated that the engines operated normally at 2700 RPM and 45 inches of manifold pressure at take-off.

Flight tests of a C-46F aircraft, conducted under the supervision of the CAA after the accident to determine the transport category performance, indicate that under the conditions prevailing at the time of the accident a balanced loss of approximately 40 per cent of the power normally available from both engines at the equivalent altitude would be necessary to reduce the climb to zero in the takeoff configuration at an air speed of 105 MPH. However, such a large loss of power is inconsistent with the testimony of the crew and results of the engine examination.

The failure of the aircraft to gain an air speed of more than 100 to 105 MPH after take-off, combined with the severe shuddering of the aircraft and the slackening of the controls noted by the pilot in the climb to 100 feet altitude definitely indicates that the air speed dropped in the climb and the aircraft entered a partially stalled condition after which a crash was inevitable due to inadequate ground clearance to effect a recovery. Since the landing gear was not fully retracted at the time of the crash, it appears that it never completed retraction after the take-off and the extra drag contributed to the failure of the aircraft to climb.

Three weeks after this accident occurred, another C-46 flight experienced similar difficulty in taking off from Runway 17 at Stapleton. Observers stated that the aircraft accelerated slowly, and that it did not become airborne until near the end of the runway. After becoming airborne, it climbed very slowly, brushing the tree tops south of the field. The aircraft returned, at which time the pilot said that he had been unable to obtain more than 105 miles per hour air speed during the take-off and initial climb. Density altitude at the time was 5,800 feet. It is

not known what the aircraft weighed. Following this incident, the Director of Aviation at the Stapleton Airport notified The Flying Tiger Line that they would be restricted from using Runway 17 or 21 unless the wind from the south or southwest was of a velocity of 16 miles per hour or more.

As a result of this and other experiences with the C-46 which indicated certain deficiencies in the takeoff performance of this model aircraft, the Civil Aeronautics Board and the Civil Aeronautics Administration undertook a general study of this problem. In addition, and as previously stated, the CAA conducted a series of tests on a C-46 aircraft for the purpose of establishing its performance in terms of requirements which are currently applicable to transport category aircraft. From information gained during these tests and from the Board's study, the Board has proposed by appropriate amendment of the Civil Air Regulations to adjust downward the maximum take-off weights of certain C-46 type aircraft used in the carriage of passengers, and to prescribe certain limitations on maximum take-off weights of C-46 type aircraft used for the carriage of cargo. After receiving public comment on the proposal, the Board will take final action on the matter.

Findings

On the basis of all available evidence, the Board finds that:

1. The company, the aircraft, and the crew were properly certificated.

2. The aircraft was overloaded 172 pounds, but this amount did not appreciably affect the aircraft's take-off performance.

3. Under conditions of aircraft weight and density altitude that

existed at the time of the accident, the flight should have obtained an altitude of 50 feet and an air speed of 123-1/2 miles per hour after traversing a distance of 5,850 feet from the start of the take-off roll according to data contained in the CAA approved flight manual.

4. The aircraft, N-67960, was reported to be consistently slower in accelerating and taking off than other aircraft of the same type.

5. A runway 6,980 feet long was selected for take-off although the practically calm wind condition permitted the use of another runway which is 8,500 feet long.

6. The take-off run was made with the aircraft in an unusually tail low attitude and nearly the entire runway length, 6,980 feet, was used before the aircraft was pulled off the ground.

7. In a climb to 100 feet altitude after take-off a partial stall developed.

8. The aircraft settled, collided with obstructions and crashed.

9. No defects were found in the aircraft, the engines, or the propellers.

Probable Cause

The Board determines that the probable cause of this accident was the sub-normal take-off performance of the aircraft, the reason for which cannot be determined.

BY THE CIVIL AERONAUTICS BOARD:

/s/ DONALD W. NYROP

/s/ OSWALD RYAN

/s/ JOSEPH P. ADAMS

/s/ CHAN GURNEY

Josh Lee, Member of the Board, did not participate in the adoption of this report.

S U P P L E M E N T A L D A T A

Investigation and Hearing

The Civil Aeronautics Board received notification of the accident at 0345, July 30, 1950, from CAA Communications at Stapleton Airport, Denver, Colorado. An investigation, in accordance with provisions of Section 702 (a)(2) of the Civil Aeronautics Act of 1938, as amended, was immediately initiated. As a part of the investigation, a public hearing was held in Denver, August 11, 1950.

Air Carrier

The Flying Tiger Line is a corporation organized under the laws of the State of Delaware. Its main operation base is located at Burbank, California. The company operates under Part 42 of the Civil Air Regulations and under an irregular air carrier operating certificate issued by the Civil Aeronautics Administration. The company holds a five-year certificate of public convenience and necessity issued by the Civil Aeronautics Board.

Flight Personnel

Captain Douglas K. Robins, age 34, was employed by the company December 17, 1945. He held a valid airline transport pilot rating, and was fully qualified by the company to fly the C-46 aircraft. At the time of the accident, he had a total of 8,479 flying hours of which 479 were in the C-46. Captain Robins received previous training in the Air Force and with a scheduled carrier. Training given to him by The Flying Tiger Line in the C-46 included flying the aircraft with one engine inoperative, and taking off with an aircraft loaded to 48,000 pounds.

Copilot Cleo Monte Treft, age 37, was employed by the company

July 7, 1950. He also held a valid airline transport pilot rating and was fully qualified to fly the C-46 aircraft. He had a total of 6,479 flying hours of which 74 were in the C-46F. Mr. Treft received training in the Air Force and also in a school operated by a scheduled carrier.

The Aircraft

The aircraft, N-67960, was a C-46F leased to The Flying Tiger Line by the Air Force. It had been modified in accordance with Aircraft Specification Number A-772 and with Slick Airways Report A-06 and was certificated for a total gross weight of 48,000 pounds. The engines were Pratt & Whitney, Model R-2800-75. The left engine had a total of 872 hours, and the right, a total of 800 hours, since the last overhaul. According to the aircraft flight log, the aircraft had been flown a total of 2,180 hours. The propellers were Hamilton Standard, Model No. 23-E-50-473.