

## CIVIL AERONAUTICS BOARD

## ACCIDENT INVESTIGATION REPORT

Adopted: May 13, 1948

Released: May 17, 1948

## COASTAL AIR LINES, INC.—SAVANNAH, GEORGIA—JANUARY 7, 1948

## The Accident

A Douglas DC-3C, owned and operated by Coastal Air Lines, Inc., a nonscheduled air carrier crashed approximately 10 miles east-northeast of Savannah, Georgia, at 0745,<sup>1</sup> January 7, 1948. Aldino A. Antonioli, captain, and 17 of the 25 passengers were fatally injured; Raymond Eick, co-pilot, and 8 passengers were seriously injured. The aircraft was destroyed.

## History of the Flight

NC-60331 departed from Newark, New Jersey, for Miami, Florida, at 2159, January 6, with 23 passengers and a crew of two. The first stop was at the Northeast Airport, Philadelphia, Pennsylvania, at 2246, where 2 additional passengers were taken aboard. Departure from this point was made at 0237, January 7, and 2 hours and 39 minutes later the flight arrived at the Raleigh-Durham Airport, Raleigh, North Carolina.

After refueling to 600 gallons of gasoline, the flight departed at 0553 on an instrument flight plan to Miami, via Airway Amber 7, at an altitude of 2,000 feet. The crew reported over the Florence, South Carolina, range station at 0643 at an altitude of 2,000 feet. At 0716 they reported over Charleston, South Carolina, at an altitude of 2,000 feet, and estimated their arrival over Savannah at 0744. This was the last communication received from the flight.

Between Charleston and Savannah, Co-pilot Eick left the cockpit to obtain navigational charts, during which time he heard one or both of the engines run roughly. By the time he returned to his seat, however, both engines were again operating normally. A few minutes later both engines stopped, and the fuel pressure gauges were observed to be at zero.

<sup>1</sup>The times noted in this report are Eastern Standard and based on the 24-hour clock.

The wobble pump was used, different positions of the fuel tank selector valves were tried, the cross-feed valves were turned to the "on" position, but no fuel pressure could be obtained.

When it became apparent that the engines could not be restarted, Captain Antonioli informed the co-pilot that it would be necessary to make a forced landing in a nearby marsh, and instructed him to see that the passengers were secured by safety belts. Co-pilot Eick proceeded immediately to the cabin where he buckled the safety belts of 4 or 5 passengers. Then he felt the airplane turning steeply, and he attempted to return to the cockpit. By the time he reached the radio compartment passageway between the passenger cabin and the cockpit he was forced to the floor by centrifugal force. The aircraft shuddered as though in a stall, and crashed.

Witnesses on a nearby barge saw the aircraft approaching from a north-westerly direction at an altitude estimated to be 1,000 feet, descending without audible engine noise. It was observed to enter a gliding turn to the left which was continued for about one and one-half revolutions, until the airplane crashed into a marsh and burst into flames.

## Investigation

The first point of contact was where the left wing struck the marsh, at which time the left wing was torn from the airplane. The fuselage then broke in two immediately forward of the rear cargo door, the rear portion coming to rest right side up, and reversed in direction about 415 feet from the point of initial contact. The forward portion of the fuselage, part of the right wing, and the center section continued for an additional 140 feet, then came to rest in an inverted position. Fire started almost immediately after the crash and destroyed the remains of the forward portion of the

fuselage, and the center section. The landing gear and the flaps were found to have been retracted at the time of impact.

The fuel lines in the center section, both fuel tank selector valves, one wobble pump, the left cross-feed valve, and one fuel strainer were consumed by the fire. The remaining cross-feed valve was found in the "off" position. The remaining fuel strainer was found clean and in a satisfactory condition. Magnetos of the right engine were badly broken, and could not be tested. Tests conducted on both carburetors, both engine-driven fuel pumps, the left engine magnetos, spark plugs from both engines, and the one remaining wobble pump indicated that they were all operating satisfactorily before the crash. Since there was no evidence of mechanical failure, no teardown inspection of the engines was made, and no evidence of structural failure in the aircraft was found which could have occurred before the crash.

When the fuel lines from the fuel pumps to the carburetors were disconnected at the carburetors, considerable gasoline flowed from the lines and the fuel pumps. When the carburetors were removed from the engine mountings considerable gasoline flowed from each carburetor. The fuel pump drive on each engine was checked and the gears were found in a satisfactory condition.

Several aircraft and engine log sheets were found to be missing from the company maintenance records. In some instances it appeared that no written record was made of pilot aircraft operation reports, and that such reports were, instead, given verbally to maintenance personnel. With the exception of pilot preflight inspection, no regular procedure had been instituted for aircraft inspections at intervals less than the 100-hour inspection unless such inspections were specifically requested by the company.<sup>2</sup> However, all maintenance and inspection operations were accomplished by certificated mechanics. So far as could be determined, these operations were accomplished in accordance with

<sup>2</sup> At the time of this accident the Civil Air Regulations required only 100-hour and annual inspections for nonscheduled air carrier aircraft. On February 18, 1948, the Board published a Draft Release (48-1) proposing the amendment of Part 42 of the Civil Air Regulations to require an air carrier operating multi-engine aircraft to specify inspection and overhaul periods in a maintenance manual to be approved by the Administrator of Civil Aeronautics

accepted practices and techniques. No evidence was found of any malfunctioning of the aircraft or its components which was not satisfactorily remedied prior to this flight.

A 100-hour inspection had been performed on the aircraft on December 27, 1947. No abnormal discrepancies were discovered and the aircraft was found airworthy. After this inspection, and before the last flight the aircraft was flown 55 hours. Gross weight at the time of departure from Newark was within the maximum allowable.

NC-60331 was a converted C-47A. Before the sale of the aircraft by the War Assets Administration, the long range ferry fuel system had been removed. According to Army Technical Orders, under which the removal was accomplished, caps were to be placed over the "tees" which were located in the line where the ferry fuel system connected into the main fuel system. The caps were to be an airtight seal, and a caution note in the Army Technical Order stated that if the seal were not maintained airtight, air would enter the main fuel supply system and result in engine failure. No one who performed maintenance work on this aircraft could remember checking this particular item, and the "tees" and caps were destroyed by fire after impact.

Refueling at Raleigh-Durham Airport required 246 gallons of gasoline for a total of 600 gallons. One hundred gallons were placed in each of the two auxiliary tanks, which were measured by a dip stick, and the two main tanks were filled to capacity. Co-pilot Eick verified the quantity of fuel on board by checking the fuel quantity gauges while the aircraft was being taxied out for take-off.

After the take-off from Raleigh-Durham Airport, a check of fuel consumption showed the rate of consumption to be 84 gallons an hour. This check, according to Co-pilot Eick, was made while running the engines on their respective main tanks with the cross-feed control in the "off" position. To the best of Mr. Eick's knowledge, the fuel selector valves were in the same position at the time of take-off, and at the time he left the cockpit to obtain the navigational charts. Furthermore, Mr. Eick stated that it was a policy of Captain Antonioli to conduct his flights with the valves in this position, switching to the auxiliary tanks

when the main tanks had approximately 25 gallons of fuel remaining.

Weather conditions from Raleigh to Savannah during the period of the flight were very good; a clear sky existed and the lowest visibility encountered was 5 miles. At Savannah at the time of the accident the sky was clear, the visibility was 7 miles, the wind was from the west, 5 miles per hour, and smoke layers were aloft. Thus, the weather was not a factor in this accident.

### Discussion

Testimony of Co-pilot Eick to the effect that the fuel pressure for both engines dropped to zero at or about the time that the engines stopped firing, limits the possible causes of engine failure to the fuel system. Many parts of the fuel system and the fuel lines were consumed by fire, and it was accordingly impossible to determine directly from an examination of the wreckage the cause of the loss of fuel pressure and the resulting failure of both engines. However, the known circumstances and conditions of flight, as described above, were sufficiently complete to afford a reasonable basis from which to deduce the probable cause of power failure.

Fuel consumption was computed by the crew during the course of this flight to be 84 gallons per hour, 42 gallons per engine per hour, which was a normal rate of consumption for the R-1830-92 engines installed in this aircraft. Had each engine been operated from its own main or auxiliary tank during the entire course of the flight, no fuel exhaustion would have been possible. The main tanks at take-off contained 210 gallons each and the auxiliary tanks 100 gallons each. Thus, the fuel supply in any one tank was more than ample to supply the needs of either one of the two engines for more than one hour and 52 minutes of flight. Therefore, only two possibilities of total power failure remain. Either both engines were operated from only one tank until the contents were drained, or a rupture in a line occurred in the fuel system.

The Safety Bureau has on record no case in which a ruptured fuel line has been the cause of engine failure in DC-3 type aircraft. The possibility of a broken or ruptured fuel line is extremely remote, and it would seem more likely that the loss of fuel pressure was due to

operating two engines from one tank until the fuel supply in the tank was exhausted. Fuel found in the fuel lines, pumps, and carburetors at the scene of the accident may have flowed into these parts of the system after engine stoppage and after the many adjustments had been made in the fuel selector valve controls. It was not necessarily a sufficient amount for engine operation.

Had both engines been operated from one auxiliary tank which contained 100 gallons during the entire course of the flight, the tank would have been emptied in approximately one hour and 20 minutes of engine operation and fuel exhaustion would have been experienced prior to the time that it actually was. Had both engines been operated from one main tank which contained 210 gallons, fuel exhaustion would have been experienced only after 2:25 hours of flying. These estimates do not include fuel which would have been used in engine warm-up, taxiing, and take-off. It is highly possible, however, that the engines were operated from their respective main tanks until all flight and engine controls were adjusted for cruise. Then, the fuel selector valves were inadvertently positioned so that both engines were supplied fuel from only one of the auxiliary tanks until the fuel in the tank was exhausted. Such a theory is largely supposition, but it logically accounts for the events known to have occurred during flight.

If only one main tank was used to feed both engines at the time that fuel pressure was lost, any change in either one of the engine fuel selector valves should have restored power to at least one engine. However, had the first change in the fuel valve settings been to place the cross-feed in the "on" position rather than to change the position of the fuel selector valves, then no additional supply of fuel from another tank would have been made available, and fuel pressure would not have been restored. Air would be introduced into the lines under such conditions, and any further alteration of the fuel selector valves would not immediately restore fuel pressure since its flow might then be restricted by air or vapor in the system.

As stated above, the evidence recovered from the wreckage is not sufficient in itself to make any positive determination in this case. The possibility of a broken fuel line still remains.

It should be understood, however, that even though the extremely remote possibility of a broken fuel line had occurred in this case, only one engine would have been affected unless at the time of total power failure the cross-feed valve was in the "on" position for the fuel system for each engine operates independently of the other unless connected by means of the cross-feed valve. An attempt was made during the course of the investigation to determine whether or not such a break in the fuel system could have occurred where the "caps" had been placed on the "tees" where the ferrying fuel system had originally been connected with the other fuel lines of the aircraft. But, since these caps had been destroyed in the fire no determination could be made.

After considering all possibilities and known circumstances of flight it appears that the most probable cause of total power failure was, that one fuel tank was used to operate both engines until its contents were drained, and that the pilot then placed the cross-feed valve in the "on" position before changing the position of either of the fuel selector valves. The steep turn and stall which the co-pilot described as occurring just before the crash and the fact that the airplane struck the ground when in a steep turning attitude indicated that the pilot lost control of the airplane during the descent. Had the co-pilot been in his seat where he could have assisted either in the manipulation of the flight controls or in the attempts that were made to restore power, the aircraft could have undoubtedly been flown to a normal crash landing on the marsh. Therefore, the complete destruction of the airplane and the resulting fatalities that occurred in this case can be attributed in a large part to the lack of crew coordination and proper cockpit procedure.

### Findings

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

1. The aircraft, carrier, and crew were properly certificated.
2. Company flight, aircraft, and engine maintenance records were not maintained at the carrier's headquarters.
3. The aircraft was in an airworthy condition and properly loaded immediately prior to, and during the course of the flight.
4. At Raleigh, North Carolina, the aircraft was fueled to 600 gallons of gasoline, the two auxiliary tanks containing 100 gallons each, and the two main tanks 210 gallons each.
5. The flight proceeded normally toward Miami, Florida, for one hour and 52 minutes, at which time complete power failure occurred, and the fuel pressure for both engines dropped to zero. Attempts to restart the engines by adjustment of the cross-feed and fuel selector valves were unsuccessful and an emergency landing was attempted in a nearby marsh.
6. The co-pilot left his seat during the course of the emergency to assist the passengers in securing their safety belts, and did not return to the cockpit before the aircraft struck the ground. Control of the airplane was lost during the descent and it struck marsh land 10 miles north-northeast of Savannah, Georgia, in a turning attitude.

### Probable Cause

The Board determines that the probable cause of this accident was the lack of fuel management which caused engine failure and resulted in a forced landing during which control was lost of the aircraft.

BY THE CIVIL AERONAUTICS BOARD

/s/ JOSEPH J O'CONNELL, JR.

/s/ JOSH LEE

/s/ HAROLD A. JONES

Ryan, Vice Chairman, and Adams, Member, did not take part in the decision.

# Supplemental Data

## Investigation and Hearing

The Civil Aeronautics Board was notified of the accident at 1205, January 7, 1948, and an investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. Air Safety Investigators of the Board's Atlanta Office arrived at Savannah, Georgia, the same day and were later assisted in the investigation by other members of the Safety Bureau staff. A public hearing was ordered by the Board and was held in Philadelphia, Pennsylvania, January 22, 1948.

## Air Carrier

Coastal Air Lines, Inc., a Delaware corporation with headquarters in Philadelphia, Pennsylvania, had been issued a letter of registration as an irregular air carrier and a nonscheduled air carrier operating certificate.

## Flight Personnel

The captain of the aircraft, Aldino A. Antonioli, age 24, had a total of 2,250 hours flying time, of which at least 1,072 had been in DC-3 type aircraft. He had obtained a student pilot certificate on April 1, 1941, and, on the basis of military competency while serving with the U. S. Army Air Forces, was issued a commercial pilot rating on August 16,

1945. He also held a valid instrument rating. The co-pilot, Raymond Eick, age 27, had a total of 4,348 hours flying time, of which 454 had been in DC-3 type aircraft. He had obtained a student pilot certificate on May 18, 1939, and, on September 16, 1941, was issued a commercial pilot rating. Records indicate that he had logged 1,450 hours as first pilot while serving with the U. S. Navy. He also possessed a valid instrument rating. Both pilots' rest periods prior to the flight were adequate.

## The Aircraft

The Douglas DC-3C, NC-60331, was manufactured in May, 1944 and had accumulated since that time 2,409 hours flying time. It was equipped with Pratt and Whitney engines with Hamilton Standard propellers installed. The right engine, an R-1830-65-92, was new and had been operated a total of 187 hours. The left engine, an R-1830-92, had been operated a total of 2,327 hours, of which 720 had been since last overhaul. Up to the time of the accident, both engines had been operated a total of 55 hours since the last 100-hour inspection. At the time of departure from Raleigh-Durham Airport, the weight was 600 pounds less than the maximum allowable gross, and the load was distributed with respect to the center of gravity within approved limits.