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Cargo Airplane Strikes Building During Rejected Takeoff

The accident report said that an engine malfunction may have occurred at a critical time during the Douglas C-54A-DC's takeoff, that the flight crew used inadequate procedures during the rejected takeoff and that the first officer was impaired by medications.

FSF Editorial Staff

At 0016 local time on April 4, 1997, a Douglas C-54A-DC yawed left when the no. 1 engine apparently malfunctioned approximately 900 feet (275 meters) from the end of the 3,701-foot (1,129-meter) runway during takeoff at Griffin–Spalding County Airport in Griffin, Georgia, U.S. The flight crew applied heavy braking approximately 650 feet (198 meters) from the end of the runway, but the airplane overran the runway and exploded when it struck a vacant building. The airplane was destroyed, and both pilots were killed.

In its final report, the U.S. National Transportation Safety Board said that the probable causes of the accident were "the flight crew's inadequate procedures during a rejected takeoff following a possible engine malfunction at a critical time in the takeoff, and the [first officer's] physical impairment."

The report said that inadequate flight crew coordination was a factor in the accident.

Although registered in the United States as a C-54A-DC (military version of the DC-4) at the time of the accident, the airplane had been modified in 1962 by Britavia in England to accommodate the loading of automobiles through the fuselage nose section (see "Aviation Traders ATL.98 Carvair," page 2).

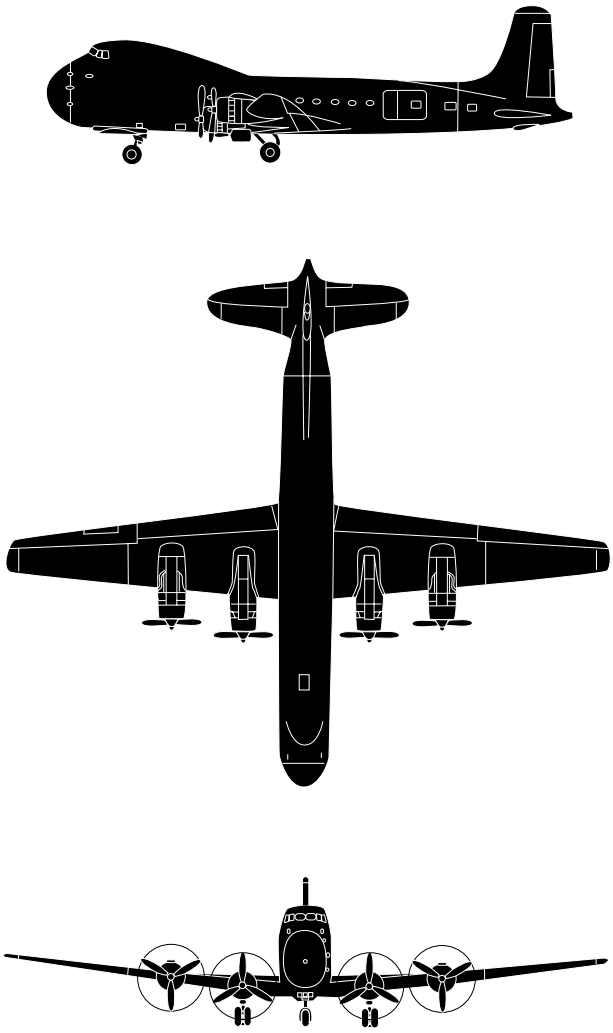
The modification was performed in accordance with U.S. Federal Aviation Administration (FAA) Supplemental Type Certificate SA2IN. Following the modification, the airplane was registered by the U.K. Civil Aviation Authority as an ATL.98 Carvair. The airplane later was re-registered in the United States.

At the time of the accident, the airplane was operated by Custom Air Service, which was based in Griffin and was authorized by FAA to conduct cargo operations for hire under U.S. Federal Aviation Regulations (FARs) Part 125.

The airplane had accumulated 50,558 flight hours, including 91 flight hours since the last required inspection was performed.

"The airplane was inspected using eight numbered inspections at intervals not to exceed 150 hours," the report said. "A review of the operator's completed inspection forms for the airplane indicated this requirement had been met. … There were no uncorrected discrepancies found in the operator's inspection records for the airplane."

The airplane's engines are required to be overhauled every 1,600 hours. The operator's records showed that the times since overhaul were: 688 hours for the no. 1 engine, 936 hours for



Aviation Traders ATL.98 Carvair

Aviation Traders — a British company that repaired, designed and manufactured aircraft — developed the ATL.98 Carvair modification of the Douglas DC-4 (U.S. military designation C-54) in 1961.

The modification involved the installation of a larger nose section with an elevated flight deck and a vertically hinged door to accommodate the loading of automobiles and other heavy cargo, and the installation of a larger vertical stabilizer and rudder.

The airplane has four 1,450-horsepower (1,081-kilowatt) Pratt & Whitney R-2000-7M2 Twin Wasp radial engines and three-blade Hamilton Standard propellers. Empty weight is 41,365 pounds (18,763 kilograms). Maximum takeoff weight is 73,800 pounds (33,476 kilograms). Rate of climb at sea level is 650 feet (198 meters) per minute.

Source: *Jane's All the World's Aircraft*

the no. 2 engine, 399 hours for the no. 3 engine and 1,449 hours for the no. 4 engine.

The accident occurred during takeoff for a FARs Part 91 positioning flight to Americus, Georgia, where automobile parts were to be loaded aboard the airplane for shipment to Rockford, Illinois. [Americus is approximately 70 nautical miles (130 kilometers) south of Griffin.]

The captain, 58, had an airline transport pilot certificate with a DC-3 type rating and a DC-4 type rating, and a mechanic certificate with an airframe rating and a powerplant rating. He was employed by the operator as a pilot.

"Airman records obtained from [FAA] indicated that the captain received a DC-4 rating on March 11, 1995," the report said. "According to records provided by the operator, the captain successfully completed a proficiency flight check in the DC-4 aircraft on Oct. 28, 1996."

The operator's records showed that the captain had more than 12,000 flight hours, including more than 1,000 flight hours in type.

"The records indicated that the captain had a total of 45.4 flight hours within the 90 days prior to the accident, with 27.7 hours in the same make and model airplane," the report said. "[The captain] had in excess of 32 flight hours at night and more than 10 hours of actual instrument flight hours within the 90 days prior to the accident."

The first officer, 63, had a commercial pilot certificate with a multi-engine airplane rating and an instrument rating, a flight engineer certificate with a reciprocating-engine airplane rating, and a mechanic certificate with an airframe rating and a powerplant rating. He was employed by the operator as a maintenance technician and as a pilot.

"Records provided by the operator indicated that the [first officer] received a proficiency check as second-in-command in the DC-4 on July 19, 1996," said the report.

The operator's records showed that, at the time of the accident, the first officer had more than 5,000 flight hours, including more than 1,500 flight hours in type.

"According to his request for a medical certificate dated July 23, 1996, he had 3,550 total flight hours with 50 flight hours within the six months prior to the examination," the report said. "According to records provided by the operator, the [first officer] had 78.2 total flight hours within the 90 days prior to the accident, all in the same make and model airplane. [His] night and instrument flight hours within the previous 90 days were listed as more than 45 [hours] and 15 hours respectively."

The last flight of the airplane prior to the accident was conducted on April 1, 1997. The captain on that flight said

that there were no airplane discrepancies. His first officer was the accident first officer.

"[During the flight, the captain and the first officer] commented to each other how well the airplane [was] operating," the report said. "[The captain] said the engines were running exceptionally well. He remembered that there weren't any systems problems."

The captain said that, during the flight, he and the first officer discussed the most significant risk encountered during typical company operations in the C-54: the departure from Griffin.

"They decided that, with the normal takeoff weight of about 59,000 pounds [26,762 kilograms] from Griffin, if the airplane had a problem after [accelerating to] 50 [knots] or 60 knots, the best course of action was to continue the takeoff, rather than try to stop," the report said. "[They agreed that] if an attempt was made to stop, it would just result in smoking the tires and blowing them out."

Griffin–Spalding County Airport is an uncontrolled, public airport with an elevation of 958 feet. The asphalt runway is 75 feet (23 meters) wide.

"The runway was equipped with medium-intensity runway lighting preset to low intensity between dusk and dawn," the report said. "Higher-intensity runway lighting could be activated using the common traffic advisory frequency."

The operator's weight-and-balance form showed that, when the accident occurred, the airplane was within weight-and-balance limits. The airplane weighed 56,345 pounds (25,558 kilograms), and the center of gravity was at 14 percent mean aerodynamic chord.

Visual meteorological conditions prevailed on what the report described as a dark night. The sky was clear of clouds, and visibility was greater than 10 statute miles (16 kilometers). Temperature was 56 degrees Fahrenheit (13 degrees Celsius). Surface winds were calm. The runway was dry.

The airplane flight manual (AFM) "minimum takeoff runway length" chart showed that, under the conditions when the accident occurred, the minimum takeoff runway length was 2,750 feet (839 meters). Minimum takeoff runway length was defined as the distance required to accelerate to V_1 (called the critical engine failure speed when the airplane was certificated) and, assuming an engine failure at V_1, either to reject the takeoff and stop, or to continue the takeoff and climb to 50 feet. The AFM "critical engine failure speed" chart showed that V_1, under the existing conditions, was approximately 80 knots (148 kilometers per hour [kph]).

The AFM recommends the following initial takeoff procedure: "Open up all engines to full power and, having confirmed satisfactory engine and propeller operation, release the wheel brakes. … Use nosewheel steering until rudder control is found to be adequate at approximately [52 knots (97 kph)] IAS [indicated airspeed]. The nosewheel should be held on the ground to V_2-5 [takeoff safety speed minus five knots] when the aircraft should be rotated and takeoff safety speed should be attained during the transition to the 50-foot point. … Rotation and achievement of [takeoff] safety speed when taking off at forward CG positions involves the use of considerable 'up' elevator."

The AFM "all engines operating" chart showed that V_2 was approximately 91 knots (169 kph) under the existing conditions.

The captain said that, during the flight, he and the first officer discussed the most significant risk encountered during typical company operations in the C-54: the departure from Griffin.

The AFM recommends the following initial procedures for an engine failure on takeoff:

- "If the decision is made to abandon the takeoff, immediately close all four throttles and apply maximum wheel braking until it is certain that adequate stopping distance is available, keeping straight by use of nosewheel steering; [or,]
- "If the decision is made to continue the takeoff, maintain directional control by means of coarse use of rudder and aileron (if an outer engine has failed, full corrective rudder and considerable aileron will be necessary), holding the nosewheel in contact with the ground by firm forward pressure on the control column until rotation is initiated at V_2-5 (mph or knots) by a firm rearward movement of the control column. The propeller of the failed engine should be feathered at the earliest opportunity after the failure has been confirmed."

A witness, who was employed as a pilot and as a mechanic by the operator, was near the departure end of the runway when he watched the engines being started and the airplane being taxied to Runway 14 for takeoff. He said that the engine start was normal and that he observed the position of the elevator as the airplane was taxied to the runway.

"I always look at the elevator to see if the controls are locked," the witness said. "The elevator was in the 'down' position." The witness said that this showed that the controls were not locked; the elevator is in the neutral position when the control lock is engaged.

The witness said that the crew conducted a before-takeoff check of each of the four engines.

"I heard the run-up for all four engines individually and heard no evidence of anything wrong," he said.

The witness said that, during the takeoff roll, the no. 1 engine showed "signs of losing power" when the airplane was about three-quarters of the way down the runway.

"The exhaust flames changed from blue to yellow," the witness said. "The aircraft yawed hard to the left."

He described the yawing motion as severe and as more than he would have expected from a sudden loss of power from an outboard engine.

"The left wing dipped almost to the point of striking the props in the ground," the witness said. "It appeared as though the nosewheel was firmly on the ground."

The witness then heard the sounds of braking and of tires bursting.

"As the plane passed me, I heard the tires blow," the witness said. "The plane went off the runway, all the time turning to the left. After crossing the road, the aircraft made one turn to the right, approximately 20 degrees. Impact was made into an empty building, [and] the aircraft burst into flames.

"During the entire event, I never heard power reduced, except for the no. 1 engine at the time of the [exhaust] flame change and the start of yaw. I observed that the tail was extremely high throughout the continued takeoff roll."

Another witness was in his home, approximately 1,500 feet (458 meters) from the end of Runway 14, when he heard the airplane being prepared for departure.

"[The witness] said that he had seen the airplane taking off numerous times and [that] it usually got airborne approximately 100 feet [31 meters] before the end of the runway," said the report.

The witness heard a sound "like a gunshot" when the airplane was rolling for takeoff.

"He thought he heard one of the engines backfiring," the report said. "Then, he heard a very loud screeching and the sound of the brakes being applied. He said that the skidding sound was so loud that he could not hear the engines."

The witness went to his back porch and saw the airplane cross a parking lot. He said that the airplane's "fins" were on fire.

"Moments later, he saw the aircraft impacting the building," the report said. "There was a very loud explosion and a huge ball of fire."

Two other witnesses were at their home near the airport. One witness said that the engines sounded different, "rougher than normal," as the airplane was taxied to the runway. She said that the airplane was on its takeoff roll when she heard "explosions or backfires, followed by squealing of tires and very loud screeching."

The other witness said that he heard one of the engines sputtering and that he saw "flames coming out of the back of the airplane" before it struck the building.

The report said that black tire-skid marks began 650 feet before the departure end of Runway 14 and that the airplane traveled in a straight line after leaving the runway.

"Skid marks and a debris trail of about 1,360 feet [415 meters] led from the runway to the airplane wreckage, which came to rest inside the abandoned store," the report said. "The airport perimeter fence, a wooden sign … , a wooden privacy fence bordering an apartment complex, a utility pole, a fire hydrant and a parking lot metal light pole were all found broken along the debris trail."

The witness heard a sound "like a gunshot" when the airplane was rolling for takeoff.

The report said, "The skid marks and debris trail were oriented to a magnetic heading of 095 degrees between the end of the runway and the impacted building."

The privacy fence and the utility pole were struck by the airplane's left wing. A fuel tank in the left wing was punctured and leaked fuel, which ignited. The privacy fence, the utility pole and the ground near the fence and pole were scorched.

"The scorched ground pattern continued to the building, widening as the debris trail proceeded southeast," said the report.

The first piece of airplane wreckage in the debris trail was a nose-gear-door brace, which was found at a curb 25 feet (eight meters) from the building.

"The no. 1 engine, cowling and propeller assembly [were] found adjacent to the outside of the northeast wall of the building," the report said. "The empennage and about 30 feet [nine meters] of the fuselage remained outside the building, while the remainder of the airplane was found inside the building. The building's steel girders, interior ceiling and asphalt roof were mingled among the airplane debris. The airplane and building were extensively burned."

Examination of the wreckage showed that the elevator trim was set two degrees trailing-edge-down and the flaps were

extended 15 degrees. The report said that the elevator trim and flaps were set properly for takeoff.

The investigation did not determine the probable cause of the apparent malfunction of the no. 1 engine. "Fire damage to all engines precluded a detailed postcrash examination of essential fuel and ignition systems," said the report.

No evidence of mechanical failure was found during disassembly of the no. 1 engine.

"There was evidence of heat distress to the connecting rods and the master rod," the report said. "The carburetor was burned and could not be tested. Both magnetos were removed and placed on a test bench, where a spark was produced for each cylinder. The propeller-pitch-control mechanism was found on the low-pitch, high-rpm mechanical stop."

The operator's director of operations said that the reported change in color of the exhaust flames from blue to yellow could have been the result of a loss of engine power, particularly from a reduction in fuel flow. He said that the normal exhaust-flame color during takeoff is blue.

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The airplane was dispatched for the flight with 2,000 gallons (7,570 liters) of grade 100LL aviation gasoline. The fuel load included 1,479 gallons (5,598 liters) that were placed in the tanks the day before the accident.

"The airport manager provided a copy of a fuel-analysis report indicating that the sample of fuel taken from the airport met the requirements of 100LL aviation gasoline, including [requirements for] cleanliness," said the report.

The airplane had two main-fuel tanks and one auxiliary-fuel tank in each wing. The report said that each auxiliary tank contained no more than 15 gallons (57 liters) of fuel.

The fuel-control levers for the two outboard engines (the no. 1 engine and the no. 4 engine) had three positions: "off," "main tank on" and "aux tank on." The fuel-control levers for the two inboard engines (the no. 2 engine and the no. 3 engine) had two positions: "off" and "main tank on."

The AFM said, "Pilots are warned of the need to correctly locate the fuel-cock-control levers by the feel of the detent in the intended position. Failure to do so even by only a small amount will allow all ports of the cock to be open to each other, which may lead to feeding engine(s) from unintended tank(s) or unwanted tank-to-tank transference. If not noticed and corrected, this can lead to power loss from unexpected fuel exhaustion in the tank feeding the engine(s)."

The operator's "before takeoff" checklist calls for the fuel-control levers for all four engines to be positioned to the main tanks.

The report said, "The cockpit instruments that could be located were generally burned beyond reading. A rod was located that had the appearance of the fuel-selector torsion bar. It was noted that the left actuating fixture, corresponding to the no. 1 engine fuel selector, was not aligned with the other three fuel-selector fixtures."

The medical examiner who conducted postmortem examinations of the pilots said that the cause of death of both pilots was blunt-force trauma. Toxicological tests were conducted by FAA. The toxicological tests on the captain showed negative results for ethanol and other drugs.

The toxicological tests on the first officer showed a therapeutic-dosage level of Paroxetine in the blood and urine.

"Paroxetine is a prescription antidepressant that has been shown to have little effect on performance," said the report.

The toxicological tests detected Diphenhydramine in the first officer's blood and urine.

"Diphenhydramine is a sedating antihistamine often found in over-the-counter allergy medications," the report said. "The level of Diphenhydramine found during toxicology examination of the [first officer] approximated 10 times the levels found following a dosage at twice the recommended strength.

"Pseudoephedrine was also found in the [first officer's] blood. Ephedrine, Pseudoephedrine and Phenylpropanolamine, decongestants commonly found in over-the-counter medications, were also detected in the urine."♦

[Editorial note: This article, except where specifically noted, was based on the U.S. National Transportation Safety Board factual report and brief-of-accident report ATL97FA057. The reports comprise 458 pages and contain diagrams and photographs.]

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