



Faulty Instrument, Poor Judgment Bring Down Convair Turboprop

When the command pilot flaunted minimum equipment list requirements and assigned an inexperienced copilot for takeoff, the stage was set for tragedy.

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Editorial Staff Report

The Convair 340/580 twin turboprop took off from New Zealand's Auckland Airport at night in a light drizzle with a full load of cargo. Seconds later, the aircraft struck an embankment at the airport boundary and plunged into Manukau Harbour, destroying the aircraft and killing the three crew members aboard.

The crash followed a normal ground roll, rotation abeam of the control tower and initial climb. The aircraft was last seen disappearing into drizzling rain about two-thirds down the runway. A crash inquiry conducted by the New Zealand Transport Accident Investigation Commission said two crew members probably survived the crash, but drowned because they suffered injuries that prevented their escape from the submerged wreckage.

Auckland Airport has a single runway measuring 3,291 meters in length. Part of the runway is built on reclaimed land extending into Manukau Harbour. The first evidence of ground impact along the flight path was a series of propeller slash marks in loose soil about 387 meters beyond the end of the runway and 91 meters left of the extended centerline. The propeller marks did not progressively deepen, indicating a shallow descent angle.

The aircraft, which was bound for Christchurch, was on the second leg of a night freight and training flight. The crew was made up of a training captain and two new copilots who were to fly alternate legs as copilot and observer. The air freight company was in its second week of operation.

Originally built as a Convair 340 in 1954 and later modified with Allison model 501-D13D turbine engines, the aircraft had been delivered to New Zealand from Canada just days prior to the accident.

The 41-year-old pilot in command had logged 3,760 total flight hours, with the most time in heavy multi-engine aircraft. He had 140 hours in the Convair 580 with a total of 601 hours flown at night and 477 instrument hours. In the 90 days before the accident, he had logged more than 51 hours in Convairs. However, no instrument time had been recorded in the three months before the crash. While the captain was an approved flight instructor, he had little experience in that role. He had received no civilian or military instructor training and his instructor rating had been issued without a flight test following a written reference from Canada.

The copilot flying the aircraft at the time of the crash had logged 1,086 hours total flight time, including 215 hours in light multi-engine airplanes. She had flown 32 hours at night and 101 hours on instruments. Her total on the Convair 580 type was 6.1 hours of dual training accomplished in May 1989 for the type rating. But this training was done in another company aircraft that was equipped with a different instrument panel layout. The copilot flying, aged 28, had not flown at all in the nine weeks prior to the accident and her instrument flight total for that period was 4.7 hours, below the six-hour regulatory minimum. Records indicated that the night-flying sec-

tion of her training syllabus had not been completed and that she had never flown the crash aircraft.

A Transport Accident Investigation Commission report on the crash revealed that a series of equipment failures and flight crew misjudgments contributed to the crash.

According to the commission's recently released official report on the July 1989 accident, the Convair's instrument panel was equipped with a dual Sperry "Stars" flight director instrument system that provided an independent attitude direction indicator (ADI) and radio navigation instruments for each pilot. Separate directional and vertical gyros provided attitude signals to each pilot's instruments. A separate stand-by artificial horizon was also fitted to each panel alongside the ADIs.

The crash investigation revealed, however, that the copilot's ADI had been reported defective on the ferry flight from Canada and that it had malfunctioned several times after the airplane's delivery. The airline's maintenance department found the defect and ordered replacement parts. The "action taken" section of the aircraft's maintenance log said repairs were "deferred for parts." The ADI's pitch angle indication reportedly drifted to indicate a nose-up error of between 5 and 10 degrees and had displayed an erroneous bank indication on at least one occasion. The malfunction occurred most frequently after about 30 minutes in flight, but had also been observed during takeoff.

The pilot in command, who also served as the freight

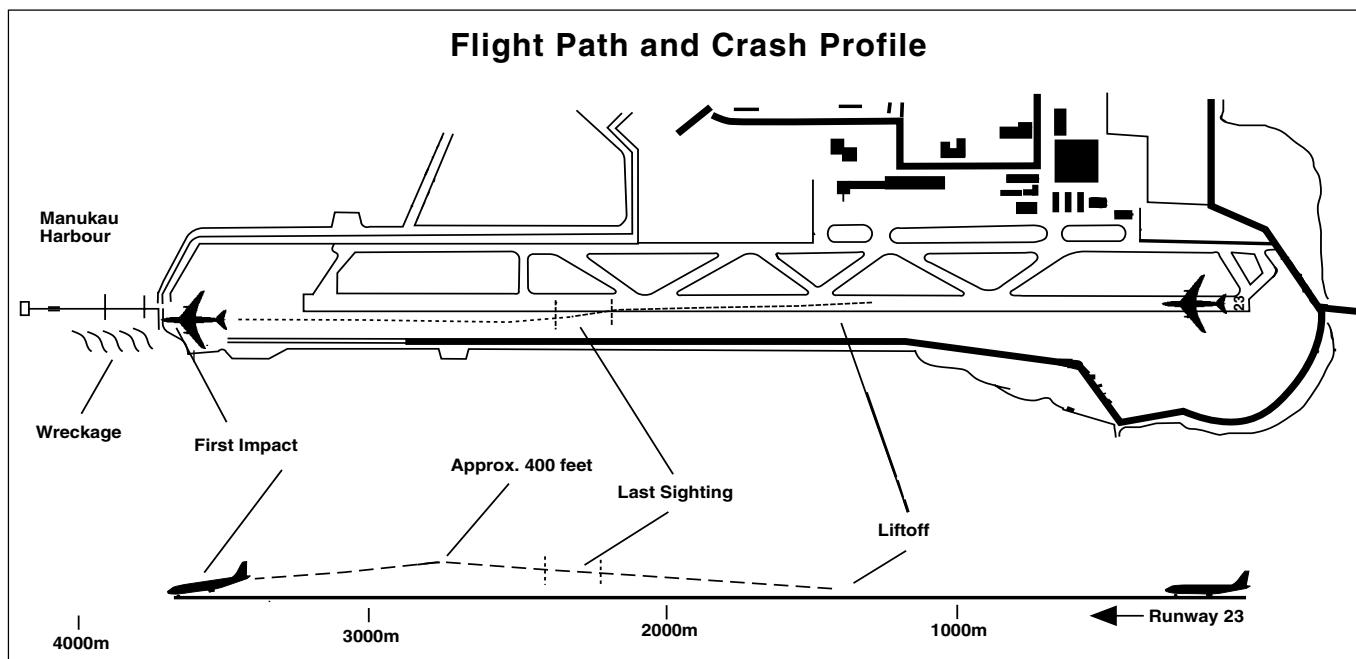
carrier's operations manager, was aware of the ADI problem but recommended that the aircraft remain in service until a replacement vertical gyro was found and installed. The decision to keep the aircraft in service violated provisions of the aircraft's minimum equipment list (MEL) and airworthiness standards that prohibited night IMC (instrument meteorological conditions) flight with a faulty ADI. Regulations also required that the defective instrument be flagged inoperative, but there was no evidence that this was done.

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The commission's investigation also revealed that the cockpit voice recorder (CVR) failed after the number one engine's rpm was shifted from low- to high-speed ground idle. (It was determined that the failure was due to faulty electrical relays actuated at upshift. After another accident involving a Convair 580, checks with other 580 operators revealed the same defect and corrective action was taken.)

The flight data recorder (FDR) was also found to have been defective for some 10 hours before the crash, with its recording foil torn and jammed in the spools. Thus, two vital crash investigation resources were limited or lost.

Powerplant and structural tests found no engine or airframe defects, and there was no indication that the aircraft had been improperly loaded. There was no evidence of fire or explosion, and toxicology tests concluded no incapacitation of the crew. Gear and flaps were fully retracted, indicating that the aircraft's hydraulic system was functioning properly. The servo and trim tabs, eleva-



tor down spring and aileron/rudder interconnect showed no evidence of pre-impact failure.

The investigation concluded that the defective ADI was a major factor in the crash. The report noted that the normal initial climb attitude for the Convair was between 6 degrees and 8 degrees nose-up.

Instrument indications found after the crash for the ADIs were 10 degrees nose-down, 8 degrees left bank, with both warning flags on the captain's panel; and 0 degrees pitch and 0 degrees bank, with both warning flags on the copilot's panel.

"If the aircraft was being flown solely with reference to the copilot's ADI and the defect occurred, the handling pilot would have pitched the aircraft nose-down by the amount of the error to retain the same attitude indication. Such a pitch-down could have resulted in a descent of sufficient magnitude to achieve the path of the accident flight," the commission report said.

The report suggested that because of her lack of experience on type and lack of instrument currency, the copilot would have executed a minimal instrument scan and would have likely concentrated on the ADI.

"As a result, she could not reasonably be expected to detect, analyze and compensate for an ADI failure," the report said. The commission report added that the captain may not have been aware that the ADI had also malfunctioned on previous takeoffs and therefore might have only briefed the copilot on the ADI's failure after 30 minutes in flight.

The commission's report reserved its severest criticism for the captain, who was pilot in command of the training flight.

"Such a (ADI) failure ... should not have resulted in the accident," the report said. "The defect was well-known and should have been anticipated by at least the captain. A competent, current and fully-trained pilot could be expected to scan and cross-check instruments to confirm the attitude information from the ADI — in the initial climb the altimeter and the vertical speed indicator (VSI) would be particularly included because of their prompt information about climb and descent."

According to the investigation, there was no evidence that recovery maneuvers were initiated (nose-up attitude or power increase). The evidence indicated that the aircraft's descent was not detected by the flight crew. The aircraft apparently gained no more than 400 feet in altitude and impact would have occurred in less than 20 seconds at a descent rate of between 1,200 feet and 2,000 feet per minute.

The commission report also suggests that the captain may have been distracted from the attitude indicators because he was busy retracting the flaps and setting climb power, which requires scanning flap gauges and engine instruments.

"While the captain was carrying out these actions, it was probable that he would have scanned the copilot's ADI rather than his own, as the engine and flap instruments were closer to the copilot's panel. He could thus have been misled by the same erroneous ADI indication."

Investigators were puzzled, however, about why the captain was involved in those actions so soon into the climb, noting that 400 feet is the minimum height at which flap retraction should begin. "No urgency existed and prudent airmanship would defer such action, especially in a training situation, to a substantially greater height," the report said.

Convair 580 Turboprop

The Convair 580 is the modified turboprop version of the Convair 340, which first flew in 1951. The first 340 was delivered to United Airlines in 1952.

The last two Convair 340s were delivered to REAL (Brazil) in 1955, bringing the total number built to 209.

The Convair 340 (and 440) both proved well-suited for turboprop conversion. Pacific Airmotive converted more than 120 of the aircraft to Allison 501-D13D turboprops (CV-580s) in the 1950s and 1960s. Kits were also created to refit 340s and 440s with Rolls-Royce Darts to produce the CV-600/640.

The trim change that followed after flap retraction was nose-down, and the report suggested that the change could have initiated a pitch-down that went undetected by the copilot because of the ADI error. (The Convair 580 Pilot's Handbook warns pilots to be alert to any change in aircraft attitude angles after takeoff. The warning suggests the aircraft is susceptible to sinking if allowed to pitch down at flap retraction. The handbook cautions that substantial control pressure changes were required at flap retraction and power reduction.)

The report questioned why the second copilot, positioned in the jump seat behind the other two crew members, apparently did not observe the pitch-down and alert the pilot. "Although his view covered only part of each pilot's instrument panel, he should have been able to see either

the copilot's stand-by artificial horizon or the captain's ADI, VSI and altimeter."

But the report added: "His ability to communicate would have been limited by the absence of an intercom system between crew members."

The second copilot, aged 41, had 2,604 total hours, with 795 in multi-engine aircraft. The total also included 221 night hours and 391 on instruments. Although he had considerably more overall flying experience than his copilot colleague, he had about the same experience on type, having logged just 6.8 hours of dual flight time in the Convair 580.

The report also said a ground proximity warning system (GPWS) might have helped avoid the crash. Although such equipment was recommended by the International Civil Aviation Organization (ICAO) for the Convair's aircraft class on international operations, it was not required for New Zealand-registered turboprop aircraft after a trial test period resulted in unacceptable false warning rates.

The fact that the airline had only been operating for two weeks before the accident may also have contributed to events that ultimately helped cause the accident, the report said.

"Although a nucleus of captains had gained experience in Canada, overall experience of both the operation and the aircraft was low. The aircraft, although recently overhauled, were old, differently equipped and (were plagued by) numerous initial defects."

The report concluded: "In the early stages of a new airline's operation, it is likely that the levels of experience

of the aircraft and the operation by management, flying and engineering staff alike, will be low. In such circumstances, a cautious approach to the problems is essential to ensure that a basic level of safety is maintained. This accident suggests that less than prudent caution was exercised. ..."

The commission also criticized management's role in events that led to the crash. "The ADI problem was best known to the operations manager (the command pilot), but the airline's engineers were aware of it. ... As they were unable to remedy it (the faulty ADI) ... the airline management, and particularly the chief engineer, should have countermanded the operations manager's decision and grounded the aircraft."

But the captain, the report said, must carry the most responsibility for the accident.

"By not (grounding the aircraft and placarding the faulty ADI), the captain created a potential for an ADI error to cause an accident. By requiring or allowing the inexperienced and uncurrent copilot to perform the takeoff, he made it likely that some mishandling of the aircraft would occur. By not detecting or correcting the pitch-down, he allowed it to develop into a major flight path deviation that resulted in the collision with the terrain."

Based on its investigation, the commission recommended that inspectors charged with supervising the introduction of new airlines make sure that training captains demonstrate by flight test that they are competent to instruct others. The commission also said steps must be taken to ensure that pilots complete approved training programs and meet currency requirements before being assigned to line training on scheduled services. ♦

—G.C.S.

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