



FLIGHT SAFETY FOUNDATION

# Accident Prevention

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## Crew Loses Control of Boeing 737 While Maneuvering to Land

*The airplane was high on approach to Patna, India, and the crew received clearance from air traffic control to conduct a 360-degree turn to reposition for landing. The airplane stalled and descended into a residential area. Fifty-five occupants of the airplane and five people on the ground were killed in the approach-and-landing accident.*

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FSF Editorial Staff

At 0734 local time July 17, 2000, an Airlines Allied Services (Alliance Air) Boeing 737-200 Advanced stalled and struck terrain during an approach in visual meteorological conditions to Patna (India) Airport. Both pilots, all four cabin attendants and 49 passengers were killed; two passengers received serious injuries, and one passenger received minor injuries. Five people on the ground were killed.

A court of inquiry convened by the Indian Ministry of Civil Aviation said, in its final report, that the cause of the accident was “loss of control of the aircraft due to human error (aircrew).”

The report said, “The crew had not followed the correct approach procedure, which resulted in the aircraft being high on approach. They had kept the engines at idle thrust and allowed the airspeed to reduce to a lower than normally permissible value on approach. They then maneuvered the aircraft with a high pitch attitude and executed rapid roll reversals.



“This resulted in actuation of the stick-shaker stall-warning [system], indicating an approaching stall. At this stage, the crew initiated a go-around procedure, instead of an approach-to-stall recovery procedure, resulting in an actual stall of the aircraft, loss of control and subsequent impact with the ground.”

Alliance Air, a subsidiary of Indian Airlines, began operations in April 1996. At the time of the accident, Alliance Air operated 11 B-737-200s. Maintenance and inspection of the 11 airplanes were performed by personnel at both Alliance Air and at Indian Airlines. The report said that the resulting division of decision-making responsibilities, while not a factor in the accident, could cause confusion.

“[This] system of dual channels of responsibility for the same fleet of aircraft being operated by one airline could lead to confusion and divergent decisions,” the report said. “Even though there was no evidence of safety being compromised,



### Boeing 737-200 Advanced

The Boeing 737 originally was designed as a short-range jet transport that would use many components already in production for the B-727. Deliveries of the B-737-100 began in 1967. Fewer than 30 of the 100-series airplanes were built before the model was replaced with the B-737-200, which had a 76-inch (193-centimeter) longer fuselage and accommodated 12 more passengers. The B-737-200 Advanced, introduced in 1971, has aerodynamic improvements, including modified wing-leading-edge slats, Krueger flaps and engine-nacelle fairings.

Standard accommodation is for two flight crewmembers and up to 120 passengers. Standard maximum ramp weight is 115,500 pounds (52,391 kilograms). Maximum landing weight is 103,000 pounds (46,721 kilograms).

Pratt & Whitney JT8D-9A engines, each producing 14,500 pounds thrust (64.5 kilonewtons), were standard. More-powerful JT8D-15 and JT8D-17 engines were options.

Maximum operating speed is Mach 0.84. Maximum cruise speed with JT8D-17 engines is 562 knots. Stall speed at maximum landing weight with flaps extended is 102 knots. ♦

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

there appears to be a strong case to revamp the quality control system in order to eliminate dual control over the ... fleet."

The accident airplane was built in 1980 and was registered in India the same year. The airplane had accumulated 44,087 hours in service and 51,278 flight cycles.

On the day of the accident, the airplane was scheduled to be flown from Calcutta to Delhi, with stops in Patna and Lucknow. The airplane had been flown to Calcutta on July 15 and had received a "layover check."

"There were no observed defects, except for one windshield wiper, which was replaced," the report said.

The crew reported to Alliance Air Operations at 0545 on the day of the accident.

"Both pilots and the four cabin crew[members] subjected themselves to preflight medical examination, including [breath tests] for alcohol," the report said. "Each of them had negative test reports (no alcohol found).

"Personnel on duty at [Calcutta] Airport on that day reported that they had not noticed any abnormal [behavior] or indifferent behavior of the crew while interacting with them. The doctor who performed the preflight medical examination stated that both pilots were temperamentally, clinically and verbally coherent."

The captain, 35, had 5,361 flight hours, including 1,778 flight hours as a B-737-200 pilot-in-command. During the accident flight, the captain occupied the right seat on the flight deck and conducted all radio communication with air traffic control (ATC). The report said that the captain was not qualified as an examiner/instructor/check pilot.

The first officer, 31, had 4,085 flight hours, including 3,605 flight hours as a B-737-200 second-in-command. The first officer's training records showed that, during a simulator session, an instructor had observed inadequate thrust management and had provided additional training to the first officer. The first officer flew the accident airplane from the left seat on the flight deck.

The airplane, operating as Alliance Air Flight 7412, departed from Calcutta at 0651 — 21 minutes after the scheduled departure time. The cruise portion of the flight to Patna was conducted at Flight Level (FL) 260 (26,000 feet). The crew navigated on air route W52 to the SAREK intersection, which is 117 nautical miles (217 kilometers) southeast of the PATNA VOR (PPT).

At 0712, the captain told Calcutta Area Control that the airplane was crossing SAREK.

The controller said, "Contact Patna. No reported traffic for your descent. Coordinate descent with Patna. Good day."

After crossing SAREK, the crew began to conduct the arrival procedure for the instrument landing system (ILS)/distance-measuring equipment (DME) Arc approach to Runway 25 at Patna Airport. The arrival procedure required that, after crossing SAREK, a 315-degree course be flown inbound to an initial approach fix (IAF) 13 nautical miles (DME) from PPT, then a right turn to intercept the 11-DME arc, which leads to the ILS localizer course for Runway 25.

After the crew established radio communication with Patna Tower, they were cleared to conduct the ILS/DME Arc approach to Runway 25. The controller told the crew that the airport had calm winds, 4,000 meters (2.5 statute miles) visibility in haze and broken clouds at 25,000 feet. Surface temperature was 29 degrees Celsius (84 degrees Fahrenheit).

Runway 07/25, the only runway at Patna Airport, was 2,286 meters (7,500 feet) long and 46 meters (150 feet) wide. Available landing distance on Runway 25 was 1,820 meters (5,971 feet). The report said that, because of obstructions on the approach path to Runway 25, the runway threshold was displaced 122 meters (400 feet) and the decision height for the ILS approach was 300 feet (100 feet higher than normal for a Category I ILS approach). The obstructions included tall trees and vehicular traffic on an airport road near the approach end of the runway. (The threshold of Runway 7 was displaced 458 meters [1,500 feet] because of buildings and a railway near the approach end.)

“Pilots tend to instinctively stay above the normal glide path because of the presence of tall trees ... just before the threshold [of Runway 25],” the report said. “This [typically results] in a late touchdown further up the runway from the normal touchdown point and consequent severe use of thrust reversers and brakes. In conditions of poor visibility, rain and at night, this could have serious consequences.”

After receiving clearance for the ILS approach, the flight crew conducted the approach checklist but did not conduct a briefing for the instrument approach and landing.

At 0719, the captain requested descent clearance from ATC.

The controller told the crew to descend to 7,500 feet and to report 25 DME (46 kilometers) from PPT.

At 0726, the captain reported that the airplane was 25 DME from PPT.

The controller told the crew to descend to 4,000 feet and to report “13 DME for ILS/DME Arc approach Runway 25.”

At 0728, the captain told the controller, “Commencing the arc; call you established [on the] localizer.”

The controller told the crew to descend to 2,000 feet and to report crossing the lead radial (i.e., the PPT 080-degree radial, which serves as a reference to begin a left turn from the 11-DME arc to intercept the localizer course).

Flight data recorder (FDR) data showed, however, that the crew did not fly the 11-DME arc; after crossing the IAF, the crew flew a heading of 329 degrees.

“The [flight crew] would have had to turn right through 60 degrees to 70 degrees to join the arc and, thereafter, execute a slow but continuous left turn to 250 degrees to align with Runway 25,” the report said. “However, no such maneuver was recorded.

“The [crew] was supposed to descend to 2,000 feet while flying the arc approach, but the FDR data indicated that the height remained at 4,000 feet, even two minutes after [the captain reported that they had begun flying the arc].”

The first officer turned the airplane slowly left (to 323 degrees), then right (to 327 degrees) and left (to 321 degrees). The crew extended the landing gear, selected flaps to position 15 and conducted the landing checklist.

At 0731, the captain told the controller that the airplane was crossing the lead radial and “coming up on the localizer.”

The controller told the crew to descend to 1,700 feet and to report established on the localizer.

“Per the approach procedure, at the crossing of lead radial 080, the aircraft should have been 11 nautical miles [20 kilometers] from Patna DME and at 2,000 feet,” the report said. “[Actually,] the aircraft was approximately 3.5 nautical miles [6.5 kilometers from the Patna DME transmitter] and at 3,000 feet.”

The report said that the airplane then passed through the localizer course on a heading of 320 degrees.

“At 3.5 nautical miles, the aircraft should have been well established on the localizer and tracking the glideslope, aligned with the runway centerline,” the report said. “The height should have been about 1,400 feet.”

The crew began a left turn, from a heading of 320 degrees to a heading of about 231 degrees, and selected flap position 40. The cockpit voice recorder (CVR) then recorded the

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sound of a horn, which the report identified as an altitude alert. The heading then changed from about 231 degrees to 240 degrees.

The first officer then said either “left hand down” or “left and down.” The report said that the first officer, by saying “left hand down,” might have expressed his intention to conduct a go-around — and establish the airplane on a left downwind for Runway 25; or, in saying “left and down,” the first officer might have called out the location of the runway.

“Either way, this brings into picture a conflict of views, which the [captain] decided to resolve in a completely different manner without any discussion with the [first officer],” the report said.

At 0732, the captain told the controller, “I would like to do one 360 due to high on approach, sir.”

At the time, the airplane was at 1,280 feet and was 1.2 nautical miles (2.2 kilometers) from the threshold of Runway 25.

The controller said, “Confirm aerodrome in sight.”

“Affirm, sir, affirm field in sight,” the captain said.

“Roger, report final Runway 25 after carrying out 360,” the controller said.

The captain acknowledged the instruction.

“This was the last communication from the aircraft,” the report said. “Immediately thereafter, the aircraft was spotted by the air traffic controller in a normal descent aligned with Runway 25. It, however, appeared to be high on approach.”

During the 16 seconds that elapsed between the captain’s request to conduct a 360-degree turn and his acknowledgement of the controller’s instruction to report established on final approach to Runway 25, the airplane’s indicated airspeed decreased from 130 knots to 122 knots. The report said that neither pilot apparently noticed this “drastic” reduction in airspeed.

“This speed reduction did not appear to be intentional,” the report said. “It meant that the [first officer] was not concentrating on flying. He was probably looking out for the runway and judging the situation, or his attention was diverted to what the [captain] was conveying to Patna Tower, which had caught him unaware.

“The [captain] was probably busy with the conversation.”

The report said that a 360-degree turn on final was not a procedure authorized by the airline and that the captain’s

request to conduct a 360-degree turn might have confused the first officer, who likely was expecting to conduct a go-around.

The first officer rolled out of a left turn into a right turn. He then began a steep left turn and, finally, a right turn.

“In approximately 15 seconds, the FDR recorded bank-angle changes from left 21 degrees to right 14 degrees to left 47 degrees to right 30 degrees,” the report said. “The nose-down pitch attitude of the airplane reversed to airplane nose-up, first to eight degrees and then to a peak of 16 degrees.”

The report said that the engines were operated at idle thrust from the beginning of the descent from FL 260 until about eight seconds before impact, when the stick shaker activated. At the time, indicated airspeed was 119 knots, flaps were at position 40, the landing gear was extended, pitch attitude was 10-degrees nose up, and the airplane had been rolled rapidly from right to left.

“Under normal circumstances, the stick shaker was expected to be activated at a speed much below 119 knots,” the report said. “However, a rapid roll reversal with a higher-than-normal nose-up pitch attitude might have activated the stick shaker at [the] higher speed.”

After the stick shaker activated, the crew increased thrust to 1.84 EPR (engine pressure ratio) and repositioned the flap lever from the flaps-40 gate to the flaps-15 gate. The first officer told the captain to retract the landing gear.

“This was followed by a click sound [recorded by the CVR], indicating operation of the gear lever,” the report said.

The gear-unsafe warning then activated, indicating that the flaps were in landing configuration (position 25 or position 40) and that the landing gear was not down and locked. The gear-unsafe warning stopped when the flaps moved through position 25.

“The actions of the crew — that is, full engine thrust, flaps to 15 and landing gear up — related to a go-around procedure,” the report said. “This, along with the pitch attitude of 10 [degrees] to 12 degrees, as recorded by the FDR, indicated that the crew had initiated a go-around to fly out of the situation.

“However, activation of the stick shaker was a warning that the aircraft was approaching a stall and would stall unless an aggressive approach-to-stall recovery action was initiated.”

The report said that when the stick shaker activated, the crew might have prevented the airplane from stalling if, in addition

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to applying full thrust, they had reduced the airplane's angle-of-attack by lowering the nose and had maintained the flap setting at position 40.

"Six seconds after the flap lever was moved to [position] 15, the rate of descent increased," the report said. "This high rate of descent, together with the high nose-up pitch attitude held by the pilot, resulted in the aircraft attaining a very high angle-of-attack, of the order of 26 degrees.

"The aircraft had completely stalled by this time, and, even though thrust had been increased to the maximum possible on both engines, recovery was not possible."

Five seconds before impact, the CVR recorded the sound of a ground-proximity warning system (GPWS) warning: "whoop, whoop, pull up."

The airplane struck six trees, grazed the roof of a residential building with its right wing and struck residential buildings and the ground one kilometer (0.5 mile) left of the final approach path to Runway 25 and one kilometer from the runway threshold. The airplane was destroyed by the impact and a post-accident fire.

"The aircraft wreckage was primarily spread over an area of approximately 100 feet [31 meters] by 100 feet, and the available wreckage indicated that the aircraft was structurally intact [until] it passed through the trees and grazed the roof of the residential [building]," the report said.

The controller observed the airplane descend rapidly and disappear from sight behind a row of trees, where a column of smoke began to rise. The controller then alerted the airport fire station.

The accident site was about six kilometers (10 statute miles) from the airport fire station. Station personnel had observed the airplane descend behind trees and smoke rise from the vicinity.

"They also were alerted by means of the fire bell, airport siren [and a public-address announcement], and were ordered by ATC on walkie-talkie to proceed to the crash site," the report said.

The station's two crash-fire tender (CFT) vehicles arrived at the accident site about 15 minutes to 20 minutes after the accident occurred.

"The crowd which had collected within a short time was of unmanageable proportions and definitely hampered the passage of rescue vehicles," the report said. "Crowd tempers ran high, and there was a general tendency to target anybody in uniform or position of authority with verbal abuse and

physical violence. ... At times, there were hundreds of people trying to climb onto the rescue vehicles to get a better view."

One CFT failed after being operated for three minutes. A maintenance technician was summoned from the airport to repair the vehicle.

"The CFT was put back into operation after about an hour," the report said. "Operation of the CFT after repairs lasted for a few minutes, and [the vehicle] was taken back to the airport to refill water. The CFT, however, broke down twice on the way to the airport, and, each time, the mechanic who was on board the vehicle repaired it."

The report said that the CFT failures were caused by air locks in a fuel line.

"Someone from the surging crowd might have stepped on the fuel line, disturbing its connection," the report said. "This exposed fuel line [was] provided with a protective cover subsequent to this accident."

The other CFT was operated "for a few minutes" at the accident site; the CFT crew then drove the vehicle back to the airport to replenish the water supply.

"The CFT returned from the airport after about 40 [minutes] to 45 minutes and was put back into operation," the report said. "City fire vehicles arrived at around 0830 and joined the fire fighting operations."

The fire fighting operation was completed at about 1030. Autopsies of the accident victims were performed at Patna Medical College Hospital. The report said that a post-accident inspection of the hospital showed that immediate improvements were required.

"The refrigeration equipment, which was meant for preserving bodies awaiting formalities, [had not functioned] since its installation in 1988," the report said. "The casualty ward was in need of routine maintenance and upkeep. The court also felt that there was a need to clean up the premises in general and [to] keep them that way."

As a result of the accident investigation, the court of inquiry made the following recommendations:

- "Alliance Air should review their pilot training, and [the] following aspects should be emphasized:
  - "Discipline in the air;
  - "Cockpit resource management (CRM);

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- “Adherence to standard operating procedures (SOPs); [and,]
- “Training curricula should include procedures such as recovery from approach to stall and clean stall;
- “Indian Airlines and Alliance Air should review their quality control organization to streamline the maintenance of Boeing 737 aircraft in order to remove the duality in command and control with respect to this activity;
- “[The] Airports Authority of India and [the] State Government of Bihar should ensure proper coordination to rid the approach [path] of Runway 25 of trees. Vehicular traffic on the airport road at Patna, which runs very close to the threshold of Runway 25, must be controlled. Only light vehicles should be allowed to ply on this road, and even this traffic should be stopped during the arrival and departure of scheduled airline traffic;
- “The above agencies should also coordinate their efforts to extend ... Runway 07 by acquiring railway land to the south and ... land to the north;
- “Keeping in view the future growth of air traffic and restrictions at the present Patna airport, the

government should consider development of Bihta Airport for civilian traffic by providing the necessary infrastructure in a [timely] manner. [Indian Air Force Station Bihta is about 32 kilometers (52 miles) southwest of Patna and has a 2,500-meter (8,200-foot) runway];

- “The Airports Authority of India should maintain airport equipment and navigational facilities at all airports in the country to the required standards. [The authority] should review availability of the necessary equipment, such as aircraft for air-calibration, [CFTs] and other equipment, so as to maintain them within stipulated standards; [and,]
- “The Patna Medical College Hospital should review its available facilities and provide a properly equipped mortuary. The routine maintenance of the facilities should be carried out.”♦

[FSF editorial note: This report, except where specifically noted, is based entirely on the Indian Ministry of Civil Aviation Court of Inquiry’s *Report on Accident to Alliance Air Boeing 737-200 Aircraft VT-EGD on 17th July, 2000, at Patna*. The 167-page report contains appendixes, diagrams and photographs.]

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