



National Transportation Safety Board

Washington, D.C. 20594
Safety Recommendation

Log 2589

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In reply refer to: A-96-15 through -20

Honorable David R. Hinson
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On February 6, 1996, at 2347 local time, a Boeing 757-200 (B757), TC-GEN, operated by Birgenair, crashed after takeoff from the International Airport in Puerto Plata, Dominican Republic. After climbing through 7,300 feet, the airplane descended until it crashed into the Atlantic Ocean about 5 miles off the coast of the Dominican Republic. All 189 people on board were killed, and the airplane was destroyed. The flight was a charter from Puerto Plata to Frankfurt, Germany, with a scheduled refueling stop in Canada. The National Transportation Safety Board is participating in the investigation conducted by the Director General of Civil Aviation of the Dominican Republic under the provisions of Annex 13 to the Convention on International Civil Aviation.

Although the investigation is continuing, the Safety Board has identified several safety issues that it believes the Federal Aviation Administration (FAA) should address.

Data from the cockpit voice recorder (CVR) and flight data recorder (FDR) indicate that the airspeeds displayed to the captain during the takeoff roll were incorrect and that the captain was aware of this problem. Nevertheless, the captain decided to continue the takeoff, and the first officer notified the captain when the airplane reached rotation and takeoff airspeeds. Shortly after takeoff, the captain commented that his airspeed indicator "began to operate." A normal climbout ensued, and the captain engaged the center autopilot.

During the climb, at an altitude of 4,700 feet, "RUDDER RATIO" and "MACH/SPD TRIM" advisory messages appeared on the engine indication and crew alerting system (EICAS) display unit. For the next several minutes, the crewmembers discussed the significance of these advisory messages and expressed confusion about the airspeed. At an altitude of about 7,000 feet, the captain's airspeed indicator showed 350 knots, and an "OVERSPEED" warning occurred; immediately followed by activation of the stall warning system stick shaker. Flightcrew confusion about airspeed, the proper thrust setting, and the proper pitch attitude was evident as the airplane stalled, descended, and then crashed.

There are three airspeed indicators in the B757: the captain's, the first officer's, and the standby. There is also a display of groundspeed. The standby airspeed indicator is to the right of the captain's flight instruments, in clear view of the captain. The captain's and first officer's displays are driven by separate air data computers that receive inputs from separate pitot probes and static ports. The standby airspeed indicator is pneumatically operated directly from an independent pitot probe and static port. An alternate air data switch is installed on each pilot's panel that, in the event of an erroneous airspeed indication, allows the pilot to select the other air data computer as the data source for the airspeed indication. [Note: The B767 pitot static system is similar to that of the B757, with the only exception being the use of combined pitot-static probes on the B767. The Safety Board believes that the lessons learned from this accident are applicable to the B767, and the corrective action taken should address both the B767 and the B757.]

The calculation of airspeed by the B757 airplane's airspeed indicating systems is based on the difference between dynamic air pressure measured by the pitot probes and static air pressure measured at the static ports. However, as the Safety Board noted in at least one previous air carrier accident,¹ a malfunction of the pitot/static system can cause an erroneous airspeed indication. If a pitot probe becomes blocked (by ice, an insect nest, or any other foreign object, for example), air becomes trapped in the probe, and it can no longer measure dynamic pressure. the airplane climbs, static pressure will decrease, and a difference between the trapped air pressure and the static air pressure will develop. This difference will cause an erroneous, but predictable airspeed indication. The erroneous readings from the captain's airspeed indicator in the Birgenair B757 are consistent with a blocked pitot probe. Comments by the first officer recorded on the CVR suggest that his pitot probe was not obstructed, and he was seeing normal airspeed indications on his instrument display.

The investigation of this accident continues; however, the evidence has raised concerns about the lack of a "caution" alert to warn pilots of an erroneous airspeed indication, the adequacy of procedures pilots are to follow in the event of an erroneous airspeed indication, and the need for pilots to receive training on the effects of a blocked pitot tube on airspeed indications.

The B757/767 airplanes are equipped with an EICAS system that is capable of providing alert messages to advise the pilots of system failures and non-normal operational conditions. These messages are grouped into three priority levels--advisories, cautions, and warnings. Advisories are the lowest alert level and appear in white with no aural warning. Cautions, the next higher alert, appear in yellow and trigger an aural beeper and master CAUTION light. Warnings are the highest alert, appear in red, and are accompanied by an aural beeper and a master WARNING light.

¹ Aircraft Accident Report--"Uncontrolled Collision with Terrain, Northwest Airlines, Inc., Boeing 727-251, N274US, near Thiells, New York, December 1, 1974." (NTSB/AAR-75/13)

The B757/767 EICAS system does not produce a message to alert pilots of an erroneous airspeed indication. However, the Stabilizer Trim and Asymmetry Module (SAM) computer on the B757/767, which provides inputs for various flight control functions that are airspeed dependent, compares the captain's and first officer's airspeed indications. When a difference of 10 knots is detected for 5 seconds within the SAM, the "MACH/SPD TRIM" and "RUDDER RATIO" advisory messages appear. The Boeing Commercial Airplane Group's Operations Manual states that the "MACH/SPD TRIM" advisory is for crew awareness only (no action necessary), and the "RUDDER RATIO" advisory is to notify pilots to avoid abrupt rudder inputs and to be aware of some landing limitations. The manual does not inform pilots that these two advisories together are indicative of an erroneous airspeed indication. The Safety Board believes that the FAA should require Boeing to revise the B757/767 flight manual to notify pilots of the significance of these two advisory messages when they appear simultaneously.

While the B757/767 EICAS systems do not, systems on airplanes such as the Airbus A320, Fokker F-100, and McDonnell Douglas MD-11 compare airspeed indications and activate a "caution" alert when an erroneous airspeed indication is detected. For example, in the MD-11, a discrepancy in airspeed indications will cause an amber airspeed caution message to appear on the primary flight display. This message will blink for 5 seconds and then remain on as long as the discrepancy continues. The F-100 will generate an amber "COMPARE SPEED" alert when a difference of 10 or more knots exists between airspeed indicators. The Safety Board believes that the crew alerting systems of the B757/767 should be modified to activate a "caution" alert when an erroneous airspeed is detected.

According to the FDR data, the captain did not activate his alternate air data source during the accident flight. Had he done so, it would have removed the erroneous airspeed indication, prevented the false "OVERSPEED" warning from activating, and eliminated much of the confusion in the cockpit that preceded the accident. However, the Safety Board found that B757/767 Operating Manuals did not contain procedures to identify an erroneous airspeed indication and select the alternate air data source.

Several B757 operators have developed company-wide procedures for pilots to follow in the event of erroneous airspeed indications. For example, the American Airlines B757 Operating Manual includes an emergency procedure entitled "Airspeed/Mach Indications Unreliable." This procedure states that erroneous or unreliable airspeed indications may be caused by blocked pitot-static systems and that early recognition is essential to maintaining control of the airplane. Pilots are instructed to cross-check airspeed indicators to determine, if possible, which indicators are reliable. If the captain's or first officer's airspeed indicator is not reliable, pilots are instructed to select the alternate air data source. The Delta Air Lines B757 Operating Manual includes an abnormal procedure entitled "Airspeed or Altimeter Fail," which instructs the pilot on the affected side to select the alternate air data source. However, the Birgenair Operating Manual does not contain any similar procedure. The Safety Board believes that Boeing should include procedures that address unreliable airspeed indications in its operating manuals and that the FAA should issue a flight standards information bulletin (FSIB) to direct principal operations inspectors (POIs) to ensure that their operators include this procedure in their operating manuals.

When the Birgenair B757 first officer made the 80-knot call during the takeoff roll, the captain commented that his airspeed indicator was not working. About 6 seconds later at a speed of 120 knots, the captain asked the first officer if his airspeed indicator was working. The first officer replied that it was; however, this was only 4 seconds before the airplane rotated for takeoff.

A review of the B757/767 Operations Manual, the Boeing Flight Crew Training Manual, and the FAA Takeoff Safety Training Aid revealed that all three documents stress the importance of an airspeed callout during takeoff roll. The purpose of this callout is to allow a low-speed rejected takeoff in the event of "any adverse condition significantly affecting the safety of flight." In its 1990 Special Investigative Report, "Runway Overruns Following High Speed Rejected Takeoffs," the Safety Board stated that "the speed callout (at 80 knots) can alert crewmembers to check their air speed indicators for reliability." The Safety Board is concerned that the crew of the accident airplane apparently did not recognize the implications of the inoperative airspeed indicator and consider rejecting the takeoff while at a low speed. The Safety Board believes that the FAA should issue an FSIB to notify POIs of the circumstances of this accident and to have them review the training programs of their operators to ensure that emphasis is placed on the recognition of airspeed system malfunctions while at low speed during the takeoff roll.

Finally, the Boeing B757/767 training syllabus includes an effective scenario in the flight simulator during which the student experiences the effects of a blocked pitot tube. The student must demonstrate proficiency in identifying the erroneous airspeed indication and selecting the alternate air data source. A survey of other B757/767 training providers revealed that not all include this scenario in their training programs. The Safety Board believes that the FAA should ensure that all B757/767 training providers include this scenario, or other similar scenarios that present pilots with unreliable airspeed indications, in their training programs.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue an airworthiness directive to require that the Boeing 757/767 airplane flight manual be revised to notify pilots that the simultaneous activation of the "MACH/SPD TRIM" and "RUDDER RATIO" advisories is an indication of an airspeed discrepancy. (Class II, Priority Action) (A-96-15)

Require that the Boeing Commercial Airplane Group modify the crew alerting system of the Boeing 757/767 to include a "caution" alert when an erroneous airspeed indication is detected. (Class II, Priority Action) (A-96-16)

Require the Boeing Commercial Airplane Group to modify its Boeing 757/767 Operations Manual to include a detailed emergency procedure addressing the identification and elimination of an erroneous airspeed indication. (Class II, Priority Action) (A-96-17)

Issue a flight standards information bulletin to direct principal operations inspectors to ensure that the operating manuals of their Boeing 757/767 operators include a detailed emergency procedure addressing the identification and elimination of an erroneous airspeed indication.

(Class II, Priority Action) (A-96-18)

Issue a flight standards information bulletin to notify principal operations inspectors of the circumstances of this accident and to have them ensure that training providers emphasize the importance of recognizing an airspeed indication malfunction during the takeoff roll. (Class II, Priority Action) (A-96-19)

Ensure that all Boeing 757/767 training providers include an effective scenario in the flight simulator during which the student is trained to appropriately respond to the effects of a blocked pitot tube. (Class II, Priority Action) (A-96-20)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

A handwritten signature in black ink, appearing to read "J. Hall", with a large, stylized initial "J" that loops around the first part of the name.

By: Jim Hall
Chairman