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Erroneous Airspeed Indications Cited in Boeing 757 Control Loss

Investigators concluded that the airplane had a blocked pitot tube and that, during departure, the flight crew became confused by false indications of increasing airspeed and did not respond to a stall warning. All the occupants were killed when the airplane struck the Caribbean Sea off the northern coast of the Dominican Republic.

FSF Editorial Staff

About 2347 local time on Feb. 6, 1996, a Boeing 757-225 (B-757) struck the sea off the northern coast of the Dominican Republic about five minutes after takeoff from Gregorio Luperon International Airport in Puerto Plata. The airplane was destroyed, and all 189 occupants were killed.

In its final report, the Dominican Junta Investigadora de Accidentes Aéreos (JIAA) said that the probable cause of the accident was "the failure on the part of the flight crew to recognize the activation of the stick shaker as an imminent warning of [an] aerodynamic stall and their failure to execute proper procedures for recovery [from] the control loss."

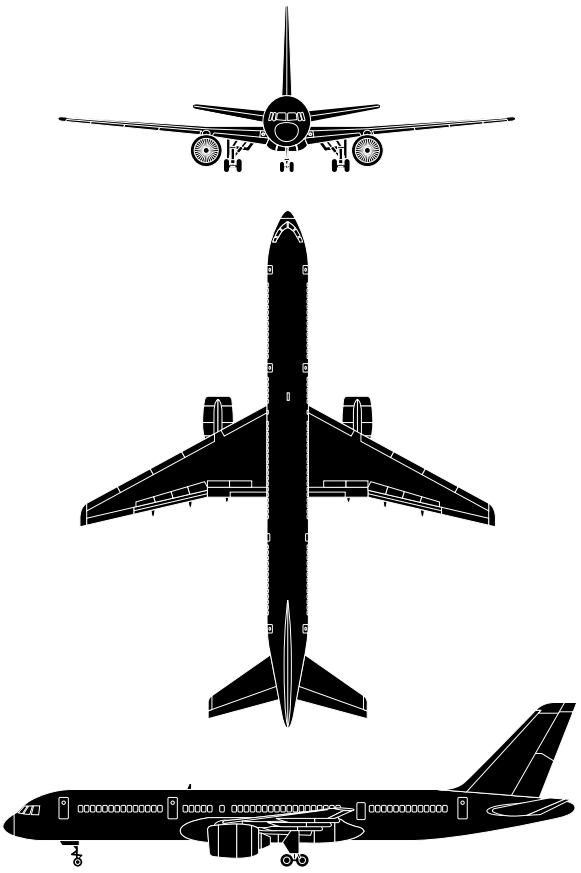
The report said, "Before activation of the stick shaker, confusion of the flight crew occurred due to the erroneous indication of an increase in airspeed [on the captain's airspeed indicator] and a subsequent overspeed warning."

The report said that the erroneous airspeed indication and the erroneous overspeed warning were caused by an obstruction of the airplane's left upper pitot tube.

The airplane was operated by Birgenair, a charter company based in Istanbul, Turkey, for the Dominican airline Alas Nacionales. The airplane was scheduled to be flown to Frankfurt, Germany, with stopovers in Gander, Newfoundland, Canada, and Berlin, Germany.

About 2110, the B-757 crewmembers were notified that they would conduct the flight. The flight originally was scheduled to be conducted in a Boeing 767, but that airplane had a mechanical failure.

"[The B-767] mechanical failure … required a change of equipment and the crew that was attached to the flight," said the report.



Boeing 757

The Boeing 757-200 series is a medium-range airliner designed to carry 186 passengers in a typical mixed-class configuration. The B-757 can accommodate up to 239 passengers in charter service, putting its capacity between that of the Boeing 737-400 and the Boeing 767. A longer range version and a freighter configuration of the B-757 are also available.

The B-757-200 is powered by two turbofan engines mounted in underwing pods. Engine pairs for the B-757 are provided by Pratt & Whitney (PW 2037 or PW 2040) and Rolls-Royce (535 series). The engines differ slightly in their static thrust.

The aircraft has a maximum takeoff weight of 104,325 kilograms (kg; 230,000 pounds [lb]) and engine thrust is rated between 170 kilonewtons (kN; 38,200 lb) and 197.1 kN (43,100 lb). At maximum takeoff weight with 186 passengers, the B-757 has a range of between 5,222 kilometers (km; 2,820 nautical miles [nm]) and 5,519 km (2,980 nm), depending on the engine installed. The B-757 has a top speed of Mach 0.86 and a normal cruising speed of Mach 0.80.

The two-pilot cockpit of the B-757 has a computerized, fully integrated flight management system (FMS) that provides automatic guidance and control of the aircraft from immediately after takeoff to final approach and landing. The FMS controls navigation, guidance and engine thrust to ensure that the aircraft flies the most efficient route and flight profile.

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

Twelve B-757 crewmembers reported for duty at the airport about 2215.

"There was an additional delay of an hour because of a delayed airline flight attendant," said the report.

Because of the duration of the flight, three pilots were required: a captain (pilot-in-command), a relief captain and a first officer.

The captain, 62, had 24,750 flight hours, including 1,875 flight hours in type. He had type ratings in the Boeing 707, 727, 737 and 757/767, the Douglas DC-8 and DC-9, and the Vickers Viscount 794. His last training occurred March 12, 1995, and consisted of B-757/767 flight simulator training at United Airlines Flight Training Center.

The relief captain, 51, had 15,000 flight hours, including 122 flight hours in type. He had type ratings in the Airbus A300-B4 and A310, Boeing 727, 737 and 757/767, Douglas C-47 and DC-9, and the Transall C-160. His last training occurred Jan. 28, 1996, and consisted of B-757/767 flight simulator training at Pan Am International Flight Academy.

The captain and relief captain were Turkish citizens. The report did not include detailed information about the first officer.

"The three flight crewmembers had proper medical authorizations indicating their abilities as flight crewmembers," the report said. "However, the captain was 62 years old, which in certain countries [with age limits for flight crewmembers] excludes him from being the pilot-in-command.

"The investigation was not able to verify the activities of the flight crewmembers during the time before reporting for the flight. Postmortem examinations were not available; therefore, no physiological evaluation could be conducted."

The report said, "It is possible that the flight crew was not physically or mentally rested and prepared to fly the trip due to the unexpected call of the crew during scheduled free time."

The airplane was manufactured in 1985 and had a Turkish airworthiness certificate. The airplane had accumulated 29,269 service hours and 13,499 cycles. It had not been flown for 20 days before the accident.

"There were no abnormalities noted during routine, recommended maintenance while the aircraft was on the ground in Puerto Plata," said the report. The maintenance included an inspection and ground test of the engines.

"Investigators believe that the engine [covers] and pitot covers were not installed before or after the engine ground test," said the report.

The airport had light precipitation, "good" visibility, scattered clouds at 1,800 feet and a broken ceiling at 7,000 feet. Surface

winds were from the east-southeast at 10 knots. The report said that "some storm cells of major intensity" were south and northeast of the airport.

"The existing meteorological conditions and the forecast for the area were favorable for the flight, [and were] not considered a contributing factor to this accident," the report said. "The dispatch procedures, including weight-and-balance [calculations] and performance calculations, were appropriate for the departure airport and within the limitations of the aircraft."

The captain and first officer began the takeoff about 2342:08. At 2342:16, the first officer called "80 knots."

The captain said "checked." He then said, "My airspeed indicator's not working."

The first officer said, "Yes, yours is not working."

The captain said, "Is yours working?"

The first officer said that his airspeed indicator was working.

The captain said, "You tell me." The report said that this meant that the captain wanted the first officer to call out airspeeds based only on the first officer's airspeed indicator.

Five sources of velocity information were available to the crew. They included the captain's airspeed indicator, the first officer's airspeed indicator, a standby airspeed indicator in the center of the instrument panel, a groundspeed readout on the captain's electronic flight information system (EFIS) display and a groundspeed readout on the first officer's EFIS display.

"The purpose of doing a check at 80 knots [during takeoff is,] among other things, to verify the proper functioning of the engines and flight instruments," said the report. "The captain underestimated the lack of indication of airspeed and, contrary to the established procedures, he continued the takeoff.

"Performance calculations made after the accident showed that the aircraft would have required only 2,280 feet of runway to decelerate from 80 knots [and that] the captain would have been able to accelerate to V_1 [takeoff decision speed] and abort the takeoff leaving sufficient runway [to stop the airplane]."

At 2342:35, the first officer called "vee one." One second later, he called "rotate." The airplane lifted off the runway four seconds later. The captain and first officer confirmed a positive rate of climb, retracted the landing gear and engaged the autopilot lateral navigation (LNAV) mode.

At 2343, the captain said that his airspeed indicator had begun to operate. At this time, the airplane was at 576 feet, and its groundspeed was 121 knots. (The flight data recorder [FDR] recorded groundspeed from the airplane's inertial reference units; the FDR recorded indicated airspeed from the captain's air-data computer [ADC].)

The flight crew turned off the windshield wipers, set climb thrust, engaged the autopilot vertical navigation (VNAV) mode, retracted the flaps and completed the after-takeoff checklist.

At 2344:07, the captain told the first officer to engage the center autopilot. The airplane was at 3,500 feet, and groundspeed was 273 knots.

At 2344:25, the captain said, "Rudder ratio, mach airspeed trim." The report said that he was referring to two messages that had appeared on the engine indication and crew alerting system (EICAS) display; the simultaneous appearance of the messages "rudder ratio" and "mach/speed trim" is an indication of a possible discrepancy between the reading on the captain's airspeed indicator and the reading on the first officer's airspeed indicator.

"There is something wrong; there are some problems," the captain said. About 15 seconds later, he said, "OK, there is something crazy. Do you see it?" The airplane was in a 15-degree nose-up attitude, and the captain's airspeed indicator showed 327 knots.

The first officer said, "There is something crazy there. Right now, mine is only 200 and decreasing, sir." The report said that the first officer was referring to the indications on his airspeed indicator, which showed that the airspeed was 200 knots and decreasing. Neither pilot made reference to the standby airspeed indicator or to the groundspeed readouts on their EFIS displays.

"There was much confusion in the cockpit, which interfered with the [crew's] analysis of the discrepancies of the airspeed and the choice of the appropriate course of action," said the report. The captain believed that both his airspeed indicator and the first officer's airspeed indicator were providing erroneous indications.

"Both of them are wrong," the captain said. "What can we do?" He then said, "Let's check their circuit breakers." FDR data showed that the airplane was at 5,344 feet and that the captain's airspeed indicator showed 327 knots.

At 2344:59, the captain said, "Alternate is correct." The first officer concurred that the alternate (standby) airspeed indicator was providing correct indications. There was no discussion among the pilots, however, about using the indications provided by the alternate airspeed indicator to check those provided by the captain's airspeed indicator and the first officer's airspeed indicator.

"Although the affirmations of the captain and the first officer indicated that both crewmembers recognized that the indications of the alternate [airspeed] indicator were correct,

Cockpit Voice Recorder Transcript, Birgenair Flight ALW-301, Feb. 6, 1996

(FSF editorial note: The following transcript is as it appears in the Junta Investigadora de Accidentes Aéreos of the Director General of Civil Aeronautics of the Dominican Republic accident report, except for minor column rearrangement and addition of notes defining some terms that may be unfamiliar to the reader. Times are local.)

Time	Source	Content
2341:40	**HOT-2**	Have a nice flight
2342:08	**CAM**	(sound of increasing engine noise)
2342:09	**HOT-1**	EPR select
2342:10	**HOT-2**	EPR
2342:16	**HOT-2**	Power's set
2342:18	**HOT-1**	OK, checked
2342:23	**HOT-2**	Eighty knots
2342:24	**HOT-1**	Checked
2342:26	**HOT-1**	My airspeed indicator's not working
2342:28	**HOT-2**	Yes
2342:29	**HOT-2**	Yours is not working
2342:30	**HOT-2**	One twenty
2342:32	**HOT-1**	Is yours working?
2342:32	**HOT-2**	Yes sir
2342:33	**HOT-1**	You tell me
2342:35	**HOT-2**	Vee one
2342:36	**HOT-2**	Rotate
2342:43	**HOT-1**	Positive climb, gear up
2342:43	**HOT-2**	Positive climb
2342:44	**CAM**	(sound of landing gear handle being moved)
2342:46	**HOT-2**	Gear is up
2342:50	**HOT-2**	LNAV?
2342:51	**HOT-1**	Yes, please
2342:52	**HOT-2**	LNAV
2342:59	**HOT-1**	Yes
2343:00	**HOT-1**	It began to operate
2343:02	**HOT-1**	Could you turn off the wipers?
2343:03	**HOT-2**	Okay, wipers off
2343:05	**CAM**	(sound of windshield wipers stops)
2343:08	**HOT-1**	Climb thrust

they did not seem to understand the importance of comparing the three [airspeed] indicators," the report said. "None of the three flight crewmembers suggested the appropriate course of action to compare the indications or to switch the instrument selector [to the alternate source] to derive airspeed information from the [first officer's] ADC and its pitot system. The alternate source [could have provided airspeed information] for the autopilot system.

"The failure of the flight crew to realize the right course of action and to understand the reduction of displayed groundspeed information on the EFIS screens indicated a lack of knowledge of the aircraft systems and a lack of crew resource management (CRM) in the cockpit.

"Instead of taking definitive action to determine a valid reference for airspeed and to control the increasing pitch attitude, the captain initiated a discussion that forced the crew to rationalize the disparity of airspeed information."

The captain said that abnormalities could be expected because the airplane had not been flown for awhile.

"As the aircraft was not flying and on the ground, something happening is normal … such as elevator asymmetry and other things," said the captain.

Then, referring to the "rudder ratio" and "mach/speed trim" messages on the EICAS, the captain said, "We do not believe them."

"His analysis prevailed in the cockpit, and a period of 19 seconds of silence followed," the report said. "The relief captain then said, 'Shall I reset its circuit breaker … to understand the reason?'" The captain told the relief captain to reset the circuit breaker. The report does not provide information on which circuit breaker was reset.

The B-757 Operations Manual contained procedures for conducting a flight with an untrustworthy airspeed indicator. The procedures included recommended pitch attitudes and throttle settings for climb, cruise and landing.

"While the flight continued to climb, the crewmembers did not discuss or demonstrate that these procedures were available," the report said. "They never focused their attention on the enormous pitch attitude that developed or the alternate sources of velocity information that were present in various indicators in the cockpit.

"During the final two minutes of the flight, the crew did not take proper actions necessary to prevent the loss of control of the aircraft."

The airplane was at 6,688 feet, and the captain's airspeed indicator showed 352 knots when, at 2345:28, an overspeed warning sounded. At this time, the airplane's groundspeed was 199 knots.

The captain said, "OK, it's no matter. Pull the airspeed; we will see … ."

The report said that the captain's statement, "pull the airspeed," was a command to pull the circuit breaker for the overspeed-warning system, so that the overspeed warning would be silenced. The overspeed warning stopped at 2345:39. At this time, the airplane was at 7,040 feet, the captain's airspeed indicator showed 349 knots, and the pitch attitude was 14.8 degrees nose-up.

"Had pitch attitude been reduced, complete recovery was possible," said the report.

At 2345:46, the crew disengaged the autopilot's VNAV mode and engaged the autopilot's vertical-speed mode. The crew then disengaged the autothrottles, reduced power — from a setting of approximately 1.6 EPR (engine pressure ratio) to 1.1 EPR — and moved the control column aft. The pitch attitude increased to 18 degrees.

At 2345:52, the stall-warning stick shaker activated. The airplane was at 7,132 feet, and the captain's airspeed indicator showed 323 knots. Five seconds later, power on both engines was increased to approximately 1.6 EPR. Pitch attitude increased to 21 degrees, and the autopilot disengaged automatically. The airplane began to descend.

"The automatic pilot disengaged [because it had reached] the limit of its operational authority," the report said. "For almost one minute after the disengagement of the automatic pilot, the aircraft maintained a positive pitch attitude (nose up) … and continued to descend."

At 2346, the relief captain said "ADI." He said "ADI" again 31 seconds later. The report said that the relief captain's reference to the ADI (attitude director indicator) was intended as a suggestion that the captain and first officer maneuver the airplane to an appropriate nose-down pitch attitude.

At 2346:07, the first officer said "nose down." Sixteen seconds later, he said "thrust." The captain then asked if the autopilot was disconnected, and the first officer confirmed that the autopilot was disconnected.

At 2346:31, power on both engines was reduced to approximately 1.1 EPR. At this time, the airplane was at 5,984 feet, groundspeed was 194 knots, and the pitch attitude was 14.4 degrees nose-up. Groundspeed then decreased to approximately 140 knots, and the airplane abruptly pitched nose-down.

The captain said, "Not climbing? What can I do?"

Postaccident tests in a flight simulator showed that a recovery from the stall might have been achieved with application of full power and proper positioning of the flight controls.

2343:09	**HOT-2**	Climb thrust
2343:10	**HOT-1**	VNAV
2343:11	**HOT-2**	VNAV
2343:16	**HOT-2**	Okay, flap speed
2343:17	**HOT-1**	Flaps five
2343:24	**HOT-1**	Flaps one
2343:25	**HOT-2**	Flaps to one
2343:30	**HOT-1**	Gear handle off
2343:32	**HOT-2**	Gear handle's off
2343:33	**HOT-1**	Flaps up
2343:34	**HOT-2**	Flaps up
2343:36	**HOT-1**	After takeoff checklist
2343:38	**HOT-2**	After takeoff checklist, landing gear up and off, flaps are up, checked up, altimeters later, after takeoff completed
2343:47	**HOT-1**	Okay
2344:07	**HOT-1**	Center autopilot on, please
2344:08	**HOT-2**	Center autopilot is on command
2344:10	**HOT-1**	Thank you
2344:12	**HOT-1**	One zero one three
2344:13	**HOT-2**	One zero one three
2344:25	**HOT-1**	Rudder ratio, mach airspeed trim
2344:27	**HOT-2**	Yes, trim
2344.28	**HOT-1**	There is something wrong, there are some problems
2344:43	**HOT-2**	Direct Pokeg
2344:44	**HOT-1**	Okay, there is something crazy … do you see it?
2344:46	**HOT-2**	There is something crazy there … right now mine is only two hundred and decreasing, sir
2344:52	**HOT-1**	Both of them are wrong, what can we do?
2344:54	**HOT-1**	Let's check their circuit breakers
2344:55	**HOT-2**	Yes
2344:57	**HOT-1**	Alternate is correct
2344:59	**HOT-2**	The alternate one is correct
2345:04	**HOT-1**	As the aircraft was not flying and on the ground, something happening is normal
2345:07	**HOT-1**	Such as elevator asymmetry and other things
2345:11	**HOT-1**	We don't believe them
2345:23	**CAM-3**	Shall I reset its circuit breaker?

2345:24	**HOT-1**	Yes, reset it
2345:25	**CAM-3**	To understand the reason …
2345:27	**HOT-1**	Yeah
2345:28	**CAM**	(sound of aircraft overspeed warning)
2345:30	**HOT-1**	Okay, it's no matter
2345:39	**HOT-1**	Pull the airspeed, we will see …
2345:39	**CAM**	(sound of overspeed warning stops)
2345:40	**HOT-2**	Now it is three hundred and fifty, yes?
2345:47	**HOT-1**	Let's take that like this …
2345:50	**CAM**	(sound of four warning alert tones)
2345:52	**CAM**	(sound of stick shaker starts and continues to end of recording)
2345:56	**CAM**	(sound of four warning alert tones)
2345:56	**HOT-1**	* * * *
2345:57	**HOT-2**	* * * *
2345:59	**HOT-2**	Sir
2346:00	**CAM-3**	* ADI
2346:05	**HOT-1**	* * * *
2346:07	**HOT-2**	Nose down
2346:19	**HOT-2**	* * * *
2346:22	**CAM-3**	Now *
2346:23	**HOT-2**	Thrust
2346:25	**HOT-1**	Disconnect the autopilot, is the autopilot disconnected?
2346:25	**HOT-2**	Already disconnected, disconnected sir
2346:31	**CAM**-3	* ADI *
2346:38	**CAM-3**	*
2346:39	**HOT-1**	Not climbing? What am I to do?
2346:43	**HOT-2**	You should level off, altitude okay, I am selecting altitude hold, sir
2346:47	**HOT-1**	Select, select
2346:48	**HOT-2**	Altitude hold
2346:51	**HOT-2**	Okay, five thousand feet
2346:52	**HOT-1**	Thrust levers, thrust thrust thrust thrust
2346:54	**HOT-2**	Retard
2346:54	**HOT-1**	Thrust, don't pull back, don't pull back, don't pull back, don't pull back
2346:56	**HOT-2**	Okay, open, open
2346:57	**HOT-1**	Don't pull back, please don't pull back
2346:59	**HOT-2**	Open sir, open

"The Boeing [Co.] informed the investigators that engineers, during flight, had inadvertently entered into a similar flight profile during the development tests of the aircraft and that they were able to regain control of the aircraft by using normal recovery techniques for the stall," said the report.

At 2346:43, the first officer told the captain, "You should level off. Altitude (is) OK. I am selecting altitude hold, sir." The captain concurred with the first officer's decision to select the autopilot altitude-hold mode.

"However, the [FDR] indicated that the automatic pilot was no longer connected and, for that reason, the altitude-hold function was not available," the report said. "The atmosphere of confusion continued between the three pilots while the aircraft [descended]."

At 2346:52, the captain said, "Thrust levers, thrust, thrust, thrust, thrust."

The first officer said, "Retard."

The captain said "thrust" and then told the first officer four times not to pull the throttles back. The first officer then confirmed that the throttles were open.

At 2346:57, EPR on both engines increased to approximately 1.6. Two seconds later, left-engine EPR was reduced to approximately 1.2; right-engine EPR remained at approximately 1.6.

At 2347:02, the reserve captain said, "Sir, pull up."

The captain said, "What's happening? Oh, what's happening?"

At this time, the airplane was at 3,520 feet, in a 53.3-degree nose-down pitch attitude and in a 99.8-degree left bank. Groundspeed was zero.

At 2347:09, the cockpit voice recorder (CVR) recorded ground-proximity warning system (GPWS) warnings: "sink rate, whoop, whoop, pull up, pull up." The airplane was at 2,368 feet, in a 17.6-degree nose-down pitch attitude and in a 9-degree left bank. The GPWS warnings continued until the CVR stopped recording at 2347:17.

The airplane was in a 34.3-degree nose-down pitch attitude and a 34.6-degree left bank when it struck the ocean 14 nautical miles (26 kilometers) northeast of Puerto Plata. The aircraft was destroyed by the impact with the water.

"Due to the severity of the impact, it is believed that no one would have been able to survive this accident," said the report. Toxicologic tests showed that none of the airplane occupants had inhaled combustible vapors or carbon monoxide.

"This indicates … that there was no fire [and] no combustible leaks before the impact, thus discarding the possibility of a pre-impact fire or explosion," said the report. "There was no evidence of fire in the wreckage found [or] in the recovered cadavers."

The wreckage sank to a depth of 7,200 feet. On Feb. 28, 1996, the CVR and FDR were recovered by a U.S. Navy remote-control submersible vehicle and analyzed by the U.S. National Transportation Safety Board.

"The inspection of the taped information in the recorders indicated that the taping system was operating normally, but … the values of calibrated airspeed [did] not correlate with the other recorded parameters," the report said. "These calibrated airspeeds correlated with a total block of the captain's pitot tube."

As the airplane climbed and the pressure of the outside air decreased, the air trapped in the pitot system expanded and caused the false indications of increasing airspeed.

"When an aircraft has a blocked pitot tube, as the altitude increases, the indicated airspeed will also increase; the airspeed indicator will eventually be able to exceed the maximum operational airspeed, and the affected [ADC] will generate an overspeed warning," said the report.

When investigators conducted flight simulator tests of a B-757 with an obstructed pitot tube, they encountered erroneous airspeed indications that were similar to those recorded during the accident flight.

"The overspeed warning and stick shaker [activation] occurred in a similar pattern to that of the actual flight," said the report.

Because the wreckage of the accident airplane was not recovered, the cause of the pitot-system obstruction was not determined.

"The probable source of obstruction in the pitot system was mud and/or debris from a small insect that was introduced in the pitot tube during the time the aircraft was on the ground in Puerto Plata," the report said. "The aircraft … was not flown for 20 days before the crash [and] was returned for service without a verification of the pitot-static system as recommended by the manufacturer's maintenance procedures.

"If this inspection had been completed as a part of the return to service, it may have discovered the blocked pitot-tube system, and the [problem] would have been corrected before the flight.

"The obstructed pitot tube was not the probable cause of the accident; however, it was a contributing factor."

The report said that Birgenair's flight-crew training did not include CRM training and that the accident flight crew's training had not prepared the pilots to recognize the malfunction and to respond properly to the malfunction.

2347:01	**HOT-2**	* * * *
2347:02	**CAM-3**	Sir, pull up
2347:03	**HOT-1**	What's happening?
2347:05	**HOT-2**	Oh, what's happening?
2347:06	**CAM-3**	*
2347:09	**CAM**	(sound of GPWS, sink rate, whoop whoop pull up warning starts and continues until the end)
2347:13	**HOT-2**	Let's do like this
2347:14	**CAM-3**	*
2347:17		**(end of recording)**

CAM	=	Cockpit area microphone
HOT-1	=	Captain
HOT-2	=	First officer
CAM-3	=	Relief captain
* * * *	=	Unintelligible
ADI	=	Attitude director indicator
EPR	=	Engine pressure ratio
GPWS	=	Ground-proximity warning system
LNAV	=	Lateral navigation
VNAV	=	Vertical navigation

Source: Junta Investigadora de Accidentes Aéreos of the Director General of Civil Aeronautics of the Dominican Republic

"The flight crewmembers were qualified 'on the record,' but did not demonstrate the necessary basic knowledge of procedures, aircraft systems and crew discipline to recognize and restore trustworthy information to the [captain's] airspeed indicator or [to the] autopilot system," the report said. "Equally, they did not refer to [the section on] 'flights with an untrustworthy airspeed indicator' [in] the B-757 Operations Manual or to the section dealing with recovery from an aerodynamic stall. Moreover, there was a complete failure of the administration of crew resources in the anomalous handling of the aircraft.

"This accident is an indicator that international requirements for flight-crew training have not been maintained at a level consistent with the growth and modernization of the air-transport industry and the development of modern aircraft."

As a result of its accident investigation, JIAA made the following recommendations to the International Civil Aviation Organization:

- "Issue a directive requiring that the flight manual of the [B-]757/767 be revised to notify the pilots that simultaneous activation of the warnings 'mach/speed

trim' and 'rudder ratio' may be an indication of discrepancies in airspeed [indications];

- "Require [The Boeing Co.] to modify the B-757/767 alert system to include an advisory ('caution alert') when an erroneous airspeed is detected;

- "Require [The Boeing Co.] to modify the operations manual of the B-757/767 to include in the emergency-procedures section information about identification and elimination of an erroneous airspeed indication;

- "Issue a flight standards information bulletin directed to all operations inspectors to assure that the operations manuals of B-757/767 operators contain procedures about identification and elimination of an erroneous airspeed indication;

- "Issue an aeronautical information bulletin notifying the inspectors of the circumstances of this accident, to assure that in training there will be an emphasis on the importance of recognizing a malfunctioning airspeed indicator during the course of takeoff;

- "[Ensure] that all training in the B-757/767 includes a scenario flight in the simulator where the pilot is trained to respond appropriately to the effects of a blocked pitot tube;

- "[Ensure] that each air business has a manual of specific training and is specialized for the type of operations specific to that airline without taking into account the generic training of the flight crew offered by businesses dedicated to the sale of training (academies, schools, etc.);

- "Establish as a requirement of all commercial air businesses a program of flight crew training in [CRM]; [and,]

- "Revise the existing training requirements to gain better efficiency for flight crews."♦

[Editorial note: This article, except where specifically noted, is based entirely on the factual report and the cockpit voice recorder (CVR) transcript in the Junta Investigadora de Accidentes Aéreos of the Dominican Republic Director General of Civil Aeronautics *Final Aviation Accident Report: Birgenair Flight ALW-301, Puerto Plata, Dominican Republic, February 6, 1996*. The factual report and CVR transcript were translated into English, reprinted and distributed by the Air Line Pilots Association, International.]

ACCIDENT PREVENTION

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