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Rejected Takeoff in Icy Conditions Results in Runway Overrun

The flight crew failed to comply with checklist procedures, leading to erroneous airspeed indications and a rejected takeoff at a speed exceeding V_1, the official U.S. accident investigation says.

Editorial Staff Report

The McDonnell Douglas MD-82 aircraft with 110 passengers on board was attempting a night takeoff at LaGuardia Airport, Flushing, New York, U.S., when anomalous airspeed indications caused the captain to command a rejected takeoff (RTO). Despite braking and reverse thrust, the aircraft continued beyond the takeoff end of the runway and came to rest with the nose pitched downward on a tidal mud flat and with the fuselage lodged on top of a dike.

There were no fatalities or serious injuries in the March 2, 1994, accident involving Continental Airlines (COA) Flight 795. Twenty-nine passengers and one flight crew member sustained minor injuries. All passenger injuries were sustained during the evacuation.

The U.S. National Transportation Safety Board (NTSB) concluded in its final aircraft accident report that the probable causes of the accident were the "failure of the [flight crew] to comply with checklist procedures to turn on an operable pitot/static heat system, resulting in ice and/or snow blockage of the pitot tubes that produced erroneous airspeed indications, and the [flight crew's] untimely response to anomalous airspeed indications with the consequent rejection of takeoff at an actual speed of [five] knots above V_1 [preselected decision speed at and below which takeoff can be aborted and the aircraft can be stopped on the runway]."

The report said that safety issues included "availability of takeoff performance data for [flight crews], the proper functioning of pitot/static heat systems, the duration of cockpit voice recordings, and problems associated with passenger evacuations from airplanes."

The accident flight was the return leg for the Denver-based crew. The flight originated at Denver Stapleton International Airport (DEN) with a first leg to LaGuardia (LGA) and a return to DEN. The first leg departed DEN at 1030 local time and arrived at LGA at 1639 local time. There was a scheduled turnaround time of about 44 minutes at LGA.

Before departing the gate, the first officer conducted a preflight walkaround and determined that the aircraft needed to be deiced, the report said.

"One of the deicing personnel said that it was not snowing heavily when the deicing was completed, but that the snowfall began to increase when [Flight] 795 was taxiing out," the report said. "The fluid applications truck driver stated that snow did not appear to be adhering to the airplane's surfaces."

The report said that after deicing was completed, the left engine was started and the flight crew began preparations for taxi and takeoff. Shortly before departing the gate, the first officer

inspected the wings from the cabin with a flashlight and told the captain that the wings looked "okay to me." Ramp surfaces were described as "slushy" by a mechanic, the report said.

"At 1756:52, the first officer started the right engine and recited checklist items for 'after engine started,'" the report said. "LGA tower cleared the flight to ' ... taxi into position and hold' on takeoff [Runway] 13 at 1757:02."

Prior to commencing the takeoff roll, the captain gave an RTO briefing to the first officer: " … [If] we have to abort, I […] I'll call the abort and ... as soon as I pull the throttles back, I have control of the airplane, you help me get it stopped mainly by makin' sure the spoilers are out, we get it stopped then you tell the flight attendants to remain seated and tell the tower we've aborted, we'll go through the ah checklist," according to the NTSB's transcript of the airplane's cockpit voice recorder (CVR).

The report said that both pilots stated that there was blowing snow on the runway but that lights and runway markings were visible. The auxiliary power unit (APU) was left running during the takeoff, the report said.

The first officer was the pilot flying during the takeoff roll. "He stated that he advanced the throttles to achieve cockpit indicator readings of 1.2 engine pressure ratio (EPR), and called 'autothrottles on,'" the report said. "The captain [cross-checked] the N_1 readings and compared them with the EPR readings for both engines to confirm that takeoff power was set. The captain said that the N_1 readings were 90 percent and that the EPRs were 1.93.

Airspeed Appeared to Stop Increasing

"The first officer released the brakes at 1758:48, and the airplane began to accelerate on the runway for takeoff," the report said. "The captain said that at 60 knots, the [knots] indicated airspeed (KIAS) appeared to stop increasing. He said the airspeed indicator increased once from 60 knots to 80 knots, then returned to 60 knots. He glanced at the first officer's airspeed indicator and noted that it also read about 60 knots. He did not recall checking the airspeed on the standby airspeed indicator. The captain said that he was considering rejecting the takeoff and, about this time, saw a red light flicker on the instrument panel, just below the glare shield."

At 1759:23, the captain called out "Abort" and applied maximum braking and maximum reverse thrust, the report said. "He [the captain] … stated that the brakes were ineffective and the airplane continued to slide down the runway. He said he thought the airplane slowed to approximately 30 knots. He attempted to turn the airplane at the end of the runway, but was unable to do so. He straightened the airplane so that the nose of the airplane impacted the dike that was beyond the end of [Runway] 13. The first sounds of impact were heard on the CVR at 1759:46."

The report said that the accident occurred about three hours before low tide and that the airplane's nose did not go below the surface of the water until the tide began to rise.

"The captain stated that after the airplane came to rest, he called for the rejected takeoff checklist and the evacuation checklist," the report said. "The CVR recorded him twice calling for the rejected takeoff checklist. He made a public address (PA) announcement that, ' ... we see no fire be careful ... go to the rear of the airplane ... after you exit the aircraft.'"

The report continued: "Some passengers and flight attendants stated that they heard a public address call to evacuate. Some said the evacuation message was garbled, and some thought they heard that there was no fire and that they should exit via the rear of the airplane. A flight attendant in the rear of the cabin went out on the catwalk in the tailcone and inflated the slide. Seeing that the tail of the airplane was high off the ground and the slide did not reach to the ground, she told passengers to move forward to exit. Some passengers reported confusion during the evacuation and a sense of lack of direction from crew."

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A Port Authority of New York and New Jersey official arrived on the scene shortly after being alerted to the accident, the report said. The official "banged on the first officer's side window and told the [flight crew] that the right engine was still running." The captain first checked the fuel levers and verified that they were in the OFF position and then pulled the fire handles "and the engines stopped running." The APU was shut down and the battery switch turned to OFF, the report said.

Flight Crew Remained in Cockpit

The flight crew was still in the cockpit when the Port Authority official entered the cabin and made his way to the cockpit, the report said. "The [Port Authority] lieutenant later stated that he observed the first officer standing near the cockpit door," the report said. "The first officer looked dazed and said that his back was hurt. The lieutenant observed that the captain was still seated in the left seat and was working on his instrument panel. The lieutenant told the captain to shut off the battery because he smelled electrical smoke and saw sparks. The captain said that he had already turned off the power source."

The Port Authority official described the captain as calm and said that he "shut everything down in a deliberate manner. The captain spoke slowly and was in no rush to leave the cockpit," the report said.

The two pilots were then escorted back to the terminal and the first officer was taken to a hospital for treatment, the report said. About 30 minutes after the accident, the captain and a U.S. Federal Aviation Administration (FAA) inspector returned to the aircraft. "Both stated that the captain retrieved some articles from the cabin and they never reentered the cockpit," the report said. "They then returned to the terminal."

Damage to the aircraft was estimated at US$5.63 million.

The captain, age 57, was hired by Continental Airlines in 1965, the report said. He holds an airline transport pilot (ATP) certificate "with ratings and limitations for airplane multiengine, and [Boeing] B-727, [McDonnell Douglas] DC-9/MD-80; and commercial pilot privileges, airplane single-engine land." At the time of the accident, the captain had logged 23,000 total flight hours, with 6,000 hours in the MD-80/82, the report said.

Captain Had Excellent Record

Records indicated that the captain had never been disciplined by the company nor was there any record of aircraft accidents, incidents or flight violations, the report said.

"A first officer who frequently flew with the captain described him as 'a perfectionist in performing checklists,'" the report said. That first officer added that the captain "always emphasized in his briefings any unusual factors, including aircraft weight, weather and runway conditions."

In its accident analysis, the NTSB devoted considerable attention to the status of the pitot/static system and flight crew performance.

The report noted that the captain had completed an eight-hour course in crew resource management (CRM) and was familiar with the RTO procedures adopted by the airline, under which only captains were authorized to call for and to execute RTOs.

The first officer, age 47, was hired by COA in 1985. He holds an ATP certificate, with ratings for multiengine land, Convair CV-340 and CV-440, and commercial pilot privileges, airplane single-engine land and sea, the report said. At the time of the accident, the first officer had logged about 16,000 total flight hours, with 2,400 hours in MD-80 series aircraft.

An assistant chief pilot told the NTSB that there had been no complaints from other pilots about the first officer's performance. "A captain, who was not the accident captain, and [who] had flown with the first officer recently, described him as methodical on checklists," the report said. "The captain of the accident flight said that one of the first officer's greatest strengths as a pilot was his attention to detail on checklists."

Weather at the time of the accident was reported as indefinite ceiling, sky obscured, vertical visibility 500 feet (152.5 meters), visibility 1/2 mile (0.8 kilometers), moderate snow and fog and winds 050 degrees at 23 knots. Runway visual range (for Runway 04) was reported as 6,000 feet (1,830 meters) and tower visibility 3/4 miles (1.2 kilometers) with drifting snow.

About 20 minutes before the accident aircraft attempted to take off, the captain of another aircraft requested a predeparture check of Runway 13. "The check was begun, but before it was completed, the captain stated that ... he was satisfied with the apparent condition of the runway, and the check was stopped at Taxiway Tango at 1755," the report said.

The report added: "The [Port Authority] deputy chief also recalled that he received a report from a USAir departing flight of slippery takeoff conditions on [Runway] 13. Two trucks were holding short of [Runway] 13 for additional sanding when the accident occurred. The deputy chief said that although no friction tests had been taken ... he described the braking action as good, using the brakes on his ... operations automobile."

In its accident analysis, the NTSB devoted considerable attention to the status of the pitot/static system and flight crew performance.

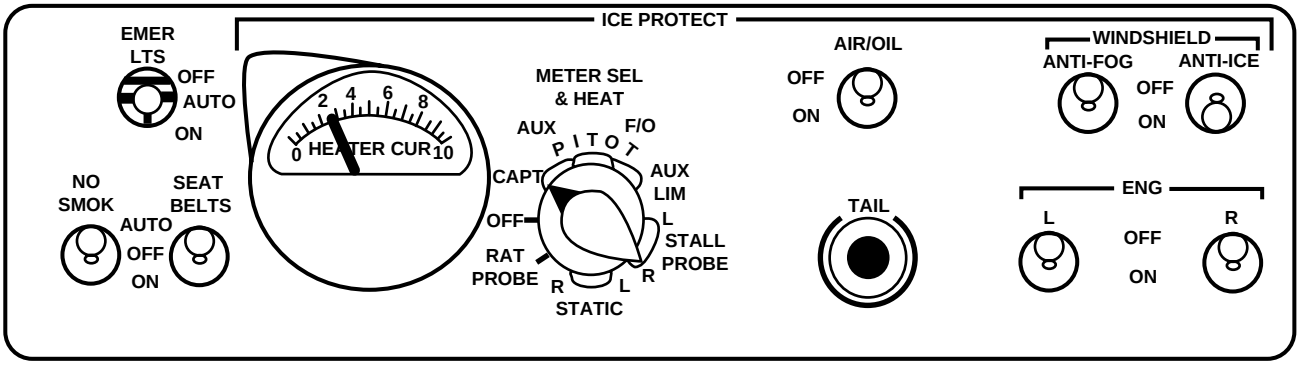
Unheated Pitot System Was Crucial

"The lack of heat to the pitot system was significant in this accident because the captain's decision to reject the takeoff was prompted by his observation of the abnormal airspeed indication and his consequent belief that the airplane was not accelerating properly," the report said. "He described his airspeed as bouncing once from 60 to 80 knots and returning to 60 knots. The FDR [flight data recorder] airspeed trace is consistent with the captain's observation. However, the FDR longitudinal acceleration trace showed normal takeoff values. An integration of acceleration values for the 32-second takeoff roll showed that the airplane reached a [ground speed] of almost 133 knots. With 10 knots headwind component, indicated airspeed should have been 143 knots, [five] knots above V_1."

The report added: "The weather conditions, freezing temperatures and precipitation were known and were conducive to icing of the aircraft surfaces, pitot inlet tubes and runway surfaces."

The pitot heating system is controlled by the METER SEL & HEAT knob located on the cockpit annunciator, with three positions (CAPT, AUX and F/O) to activate the heater systems (Figure 1, page 4). "When the switch is selected to any position except OFF, electrical power is supplied to all heaters at all times except the ram air temperature (RAT) probe heater ... ," the report said.

Pitot Heating System Control: Selector in CAPT Position



Source: U.S. National Transportation Safety Board

Figure 1

The report said that tests conducted after the accident showed that the "measured airspeed was consistent with the airspeed that would be indicated if the pitot inlet had become closed or partially closed at about 60 knots and pitot system pressure had bled off through the water drain hole."

The report said that because both the captain's and the first officer's airspeed indicators showed similar readings and because the two systems are independent (different pitot tubes), "it is evident that the inlets to both tubes were at least partially closed before runway acceleration," which would be consistent with ice buildup in the tubes.

"The positioning of the METER SEL & HEAT knob to provide heat to the pitot tubes, static ports and [RAT] probe is a prestart checklist item," the report said. "Because the prestart checklist was conducted before the CVR started recording, there was no positive confirmation that the checklist was properly accomplished. However, the captain stated that he placed the select knob in the CAPT position as part of the checklist."

But the report noted: "The Safety Board believes, however, that the captain's recollection of events could be based on his normal routine in checklist conduct rather than on specific activity associated with the accident flight. Further, the evidence of postaccident cockpit documentation of knob position [investigators found the knob in the CAPT detent following the accident] is not considered conclusive since it is known that some levers, knobs and switches were moved in the aftermath of the accident during shutdown.

"To the contrary, the Safety Board believes that the most compelling evidence supports the conclusion that the pitot tube heating elements were not energized during the takeoff roll because the METER SEL & HEAT knob was improperly positioned in the OFF detent. The postaccident examination of the ice protection system showed that all components functioned properly and that when energized, the heating elements were effective in providing heat to the pitot tubes and static ports."

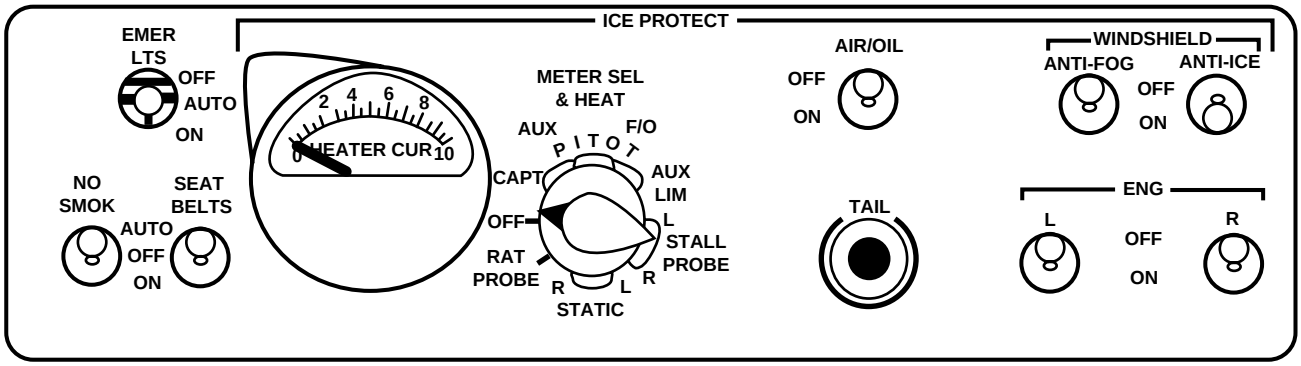
The report said that postaccident tests of the RAT probe also supported evidence that the pitot heat system was functional.

"Activating the pitot/static system also energizes circuits that provide heat to the RAT probe when the weight-on-wheels logic switches to the airborne mode as the nose wheel strut is extended," the report said. "In this accident, the nose wheel structure was sheared when the airplane hit the dike and the weight-on-wheels logic switched to the airborne mode. This switch was verified by the automated ACARS [automatic communications and recording system] transmission. Since electrical power remained on in the airplane, the RAT probe heating element should have been energized after the airplane came to rest. Because there was no air flow past the RAT probe, the probe would have sensed the high localized temperature produced by the heating element in the absence of airflow. The temperature indications would have been transmitted to the TAT [total air temperature] display on the thrust rating indicator and the TAT parameter on the FDR. Since the TAT system was found to be functional after the accident, and elevated temperatures were not recorded on the FDR, the Safety Board concludes that neither the pitot heat nor RAT heat was energized at the time of the accident."

But the report did note that the select knob pointer for the pitot heat system "was positioned about a third of the distance between the OFF and the CAPT position, when the selector was in the OFF detent" (Figure 2, page 5).

The report said that investigators considered the possibility that the knob's pointer misled the flight crew into believing the system was activated.

Pitot Heating System Control: Position of Pointer When Selector in OFF Position



Source: U.S. National Transportation Safety Board

Figure 2

"However, the prestart checklist response procedure would have required the crew to check the current on the meter adjacent to the knob when selecting or confirming the knob's position," the report said. "Also, a light on the overhead annunciator panel in the cockpit would have been illuminated, indicating that the pitot heat was off, as would the master caution light on the glareshield. …

"The Safety Board believes that the pilots failed to conduct a prestart checklist properly and, subsequently, failed to observe the illuminated light on the annunciator panel. A second opportunity to detect the status of the pitot heat knob was the annunciator panel check just before takeoff. In this case, the first officer called checklist items without the captain's request and without using normal challenge and response procedures as the airplane was being taxied into position for takeoff. The pilots appeared to be rushed, and there was no evidence that the first officer actually observed the annunciator panel. This failure and the failure to conduct a prestart checklist properly were the direct causes of this accident."

Procedural Deviations Cited

The report closely examined the performance of the flight crew before and during the takeoff roll, and concluded that the flight crew "deviated from standard operating procedures in a number of significant ways that later affected the sequence of events leading up to the accident."

The report said: "Specifically, they delayed starting the second engine contrary to a COA requirement to taxi on two engines during conditions that require the use of engine anti-ice. This deviation contributed to their being rushed during final preparations for takeoff. They failed to use the Delayed Engine Start Checklist, missed items on several other checklists and did not call checklists complete (box, page 6)." [For a detailed discussion of checklist design and implementation issues, see *Flight Safety Digest*, Vol. 14, No. 5, May 1995.]

Although the flight crew initially appeared to conduct the takeoff properly, the NTSB said that it believed "that had the captain been monitoring the airspeed adequately, he would have noted and reacted to the discrepant airspeed indication sooner."

The report said that the flight's operating environment, which included reduced visibility, a strong crosswind, a slippery runway and the first officer at the controls, elevated the captain's monitoring workload during the takeoff roll. "Still, the Safety Board believes that this situation should not have precluded the captain from attending to airspeed indications."

Investigators also considered whether a takeoff performance monitoring system or flight crew takeoff performance monitoring procedures could have prevented the accident.

"Most of the systems that have been developed to date are based on the measurement of the airplane's inertial acceleration and the comparison of these data with theoretical values for the existing conditions," the report said. "In this accident, [Flight] 795, the airplane accelerated normally during the takeoff roll, albeit the airspeed indication was reading erroneously. Thus, unless the performance monitoring system incorporated airspeed measurement in its alerting logic, it is questionable whether such a system would have been effective in preventing this accident. It is more likely that the [flight crew] would have been confused by the abnormal airspeed indication regardless of the status of an on-board takeoff performance monitoring system."

But the report added: "The Safety Board believes, however, that a more simple takeoff procedure, similar to that used by some military pilots, would have been effective in prompting an RTO before the airplane accelerated to a speed above V_1.

This procedure involves a [cross-check] of elapsed time and airspeed or a [cross-check] of distance traveled and airspeed, the latter being contingent upon the availability of runway [distance-remaining] markers, which are not yet a requirement for airports used by air carrier airplanes. …

"The Safety Board is encouraged by recent improvements in RTO safety training that have been made by the aviation industry and implemented by COA and other carriers. However, the Board believes RTO accident experience indicates that a continuing need exists to provide [flight crews] with a better means to verify acceleration during takeoff. Moreover, the Safety Board believes that this need could be met through procedural changes that incorporate currently available aircraft performance information."

The report said that acceleration data routinely developed by manufacturers during the certification process could be adapted to provide elapsed time to target speeds and made available to flight crews as part of the airplane's performance data documentation.

"Accordingly, the Safety Board believes that the FAA should require the manufacturers of transport category airplanes to publish and distribute to operators of these airplanes specific elapsed times to target speeds, under normal acceleration, over the range of authorized operational conditions," the report said. "Moreover, the FAA should require that the use of this information be incorporated as part of the takeoff performance data available to air carrier [flight crews]. Finally, the FAA should require that this takeoff performance data be incorporated into all air carrier RTO training programs."

Weather Was Not a Factor

Although the weather at the time of the accident included freezing temperatures, snowfall and diminished braking conditions, the report concluded that weather "was not a causal factor" in the accident and that runway surface conditions were adequate for takeoff operations.

"Even with the reduced friction coefficient, the airplane should have been brought to a complete stop within the confines of the runway, if an RTO were initiated by V_1," the report said. "The combination of the reduced runway braking coefficient and RTO initiation speed resulted in the overrun."

The report noted that the location of the dike beyond the takeoff end of the runway (200 feet [61 meters]) "provided little room for runway overrun, and this distance is far less than the 1,000-foot [305-meter] safety area mandated in a nonretroactive law effective Jan. 1, 1988."

The report said: "If the captain had rejected the takeoff below the calculated V_1, or if he had, based on other input, overruled the indications from his airspeed indicator and allowed the first officer to rotate and take off, the length of the 7,000-foot

Deviations from Checklist Procedures Found on Cockpit Voice Recorder

The NTSB said that it found the following deviations from stated COA checklist procedures when it reviewed the CVR:

- "The CVR begins at 1730:05, with the flightcrew going through the 'After Start' checklist. Neither pilot called the 'After Start' checklist complete;
- "The COA expanded checklist procedure for 'Delayed Engine Start' stated, 'If the use of engine anti-ice is required for takeoff, the delayed engine start procedure is not recommended.' Engine anti-ice was used for takeoff. At 1730:38, the first officer stated the checklist item, 'Engine anti-ice.' The captain replied, 'Ah it's on ah let's see ... shall I turn this on now or wait'll after we start. [Wait'll] we start then we'll turn that on.' At 1754:53, while taxiing, the captain said, 'Start up engine number two';
- "At 1754:53, the first officer started the remaining (right) engine, without calling out the 'Delayed Engine Start' checklist. This checklist was not called out at any time by either pilot;
- "COA's [single-engine] taxi procedure stated, 'The use of two engines for taxi is also required when the ramps and taxiways are slippery and/or when anti-icing is required for takeoff.' The right or No.2 engine was started about 24 minutes after the first officer of [Flight] 795 called for taxi;
- "The captain did not call for the 'Taxi' checklist. The first officer began to call out the items on this checklist about [one] minute before being told by LGA Tower, '... [Runway] 13 taxi into position and hold.' The first officer called out the flap/slat position at 1756:31;
- "At 1756:52, the first officer began to call out the challenges and the responses to items listed on the 'After Engine [Delayed] Engine Started' checklist. He did not use [COA-published] terminology to respond to 'Engine Anti-ice' and 'Packs.' He did not call out or respond to 'Hyd[raulic] (Check Rt Pump).' He did not call the checklist complete;
- "As the flight was cleared into position on the takeoff runway at 1757:16, the first officer continued to call out items on the 'Taxi' checklist. He did not call out or respond to the items: 'Air Cond[ition] Auto Shutoff,' or 'Fuel Heat';

- "During the 'Taxi' checklist, the first officer called out that the 'utilities are on.' This item was not on any COA MD-80 normal checklist;
- "At 1758:06, the first officer called the 'Taxi' checklist 'complete.' The captain then asked the first officer, 'you got the flaps out now don't ya.' Flaps appeared as the sixth item on the 'Taxi' checklist, and were called out by the first officer at 1756:31. These items were not in a challenge and response, but were stated in a continuous listing by the first officer;
- "At 1758:11, the first officer began the 'Before Takeoff' checklist. There was no request to do so stated from the captain. The first officer called out all of the items on the checklist, and was finished at 1758:18. He did not call the checklist 'Complete';
- "The sound of a crash occurred at 1759:46. At 1800:00, the first officer asked the captain what he wanted him to do. The captain stated a series of tasks for the first officer, including calling the company, getting out of the cockpit, shutting the engines down, shutting the electrical system down, and getting the speed brake. Most of these tasks appear on the 'Emergency Evacuation' checklist. The captain did not call for this checklist. At 1800:34, the captain called for the 'Abort' checklist."

[2,135-meter] runway, with its 200-foot [61-meter] safety area, would have been adequate to complete the maneuver successfully. In a rejected takeoff with the existing conditions, at an airspeed just below V_1, the airplane may have stopped just on the runway."

Evacuation Failed to Follow Procedures

The evacuation of the airplane after the accident was also given considerable scrutiny by NTSB investigators and the report said "disturbing aspects about the emergency evacuation" were found.

"For example, the [flight crew] failed to shut down the engines before the captain issued instructions to evacuate," the report said. "[The captain's] instructions were perceived by flight attendants and passengers as being ambiguous and confusing. The [flight crew] performed the shutdown procedures when told to do so by a firefighter who had entered the cabin at the L-1 exit. Unfortunately, during the shutdown procedure, the crew turned off the emergency lighting system[,] which prevented the cabin emergency lights and the floor proximity lights from illuminating when the engines were shut down."

The report said that the flight attendants "did not demonstrate assertiveness prior to and during" the evacuation.

"The cockpit [crew] was never queried on the extent of the situation before the captain ordered the evacuation some 55 seconds after the airplane came to rest," the report said. "The flight attendants did not climb onto passenger seats and shout commands to direct passengers to usable exits to maximize the egress process known as 'flow control.' While these procedures are contained in the COA flight attendant emergency procedures manual, they are not practiced during recurrent training sessions. Therefore, it is not surprising that they were not followed during this evacuation."

The report said that the emergency evacuation was "not conducted effectively due to insufficient and garbled cockpit and [cabin crew] communications, as well as failure of the [cabin crew] to take command of the evacuation process."

Checklists used by COA and the accident flight crew were approved by the FAA in 1991, the report said. But the report noted that the checklists did not include guidance from another FAA publication, *Air Transportation Inspector's Handbook* (FAA Order 8400.10), published the same year.

"In summary, the COA normal checklist policies for managing checklists do not consistently specify which [flight crew member] is responsible for initiating or accomplishing each item on the checklist, do not define [flight crew member] responsibilities for bringing to the attention of the pilot in command any observed deviation from prescribed procedures, do not include a policy for management of interrupted checklists, and do not specify that in the taxi and pretakeoff phases, specific aircraft configuration items, such as flaps, should be confirmed and responded to by both [flight crew members]."

The report said that the NTSB believes "that the FAA should require COA to meet the standards for [flight crew] checklists and that it should ensure that specific checklist callouts and responses are addressed logically and expeditiously."

The issue of inadequate checklist procedures has been addressed several times over the years by the NTSB. In 1994, the NTSB issued a special safety study that focused on flight crew–involved major accidents from 1978 through 1990. In that study, the NTSB found that "six of the eight takeoff accidents studied involved procedural checklist failures on the part of the [flight crews] during the taxi phase of operation."

The NTSB said that "checklist deviations and other pilot procedural deficiencies noted by the FAA during a special inspection, which included numerous en route inspections about [one] month before the accident, suggest that the problems identified in this accident regarding improper checklist procedures were systemic at COA. If pilots fail to adhere to procedures during en route inspections by FAA inspectors, they most likely behave in a similar manner when no inspector is present."

The report said that the investigation of the COA accident, and others in the past, had been hampered by a lack of CVR information caused by the equipment's inadequate recording duration capability.

"Investigators had no documented evidence concerning how or if the [flight crew] performed the 'Before Pushback/Before Start' checklist, and they had to rely entirely on the [flight crew's] recollection," the report said.

The NTSB said that all newly manufactured airplanes after Dec. 31, 1995, and all airplanes brought into compliance with operating rules requiring a CVR, should be equipped with a two-hour CVR.

As a result of its investigation and findings, the NTSB made the following recommendations to the FAA:

- "Require manufacturers of airplanes operated by air carriers to publish and distribute to operators specific elapsed times to target speeds … ;
- "Require that the elapsed times to target speeds be incorporated as part of the takeoff performance data available to air carrier [flight crews];
- "Require that air carrier rejected takeoff training include elapsed time to target speed takeoff performance data;
- "Require the modification of transport category airplanes to incorporate the automatic activation of air data sensor heating systems without [flight crew] action; [and,]
- "Amend the requirements of [U.S. Federal Aviation Regulations (FARs)] Part 25.1323(e) to require that, for newly certificated airplanes, anti-ice protection for the air data sensor heating systems is provided automatically (without [flight crew] action) following engine start."

The NTSB also recommended that COA review its recurrent flight-attendant training for emergency evacuations and reiterated earlier recommendations to the FAA to require evacuation and/or wet ditching drills during recurrent training and to include flight attendants in CRM training.♦

Editorial note: This article was adapted from *Runway Overrun Following Rejected Takeoff, Continental Airlines Flight 795, McDonnell Douglas MD-82, N18835, LaGuardia Airport, Flushing, New York, March 2, 1994.* Report No. NTSB/AAR-95/01, prepared by the U.S. National Transportation Safety Board (NTSB). The 84-page report included charts, diagrams and illustrations.

ACCIDENT PREVENTION

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