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Short on Speed

An ATR 42 with split flaps stalled during an unstabilized night approach in icing conditions.

BY MARK LACAGNINA

Distracted by a flap anomaly, the flight crew of an Avions de Transport Régional ATR 42 freighter did not monitor their airspeed during a night instrument approach in icing conditions, and the airplane stalled and struck terrain short of the runway at Lubbock, Texas, U.S., said the final report by the U.S. National Transportation Safety Board (NTSB).

The airplane, registered to FedEx Corp. and operated by Empire Airlines, was substantially damaged, according to the report. The captain

was seriously injured, and the first officer sustained minor injuries.

Factors contributing to the Jan. 27, 2009, accident were “the flight crew’s failure to follow published standard operating procedures in response to a flap anomaly; the captain’s decision to continue with the unstabilized approach; the flight crew’s poor crew resource management; and fatigue due to the time of day in which the accident occurred and a cumulative sleep debt, which likely impaired the captain’s performance,” the report said.

NTSB also faulted the dispatch of the cargo flight into an area of freezing drizzle that was forecast to continue beyond the estimated time of arrival in Lubbock. Freezing drizzle comprises supercooled large droplets (SLD) that can splatter and freeze on contact with an airplane, causing accumulations of ice that can exceed the capabilities of the anti-icing and deicing systems.

Three of the five NTSB members did not totally agree with the conclusions published in the report and filed separate statements of their opinions (see “Difference of Opinion,” p. 21).

One Approach Available

The ATR 42 departed from Fort Worth (Texas) Alliance Airport at 0313 local time as Flight 8284 to Lubbock Preston Smith International Airport.

The captain, 52, had 13,935 flight hours, including 1,896 hours as an ATR 42 pilot-in-command. “The captain was experienced with in-flight icing conditions because he had worked as a pilot in the Pacific Northwest and Alaska for 30 years,” the report said. “He stated that he had been dispatched into freezing drizzle before and that, while flying in such conditions, he maintained a heightened awareness of the flying environment.”

The first officer, 26, the pilot flying, had 2,109 flight hours, including 130 hours as a second-in-command of ATR 42s. “The first officer had limited experience flying in icing conditions before working at Empire Airlines, and the ATR 42 was the first airplane in which she had flown that was equipped with deicing and anti-icing systems,” the report said.

Light freezing rain and ice pellets had begun to fall the previous evening in the Lubbock area and had changed overnight to light freezing drizzle. As the airplane neared the airport, reported visibility was 2 mi (3,200 m), the sky was overcast at 500 ft, and the surface winds were from 350 degrees at 10 kt.

While en route, the crew had learned that Runway 08/26 was closed. Runway 17R/35L was the only available runway suitable for the ATR 42, but the nonprecision approach to Runway 35L, which would have allowed a landing into the wind, was not available. Nevertheless, the

tail wind component for a landing on Runway 17R was within the airplane’s 15-kt limit. Thus, the crew prepared for the only approach available, the instrument landing system (ILS) approach to Runway 17R.

The ATR 42 had encountered icing conditions during cruise at 18,000 ft. The captain recalled that the airplane had shed “substantial amounts of ice” during the descent in a relatively warm inversion layer. The airplane again encountered icing conditions in freezing drizzle below 6,000 ft. The report said that the SLD conditions were “outside the airplane’s icing certification envelope.”

Red Bug Speed

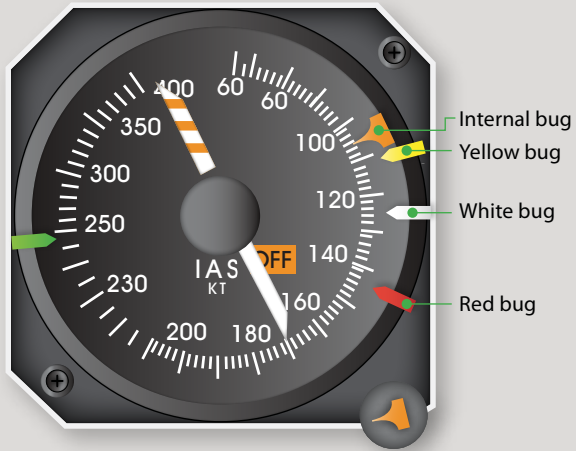
While conducting the descent and approach checklists, the captain confirmed that the airplane’s ice-protection systems were set to the highest level. While reviewing the reference speeds, or airspeed indicator “bug” speeds, for the approach, he told the first officer that the “icing speed” — the minimum airspeed for an approach in landing configuration and in icing conditions — was 106 kt.

However, the captain had incorrectly read this, and other, airspeeds, from the reference card for takeoff and landing at 33,000 lb (14,969 kg). It actually corresponded to the minimum airspeed for a *takeoff* in icing conditions; the correct airspeed for landing was 116 kt.

The airplane struck the ground short of the threshold of the runway and came to a stop off the right side of the runway



Airspeed Bugs



Notes: The ATR 42 pilots had set the red bugs on their airspeed indicators to 143 kt, the minimum airspeed for an approach in icing conditions with flaps retracted. The white bug references the minimum approach speed in non-icing conditions with flaps retracted; the yellow bug references the target approach speed plus 5 kt with full flaps. These three bugs are on the outside of the instrument's glass face and are manually slid into place. The orange "internal" bug, set with the knob, references the minimum approach speed in icing conditions with full flaps; this reference speed drives the fast/slow scales on the pilots' attitude director indicators.

Source: Adapted from U.S. National Transportation Safety Board report by Susan Reed

Figure 1

This error was inconsequential, according to the report, because the captain had correctly briefed the minimum airspeed for a no-flap approach in icing conditions as 143 kt. This airspeed provided "sufficient reference to maintain the minimum safe airspeed" during the approach, the report said, noting that the pilots set the red bugs on their airspeed indicators accordingly (Figure 1).

'We Have No Flaps'

The airplane was about 1,400 ft above ground level (AGL) and nearing the ILS outer marker at 0434, when the first officer called for flap extension to 15 degrees, the approach setting, and for the landing gear to be extended.

Perceiving that something was amiss, she then said, "What the heck is going on?"

The captain replied, "You know what? We have no flaps."

Recorded flight data showed that the two flaps on the left wing had extended only 8 to 10

degrees and that the two flaps on the right wing remained retracted. The autopilot compensated for the flap asymmetry by applying left aileron.

The report said that both pilots became distracted by the flap anomaly, and their crew resource management and adherence to standard operating procedures deteriorated. No call-outs of subsequent airspeed or flight path deviations were made. The cockpit voice recording also indicated that the pilots did not discuss the flap problem or the checklist actions to address it.

Postaccident interviews revealed that the pilots did not recognize the nature of the problem and did not see any warning messages such as "AILERON MISTRIM" on the advisory display unit. The captain said that "things were happening quickly" and that he "did not know which checklist to run."

The first officer continued flying the coupled approach while the captain repositioned the flap handle several times, to no avail. "After finding that no circuit breakers were out, he moved the flap handle back to the 'up' (or 0-degree) position because he did not want the flaps to travel inadvertently during the approach," the report said.

During simulator training, the pilots had been taught to initiate a go-around if a flap anomaly occurs on approach and then complete the applicable quick reference handbook procedures. The captain told investigators that, in this case, he "just wanted to land as soon as possible."

'Keep Descending'

The airplane was at about 900 ft AGL and indicated airspeed was 125 kt when the aural stall warning sounded, the stick shaker activated and the autopilot automatically disengaged. With the flaps up, the stick shaker normally activates at an angle-of-attack (AOA) of 11.6 degrees, or at 7 degrees AOA with the ice-protection systems activated.

The first officer voiced an expletive, and the captain said, "Yeah, don't do that. ... Just keep flying the airplane, OK?"

"Should I go around?" the first officer asked.

"No," the captain replied. "Keep descending."

The first officer had pulled the power back to about 3 percent torque after the flap asymmetry occurred. She now increased power to about 70 percent torque, and the airplane began to deviate above the glideslope and right of the localizer.

The first officer applied about 40 lb (18 kg) of pressure on the left rudder pedal and about 13 lb (6 kg) of control wheel force to counter the flap asymmetry. Her voice was strained when she said, “We’re getting close here.” The captain asked her if she wanted him to take the controls, and she replied, “Yes, please.”

The ATR 42 was at about 700 ft AGL and airspeed was 143 kt when control was transferred to the captain. He applied substantial control forces to correct the flight path deviations and reduced power to about 10 percent torque, causing airspeed again to decrease below the red-bug airspeed of 143 kt. About this time, the flaps automatically returned to a symmetric state, with the left flaps retracting to about 4.5 degrees and the right flaps extending to about 4.5 degrees.

A few seconds later, as the airplane descended below the clouds at about 500 ft AGL, the aural stall warning sounded and the stick shaker activated again. The terrain awareness and warning system (TAWS) generated a “PULL UP, PULL UP” warning. About this time, the first officer called the runway in sight.

The airplane was at about 200 ft AGL and airspeed was 124 kt at 0436:19, when the captain called for maximum propeller speed and increased engine torque. The airplane then entered a series of roll oscillations before striking flat, grassy terrain short of the runway and coming to a stop off the right side of the runway at 0436:27.

The right main landing gear separated on impact, and the right wing and a large section of the upper fuselage were destroyed by fire. The right engine and propeller also were damaged by the impact and fire.

Seeing fire on the right side of the airplane, the pilots exited through the left forward cargo door. Aircraft rescue and firefighting personnel arrived about five minutes later and contained the fire, which eventually was extinguished with help from the local fire department.

The captain told investigators that in the last seconds before impact, he had no lateral control of the airplane and that the controls were almost “snatched” out of his hands.

The report said that a performance study indicated that “the performance degradation due to ice accretion never exceeded the airplane’s thrust performance, nor would it have exceeded the airplane’s flight control capabilities if the minimum safe airspeed [143 kt] had been maintained. ... The captain’s failure to immediately respond to

Difference of Opinion

Individual members of the U.S. National Transportation Safety Board (NTSB) sometimes prepare separate statements for an accident report when their personal opinions differ from the consensus conclusions and findings related to the accident. The report on the ATR 42 accident at Lubbock, Texas, included statements by three board members.

NTSB Vice Chairman Christopher Hart contended that the report is inconsistent in concluding that the captain should have conducted a go-around while also recommending that deliberate operation in icing conditions caused by freezing precipitation should be prohibited.

“Either the conditions were flyable and should have been re-entered on a go-around, or the conditions were not flyable and the captain appropriately continued his approach, despite being unstable,” Hart said. “I believe that the evidence supports the conclusion that the conditions were flyable and the captain should have gone around.”

Hart also challenged the report’s conclusion that fatigue likely impaired the captain’s performance. “Even if the crew had been fatigued, which they probably were to some extent, I do not see any basis in the report for concluding that fatigue resulted in impairment sufficient to cause or contribute to this accident.”

NTSB Member Earl Weener agreed that the report provides insufficient evidence to support the conclusion that fatigue impairment of the captain’s performance was a causal factor in the accident. “Although fatigue may have played a role in the captain’s performance during the accident sequence, the final report does not sufficiently make the case that fatigue played a causal role in the event,” he said.

NTSB Member Mark Rosekind, an internationally recognized fatigue specialist, asserted that there was sufficient evidence to support a conclusion that fatigue affected the performance of *both* pilots. He specifically disagreed with the report’s conclusion that the first officer’s errors likely resulted from her distraction with the flap anomaly and her lack of experience in the airplane and in icing conditions. Rosekind said that there was equally compelling evidence that fatigue contributed to her errors.

“This accident exemplifies the increased safety risks associated with overnight shifts and operations during the window of circadian low,” he said.

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the aural stall warning, the stick shaker and the TAWS warning resulted in his inability to arrest the airplane's descent and avoid impact with the ground."

Flap Anomaly Unsolved

The report said that the flap asymmetry might have been caused by a mechanical problem, jamming of the flap actuator or hydraulic fluid contamination. Impact and fire damage to the flap system precluded a conclusive determination of the cause.

The system is designed to prevent an asymmetry greater than 10 degrees by isolating electrical power from the flap-control switch. "The flaps will stop

fairings on both wings that provide the pilots with a means for a direct visual check of flap position. The pilots apparently did not check these markings.

The report did not say why the flaps returned to a symmetrical state shortly before impact but noted that this normally occurs if a restriction to flap movement is removed: "The resulting flap position will be the average of the right and left flap positions when the asymmetry occurred."

Sleep Debt

A few days before the accident, the captain and the first officer had commuted on commercial flights from their homes

circadian rhythm, both pilots "took some actions before the accident to reduce the likelihood of performance decrements associated with being awake during the nighttime hours."

The first officer's actions were deemed more effective, in that she had acclimated herself to sleeping during the day and being awake at night. "She indicated that she felt rested on the evening of the accident," the report said.

The captain had deliberately awakened at 0400 the morning before the accident and had napped for nearly six hours that afternoon. The report said that although the nap likely was beneficial, the pilot had accumulated a sleep debt and "was likely experiencing some fatigue at the time of the accident."

Role Playing Recommended

Based on the findings of the investigation, NTSB made several recommendations to the U.S. Federal Aviation Administration (FAA). Among them was to require "role-playing or simulator-based exercises that teach first officers to assertively voice concerns and that teach captains to develop a leadership style that supports first officer assertiveness" (ASW, 5/11, p. 46).

The board also said that the FAA should prohibit air carrier, air taxi and fractional ownership operators from dispatching or operating airplanes in known freezing precipitation "unless the airplane manufacturer has demonstrated that the airplane model can safely operate in those conditions." ➤

This article is based on NTSB report NTSB/AAR-11/02, "Crash During Approach to Landing; Empire Airlines Flight 8284; Avions de Transport Régional Aerospatiale Alenia ATR 42-320, N902FX; Lubbock, Texas; January 27, 2009." The report is available at <ntsb.gov/Publictn/2011/AAR1102.pdf>.



U.S. Federal Aviation Administration

in the positions reached at the time of the power interruption, [and] the flaps will not move in response to movement of the flap-control lever until maintenance personnel reset the system on the ground," the report said.

When an asymmetry occurs, the flap-position indicator shows the average position of the flaps. There also are lighted markings on the external flap

in Portland, Oregon, and Salt Lake City, Utah, respectively, to Midland, Texas. The previous evening, they had flown a trip from Midland to El Paso, Texas, and to Fort Worth, where they landed about three hours before beginning the flight to Lubbock.

The report said that although the accident occurred at a time that was in opposition to the crew's normal