NATIONAL TRANSPORTATION SAFETY BOARD
Public Meeting of June 7, 2016
(Information subject to editing)

Aerodynamic Stall and Loss of Control During Approach, Embraer EMB-500, N100EQ, Gaithersburg, Maryland, December 8, 2014
NTSB/AAR-16/01

This is a synopsis from the NTSB's report and does not include the Board's rationale for the conclusions, probable cause, and safety recommendations. NTSB staff is currently making final revisions to the report from which the attached conclusions and safety recommendations have been extracted. The final report and pertinent safety recommendation letters will be distributed to recommendation recipients as soon as possible. The attached information is subject to further review and editing to reflect changes adopted during the Board meeting.

EXECUTIVE SUMMARY

On December 8, 2014, about 1041 eastern standard time, an Embraer EMB-500 airplane (marketed as the Phenom 100), N100EQ, registered to and operated by Sage Aviation LLC, crashed while on approach to runway 14 at Montgomery County Airpark (GAI), Gaithersburg, Maryland. The airplane impacted three houses and the ground about 3/4 mile from the approach end of the runway. A postcrash fire involving the airplane and one of the three houses, which contained three occupants, ensued. The pilot, the two passengers, and the three people in the house died as a result of the accident. The airplane was destroyed by impact forces and postcrash fire. The flight was operating on an instrument flight rules flight plan under the provisions of 14 *Code of Federal Regulations (CFR)* Part 91. Visual meteorological conditions prevailed at the time of the accident.

Data from the airplane's cockpit voice and data recorder (CVDR) indicated that the takeoff about 0945 from Horace Williams Airport, Chapel Hill, North Carolina, and the cruise portion of the flight were uneventful. CVDR data showed that about 15 minutes after takeoff, the passenger in the right cockpit seat made a statement that the airplane was "in the clouds." A few seconds later, the airplane's engine anti-ice system and the wing and horizontal stabilizer deice system were manually activated for about 2 minutes before they were manually turned off. About 6 minutes later, a recording from the automated weather observing system (AWOS) at GAI began transmitting over the pilot's audio channel, containing sufficient information to indicate that conditions were conducive to icing during the approach to GAI. The CVDR recorded no activity or faults during the rest of the flight for either ice protection system, indicating that the pilot did not turn the systems back on.

Before the airplane descended through 10,000 ft., in keeping with procedures in the EMB-500 *Pilot Operating Handbook*, the pilot was expected to perform the Descent checklist items in the *Quick Reference Handbook* (QRH), which the pilot should have had available in the airplane during the flight. Based on the AWOS-reported weather conditions, the pilot should

have performed the Descent checklist items that appeared in the Normal Icing Conditions checklist, which included turning on the engine anti-ice and wing and horizontal stabilizer deice systems. That action, in turn, would require the pilot to use landing distance performance data that take into account the deice system's activation.

CVDR data show that, before beginning the descent, the pilot set the landing reference (V_{ref}) speed at 92 knots, indicating that he used performance data for operation with the wing and horizontal stabilizer deice system turned off and an airplane landing weight less than the airplane's actual weight. Using the appropriate Normal Icing Conditions checklist and accurate airplane weight, the pilot should have flown the approach at 126 knots (a V_{ref} of 121 knots +5 knots) to account for the icing conditions.

The NTSB's investigation found that the pilot's failure to use the wing and horizontal stabilizer deice system during the approach (even after acknowledging the right seat passenger's observation that it was snowing when the airplane was about 2.8 nautical miles from GAI) led to ice accumulation, an aerodynamic stall at a higher airspeed than would occur without ice accumulation, and the occurrence of the stall before the aural stall warning sounded or the stick pusher activated. Because the deice system was not activated by the pilot before landing, the band indications (low speed awareness) on the airspeed display did not appropriately indicate the stall warning speed. The NTSB's aircraft performance study found that there would have been sufficient warning of an aerodynamic stall had the wing and horizontal stabilizer deice system been used during the approach. Once the airplane stalled, its altitude was too low to recover.

Based on available evidence, the NTSB could not determine why the pilot did not turn on the wing and horizontal stabilizer deice system during the approach to GAI. The pilot's EMB-500 instructors reported that use of both ice protection systems was covered during initial and refresher training and the pilot turned on both systems when he encountered conditions conducive to icing shortly after taking off on the accident flight. This information suggests that the pilot was informed about the criteria for using these systems. The NTSB considered several scenarios in evaluating the pilot's actions and identified the following areas for improvement to support safe operation of turbofan airplanes that require a type rating and are certified for single-pilot operations and flight in icing conditions, such as the EMB-500:

- **Especially when conducting single-pilot operations, pilots of these airplanes would benefit from a system that provides automatic alerting when the ice protection systems should be activated.** Postaccident interviews with the pilot's first EMB-500 instructor revealed that the pilot had a tendency to freeze up and fixate on a subtask at the expense of other critical subtasks; thus, it is possible that the pilot forgot to activate the wing and horizontal stabilizer deice system during the approach (a relatively high workload phase of flight) to GAI. In a single-pilot operation, no additional crewmember is present to help detect an error of omission. Further, 14 *CFR* Part 91 operations do not necessarily share the same regulatory and organizational controls as 14 *CFR* Part 121 and Part 135 operations, which have more stringent requirements, oversight, and training that can all help to promote consistency in performance.

- **Pilots of these airplanes would benefit from training beyond what is required to pass a check ride.** Despite being described by his first EMB-500 instructor as very intelligent and

highly motivated, the accident pilot needed a considerable amount of extra training time to prepare for his EMB-500 check ride. Although his instructors said that he was proficient by the time he passed his check ride and that all of the required special emphasis areas were addressed in some manner, evidence from the flight before the accident flight—as well as errors made by the pilot during the accident flight—revealed significant weaknesses in his capabilities.

FINDINGS

1. The airplane was properly certificated and equipped in accordance with federal regulations.

2. Examination of the airplane wreckage revealed no preimpact malfunctions or failures that would have precluded normal operation of the airplane.

3. The pilot's actions before takeoff for the accident flight were consistent with noncompliance with standard operating procedures.

4. Although the pilot's use of inaccurate occupant and cargo weights had no effect on the airplane remaining within EMB-500 *Airplane Flight Manual* weight and balance limitations, it did influence the landing speeds he selected in preparation for the approach to Montgomery County Airpark, which were slower than those that corresponded to the airplane's actual landing weight.

5. The pilot's use of the slower landing speeds in preparation for the approach to Montgomery County Airpark is consistent with his referencing the Normal (non-icing) checklist, which does not call for the activation of the wing and horizontal stabilizer deice system, and resulted in band indications on the airspeed display that did not appropriately indicate the stall speed.

6. For at least 15 minutes during the descent and approach to Montgomery County Airpark, the pilot was operating in an environment conducive to structural icing without either airplane ice protection system activated.

7. Not using the airplane's ice protection systems during the approach to Montgomery County Airpark was contrary to the pilot's training and published standard operating procedures and was inconsistent with the pilot's previous behavior during the accident flight.

8. The pilot's failure to use the wing and horizontal stabilizer deice system during the approach to Montgomery County Airpark led to ice accumulation, an aerodynamic stall at a higher airspeed than would occur without ice accumulation, and the occurrence of the stall before the aural stall warning sounded or the stick pusher activated. Once the airplane stalled, its altitude was too low to recover.

9. Providing pilots of turbofan airplanes that require a type rating and are certified for single-pilot operations and flight in icing conditions with automatic alerting about the need to activate ice protection systems would reinforce this critical procedure while operating in potential icing conditions—especially in single-pilot operations.

10. Improvements in pilot training for turbofan airplanes that require a type rating and are certified for single-pilot operations and flight in icing conditions regarding the use of ice protection systems and avoidance of stall-related accidents associated with airframe ice accumulation would help ensure that, especially when conducting single-pilot operations in these airplanes, pilots are aware of safety issues that could have life-threatening consequences.

11. Embraer's decision to install a cockpit voice and data recorder in the EMB-500 fleet greatly benefited the National Transportation Safety Board's investigation of the December 8, 2014, accident at Montgomery County Airpark by ensuring investigators had access to critical information for determining the sequence of events that led to the accident and identifying actions needed to prevent a similar accident in the future.

PROBABLE CAUSE

The NTSB determines that the probable cause of this accident was the pilot's conduct of an approach in structural icing conditions without turning on the airplane's wing and horizontal stabilizer deice system, leading to ice accumulation on those surfaces, and without using the appropriate landing performance speeds for the weather conditions and airplane weight, as indicated in the airplane's standard operating procedures, which together resulted in an aerodynamic stall at an altitude at which a recovery was not possible.

RECOMMENDATIONS

As a result of this investigation, the NTSB makes one safety recommendation each to the FAA, the General Aviation Manufacturers Association, and the National Business Aviation Association.

To the Federal Aviation Administration:

1. Work with the General Aviation Manufacturers Association to develop a system that can automatically alert pilots when the ice protection systems should be activated on turbofan airplanes that require a type rating and are certified for single-pilot operations and flight in icing conditions.

To the General Aviation Manufacturers Association:

2. Work with the Federal Aviation Administration to develop a system that can automatically alert pilots when the ice protection systems should be activated on turbofan airplanes that require a type rating and are certified for single-pilot operations and flight in icing conditions.

To the National Business Aviation Association:

3. Work with your members that are manufacturers and training providers of turbofan airplanes that require a type rating and are certified for single-pilot operations and flight in icing conditions to develop enhanced pilot training guidelines pertaining to risk management in winter weather operations, including the use of ice protection systems and adherence to checklists, with special emphasis given to deficiencies in pilot performance identified in this accident, and make the results of this effort available to the community of pilots who fly these airplanes.