ESi

CASE STUDY

FAILURE TO DEPLOY AIRCRAFT ICE PREVENTION SYSTEM RESULTS IN DEADLY CRASH

An ESi report finds that the airplane accident was due to failure to activate the ice protection system on final approach for landing.

SITUATION

On a frigid day in December 2014, a light business jet crashed less than a mile out from its runway in Maryland, USA. The impact damaged three houses, and a post-crash fire consumed the aircraft and one of the homes where three occupants resided. The pilot, the two passengers, and the three people in the house died as a result of the accident.

It was unclear whether ice buildup on the aircraft's lifting surfaces contributed to the loss of control that led to the accident.

Ice can create deadly situations in-flight. In addition to the adverse weather conditions, the formation of any ice on the aircraft's wings will result in an increase in stall speed for the aircraft. When icing occurs the aircraft needs to operate at a higher approach and landing airspeed than normal to avoid a stall.

Additionally, the aircraft's normal stall warning system may not function at the higher stall speed of the iced aircraft, essentially providing no warning to the pilot. Activating the aircraft's ice protection systems not only removes ice that has collected during the flight but also adjusts the stall warning parameters in the system to account for the higher stall speed.

ESi was retained by the aircraft manufacturer to perform an analysis of the ice accretion on the wing and horizontal stabilizer of the jet.

Practice: Aviation

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Services Utilized

- NASA LEWICE Software
- Flight Path Reconstruction

About ESi

For over 30 years, ESi has leveraged its multidisciplinary team of engineers, scientists, and professional technical staff to investigate many major accidents and disasters. Our technical expertise, hands-on experience and state-of-the-art facilities, combined with diagnostic, analytical and physical testing capabilities create an ideal environment for quickly identifying and interpreting the facts of a particular case.

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SOLUTION

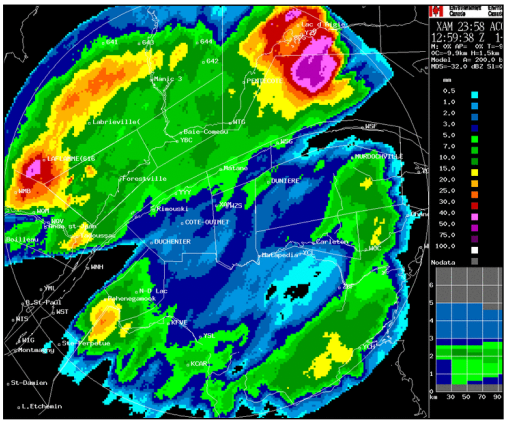
An ESi icing analysis was performed using: Environmental conditions, flight conditions determined from the on-board Cockpit Voice and Data Recorder (CVDR), data derived from the recorded Air Traffic Control radar system, and wing and horizontal stabilizer geometry supplied by the aircraft manufacturer.

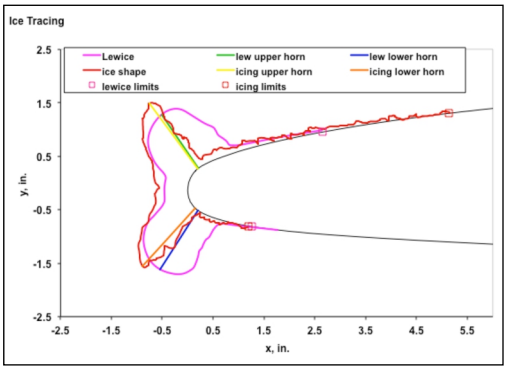
The flight conditions were initially determined from a flight path reconstruction using the recorded radar data. The wind and temperature data were used to determine the true and equivalent airspeeds. These conditions were later refined using parameters recorded by the CVDR. The aircraft's true airspeed and angle of attack were important factors in calculating the ice accumulation on the aircraft.

A study was performed using NASA LEWICE software to analyze the ice accretion on the surfaces of the wing and horizontal stabilizer sections. Water droplet trajectories and ice accumulations were computed around 2D models of cross sections at selected locations on the aircraft wing and horizontal stabilizer.

The airspeed, angle of attack, and meteorological conditions varied throughout the flight, so the flight was divided into six phases while the aircraft was in the icing environment using the average conditions for each individual phase as inputs to the LEWICE code. This provided a more accurate calculation of the ice accumulation than using a single average value for each of the parameters over the entire period the aircraft was in the icing environment.

The aircraft flight manual stated that crew must activate the ice protection system when in known icing conditions or when operating in visible moisture and temperatures that are conducive to aircraft icing. Activation of the ice protection system helps prevent the decrease in stall angle of attack and increase in stall speed through the removal of the ice and adjusts the stall warning to occur at a higher airspeed.





RESULTS

A report was submitted to the aircraft manufacturer who then presented it to the NTSB, and it became part of the NTSB Docket. Dr. Steve Morris, presented the ESi findings to members from the National Transportation Safety Board (NTSB), Federal Aviation Administration (FAA), and aircraft manufacturer.

The CVDR data confirmed that the ice protection system was not operated throughout the analyzed flight. The LEWICE analysis showed that that ice would have accreted on the wing and horizontal stabilizer based on the meteorological and flight conditions. The accretion of this ice would have caused the aircraft to stall at a lower angle of attack and higher airspeed than normal.

The final determination was that the combination of weather conditions, the aircraft's weight, and the non-activation of the ice protection system resulted in the aerodynamic stall and roll at an altitude where a recovery was not possible. Activation of the ice protection systems would have provided a stall warning to the pilot at an airspeed well above the one at which the loss of control occurred.

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Engineering Consulting and Forensic Investigation

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WHY ESi. The aviation practice group is comprised of consultants with backgrounds in:

- Mid-Air Collision Analysis
- Wreckage Site Inspection & Analysis
- Accident Reconstruction
- Flight Testing
- Material Analysis
- Fluid Dynamic Analysis