



National Transportation Safety Board

Aviation Incident Data Summary

Location:	Santa Maria, CA	Incident Number:	LAX06IA076
Date & Time:	01/02/2006, 1439 PST	Registration:	N390AE
Aircraft:	Saab-Scania AB (Saab) SF340B+	Injuries:	28 None
Flight Conducted Under:	Part 121: Air Carrier - Scheduled		

Analysis

After departure and during the cruise climb phase, the flight encountered airframe ice and departed from controlled flight.

The flight crew encountered light rime icing on the inbound leg while descending from 9,000 to 5,000 feet. Before the incident takeoff, they reviewed the dispatch package weather and noted two AIRMET (airmen's meteorological information) reports for icing in clouds. The captain decided to perform the departure and turn control of the airplane over to the first officer after completing the climb checklist at the acceleration altitude. In accordance with the operator's minimum equipment list (MEL), the airplane was dispatched with the continuous mode of the deice system inoperable, which would require the crew to manually operate the deice boots. Company procedures require activation of the deice system at the first sign of ice accretion, and operation of the deice boots continually thereafter while in icing conditions. The departure was into level 2 weather conditions (defined as 10 degree Celsius or colder with visible moisture).

The airline's Airplane Operating manual (AOM) for the airplane calls for computation of a minimum speed (V_{cln+15}) in icing conditions, which for this flight was 141 KIAS. The limitations section stipulates that Indicated Air Speed (IAS) is the only authorized flight director/autopilot mode while climbing when ice accretion is occurring or with residual ice on the airframe. In IAS mode, the flight control computer gives pitch commands to maintain the selected indicated airspeed as opposed to the Vertical Speed (VS) mode where the autopilot sacrifices airspeed to maintain climb rate. Even though the crew had encountered icing on the inbound leg and the dispatch weather reports predicted an icing encounter during the climb on the outbound leg, the captain engaged the autopilot in the medium (M) climb mode and shortly after taking the controls at 2,500 feet, the first officer changed the autopilot to VS mode.

As the airplane climbed through 11,700 feet, the captain noted light rime ice accumulating on the windshield wiper blades and about a 1/2-inch-wide area of ice on the left wing. During this time, the crew failed to detect a decaying indicated airspeed due to the ice that was accumulating. As he began to activate the manual deice boot system, he felt a heavy vibration in the airframe and the windscreen immediately turned white with ice. The airplane's nose and left wing dropped and the autopilot disconnected. As he was grabbing the yoke, the clacker sounded (indicating an imminent stall), the stick shaker activated, and the ground proximity warning system emitted a "bank angle" aural warning. Digital Flight Data Recorder (DFDR) data showed that the indicated airspeed went from 144 to 130 KIAS over the 26 seconds before the upset, and that the rate of airspeed decay accelerated in the final 10 seconds before the autopilot disconnected. The airplane departed controlled flight at an indicated airspeed of 130 knots, and before the stall warning activated. The data establishes that the airplane went through a series of roll and pitch excursions, reaching maximum values of 86 degrees left wing down, 140 degrees right wing down, 23 degrees nose up, and 40 degrees nose down before the flight crew recovered control. The data also revealed that about 26 seconds before the stall while the airplane was at a speed of 144 KIAS, the airplane began to experience a likely ice-induced slight rolling anomaly that was counter to the direction of the aileron input. Aileron input from the

autopilot arrested this slight rolling motion.

The DFDR data also disclosed that 14 seconds after the initial stall, both ailerons simultaneously traveled to the full up position for approximately 14 seconds. The Safety Board believes that the initial stall that occurred prior to stall warning, the upset, and the aileron upward deflections were caused by ice accreted on the wing in supercooled liquid droplets (SLD) conditions. Furthermore, the period of simultaneous upward deflection of the ailerons were caused by airflow separations over the ailerons, and not by opposite control wheel inputs by the captain and first officer (FO). This conclusion was based on the similar nature of past experience in accidents and incidents involving modification of aileron forces by SLD ice accretions, the higher airspeed and dynamic nature of the initiating events, the captain's and FO's statements, and the captain removing one hand from the control wheel to reduce the power. Also contributing to this conclusion was extrapolation of aileron and control wheel force measurements obtained in high speed taxi testing with a simulated ice shape in front of one aileron, and the development of airflow separation over the ailerons into a complete full wing stall.

Recommendations

The Safety Board issued several recommendations as a result of the investigation.

Urgent recommendation A-06-48 asked the FAA to require all operators of Saab SF340 series airplanes to instruct pilots to maintain a minimum operating airspeed of 1.45xVs during icing encounters and before entering known or forecast icing conditions and to exit icing conditions as soon as performance degradations prevent the airplane from maintaining 1.45xVs.

Recommendation A-06-49 and A-06-50 asked the FAA to require the installation of modified stall protection logic in Saab SF340 series airplanes certified for flight into known icing conditions and to require the installation of an icing detection system on Saab SF340 series airplanes.

Recommendation A-06-51 asked the FAA to require all operators of turbo propeller-driven airplanes to instruct pilots, to disengage the autopilot and fly the airplane manually when operating in icing conditions.

The Safety Board also reiterated the following prior recommendations to the FAA.

Recommendation A-03-53 and A-03-54 asked the FAA to convene a panel of airplane design, operations, and aviation human factors specialists to determine whether a requirement for the installation of low-air-speed alert systems in airplanes engaged in commercial operations under 14 Code of Federal Regulations Parts 121 and 135 would be feasible, and if the panel determined that such feasibility exists, establish requirements for low-air-speed alert systems.

Probable Cause

The National Transportation Safety Board determines the probable cause(s) of this incident to be:

An in-flight loss of control due to ice accreted in supercooled liquid droplets (SLD) conditions, and the flight crew's failure to maintain the specified minimum airspeed in icing conditions. Contributing to the accident was the flight crew's decision to climb the airplane in known and forecast icing conditions using an autopilot mode contrary to that specified in the operator's Airplane Operations Manual for climbs during periods of ice accretion or when ice was present on the airframe.

Findings

Occurrence #1: IN FLIGHT ENCOUNTER WITH WEATHER

Phase of Operation: CLIMB - TO CRUISE

Findings

1. WEATHER CONDITION - ICING CONDITIONS

Occurrence #2: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: CLIMB - TO CRUISE

Findings

2. (F) AUTOPILOT - IMPROPER USE OF - FLIGHTCREW
3. (C) AIRSPEED - NOT MAINTAINED - OTHER PERSON
4. (C) STALL - ENCOUNTERED

Pilot Information

Certificate:	Airline Transport	Age:	34
Airplane Rating(s):	Multi-engine Land; Single-engine Land	Instrument Rating(s):	Airplane
Other Aircraft Rating(s):	None	Instructor Rating(s):	None
Flight Time:	6765 hours (Total, all aircraft), 3982 hours (Total, this make and model), 172 hours (Last 90 days, all aircraft), 47 hours (Last 30 days, all aircraft), 7 hours (Last 24 hours, all aircraft)		

Co-Pilot Information

Certificate:	Flight Instructor; Commercial	Age:	32
Airplane Rating(s):	Multi-engine Land; Single-engine Land	Instrument Rating(s):	Airplane
Other Aircraft Rating(s):	None	Instructor Rating(s):	Airplane Multi-engine; Airplane Single-engine
Flight Time:	1368 hours (Total, all aircraft), 133 hours (Total, this make and model), 90 hours (Last 90 days, all aircraft), 24 hours (Last 30 days, all aircraft), 5 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Saab-Scania AB (Saab)	Registration:	N390AE
Model/Series:	SF340B+	Engines:	2 Turbo Prop
Operator:	American Eagle Airlines, Inc.	Engine Manufacturer:	General Electric
Operating Certificate(s) Held:	Flag carrier (121)	Engine Model/Series:	CT7-9B
Flight Conducted Under:	Part 121: Air Carrier - Scheduled		

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument Conditions	Condition of Light:	Day
Observation Facility, Elevation:	SMX, 261 ft msl	Weather Information Source:	Weather Observation Facility
Lowest Ceiling:	Broken / 2700 ft agl	Wind Speed/Gusts, Direction:	16 knots / 27 knots, 230°
Temperature:	13°C	Visibility	9 Miles
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	San Luis Obispo, CA (SBP)	Destination:	Los Angeles, CA (LAX)

Airport Information

Airport:	San Luis County Regional (SBP)	Runway Surface Type:	
Runway Used:	N/A	Runway Surface Condition:	
Runway Length/Width:			

Wreckage and Impact Information

Crew Injuries:	3 None	Aircraft Damage:	None
Passenger Injuries:	25 None	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Latitude, Longitude:	35.052500, -120.121667 (est)		

Administrative Information

Investigator In Charge (IIC):	Howard D Plagens	Adopted Date:	04/30/2009
Investigation Docket:	NTSB accident and incident docket serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov , or at 800-877-6799. Dockets released after this date are available at http://dms.nts.gov/pubdms/ .		

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