



National Transportation Safety Board Aviation Accident Final Report

Location:	Springfield, Illinois	Accident Number:	CEN11FA144
Date & Time:	January 6, 2011, 11:00 Local	Registration:	N800GP
Aircraft:	GATES LEARJET CORP. 35A	Aircraft Damage:	Substantial
Defining Event:	Aerodynamic stall/spin	Injuries:	2 Minor, 4 None
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled		

Analysis

The flight encountered light rime icing during an instrument approach to the destination airport. The copilot was the pilot flying at the time of the accident. He reported that the airframe anti-icing system was turned off upon intercepting the instrument approach glide slope, which was shortly before the airplane descended below the cloud layer. He recalled observing light frost on the outboard wing and tip tank during the approach. The stick shaker activated on short final, and the airplane impacted left of the runway centerline before it ultimately departed the right side of the runway pavement and crossed a slight rise before coming to rest in the grass. The cockpit voice recorder transcript indicated that the pilots were operating in icing conditions without the wing anti-ice system activated for about 4 1/2 minutes prior to activation of the stick shaker. A postaccident examination of the airplane did not reveal any anomalies consistent with a preimpact failure of the flight control system or a loss of anti-ice system functionality. A performance study determined that the airplane's airspeed during the final 30 seconds of the flight was about 114 knots and that the angle of attack ultimately met the stick shaker threshold. The expected stall speed for the airplane was about 93 knots. The airplane flight manual stated that anti-ice systems should be turned on prior to operation in icing conditions during normal operations. The manual warned that even small accumulations of ice on the wing leading edge can cause an aerodynamic stall prior to activation of the stick shaker and/or stick pusher.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's decision to conduct an instrument approach in icing conditions without the anti-ice system activated, contrary to the airplane flight manual guidance, which resulted in an inadvertent aerodynamic stall due to an in-flight accumulation of airframe icing.

Findings

Environmental issues	Snow/ice - Contributed to outcome
Personnel issues	Use of manual - Pilot
Environmental issues	Conducive to structural icing - Decision related to condition
Personnel issues	Decision making/judgment - Pilot

Factual Information

HISTORY OF FLIGHT

On January 6, 2011, at 1101 central standard time, a Learjet 35A, N800GP, was substantially damaged during a hard landing and runway excursion on runway 22 (8,001 feet by 150 feet, concrete) at the Abraham Lincoln Capitol Airport (SPI), Springfield, Illinois. The flight was being conducted under 14 Code of Federal Regulations Part 135 on an instrument flight rules (IFR) flight plan. Instrument meteorological conditions were encountered during the instrument landing system (ILS) approach. Visual meteorological conditions prevailed at SPI at the time of the accident. The pilot and one passenger sustained minor injuries. The copilot and remaining three passengers on-board were not injured. The flight departed from the Chicago Midway International Airport (MDW), Chicago, Illinois, at 1034, with an intended destination of SPI.

The pilot reported that the airplane was de-iced before takeoff. The departure from MDW and the descent into SPI were normal. He recalled that the airplane was in clear air during the cruise portion of the flight. They re-entered the clouds about 5,000 feet mean sea level (msl) on descent into SPI and remained in the clouds until they descended below the cloud layer on the approach about 5 miles from the runway. They were in visual conditions for the remainder of the flight. He noted that the airplane accumulated a trace of rime ice on the wing tip tank and windshield during the descent and approach. The pilot stated that the master warning and stick shaker activated when the airplane was on short final. The airplane impacted left of the runway centerline before it ultimately departed the right side of the runway pavement. The airplane crossed a slight rise before coming to rest in the grass. He directed the copilot to assist the passengers in evacuating.

The copilot noted that he was the pilot flying at the time of the accident and he was positioned in the left pilot seat during the flight. The copilot stated that the airplane was above the clouds during cruise and it re-entered the clouds on descent into SPI. He reported that he used the autopilot for the initial portion of the approach and then hand flew the airplane after descending below the cloud layer. The copilot reported that the airplane anti-icing was on during the entire cruise portion of the flight and no icing was observed on the airframe during the initial portion of the approach. The airframe anti-icing system was turned off upon intercepting the ILS glide slope, which was shortly before descending below the cloud layer. He recalled observing light frost on the outboard wing and tip tank during the approach. The copilot noted that the reference speed for the accident approach was 119 knots and his target airspeed was 124 knots.

The copilot recalled that he slowed the airplane earlier than usual in order to extend the wing flaps and landing gear. This allowed him to operate at a higher engine power setting to increase the effectiveness of the anti-icing system. He noted that with the wing/stabilizer and the engine anti-ice systems on, an engine speed of approximately 65-percent is required in order to maintain cabin pressurization. Also, the airplane needed 60 to 65-percent engine power to hold a standard 3-degree glide slope with full flaps and landing gear extended. He stated that the airplane performed normally without any indication of a malfunction or abnormal condition prior to the accident.

The copilot stated that during final approach, the captain noted "ref plus five." About that time, the stick shaker went off. He noted that the airplane was in the vicinity of the airport fence line or runway threshold at the time. He was not sure of the airspeed at the time the stick shaker activated. The copilot reportedly applied full power and at the same time the captain stated "full power." The left wing dropped causing the airplane to veer to the left. He attempted to correct to the right. He was not sure exactly when or where the airplane touched down, but he thought that it was while he was trying to correct to the right. After the airplane came to a stop, the captain directed him to evacuate the passengers.

One of the passengers reported that the flight seemed routine until immediately before the accident. He felt some lateral movement in rear of the airplane, which was somewhat more than he had experienced on previous flights. He recalled that the airplane began to sink; the left wing dropped and the airplane seemed to "flip-flop" left to right. Engine power increased, but the airplane bounced unusually hard. He thought that the initial impact was on the airplane landing gear, but that the second and third impacts were on the belly of the airplane. His perception was that the airplane was skidding across the ground and that they were not on the runway or a tarmac at that time. He noted that the subsequent evacuation went smoothly and that the fire crews were on-scene very quickly.

A second passenger reported that the left pilot's windshield appeared to be obscured except for a clear area immediately in front of the pilot. He recalled that the airplane veered to the left at the beginning of the accident sequence. The pilots seemed to be trying to stabilize the airplane and execute a go-around. The left wing initially dropped 45 to 60 degrees and then the right wing dropped a similar amount. He recalled hearing a "popping" sound as the airplane impacted the ground. After the airplane came to rest, the occupants exited and moved to a safe distance away from the airplane.

A review of the cockpit voice recorder (CVR) transcript revealed that the flight was cleared for the ILS runway 22 approach at 1055:51 (hhmm:ss). The controller informed the pilots that the flight was located about 9 miles from the approach fix LICOL at that time. Seventeen seconds later, the pilot informed the controller that they were descending into the cloud tops at 4,100 feet msl. At 1056:30, the copilot noted that the anti-ice system was off. Eighteen seconds later, the pilot noted the accumulation of rime ice on the airframe and that they were descending through 3,500 feet msl. At 1058:49, the copilot noted that the wing anti-ice was off and that the engine nacelle anti-ice was on. At 1101:01, the CVR recorded a gasp followed by the pilot commanding "full power." The sound of the stick shaker activating was recorded at 1101:05, with a sound similar to impact beginning at 1101:06 and lasting for about 10 seconds.

PERSONNEL INFORMATION

The pilot, age 44, held an airline transport pilot certificate with single and multi-engine land airplane class ratings. The single engine airplane rating was limited to commercial pilot privileges. The certificate also included LR-Jet (Learjet) and CL-600 (Bombardier Challenger) type ratings. The CL-600 type rating was limited to second-in-command privileges only. The pilot was issued a first-class airman medical certificate on September 21, 2010, without any restrictions or limitations.

According to documentation provided by the operator, the pilot had accumulated about 5,932 hours total flight time, with 827 hours in Learjet model 35 airplanes. He had accumulated about 65 hours in Learjet model 35 airplanes within 90 days of the accident. The pilot's most recent regulatory checkride was completed on October 28, 2010.

The copilot, age 25, held an airline transport pilot certificate with single and multi-engine land airplane class ratings. The single engine airplane rating was limited to private pilot privileges. The certificate also included a CE-510S (Cessna Mustang single-pilot) type rating. The copilot was issued a first-class airman medical certificate on March 2, 2010, without any restrictions or limitations.

According to documentation provided by the operator, the copilot had accumulated about 1,657 hours total flight time, with 802 hours in Learjet model 35 airplanes. The copilot's most recent checkride was completed on May 24, 2010.

AIRCRAFT INFORMATION

The accident airplane was a Gates Learjet 35A, serial number 158. It was issued a transport category standard airworthiness certificate on January 6, 1978. The airplane was registered to AGA Aviation LLC, Reno, Nevada. The accident flight was operated by Priester Aviation LLC, Wheeling, Illinois. The airplane was configured as a corporate aircraft, with 8 passenger seats.

The airplane was powered by two Honeywell TFE731-3-2AP turbofan engines; serial numbers P-75137C (left) and P-75199C (right). Each engine was capable of producing 3,700 pounds of thrust. The engines were modified by Supplemental Type Certificate (STC) SE00648CH and installed on the airframe under STC ST00649CH.

The airplane was maintained under a continuous airworthiness inspection program. The airframe had accumulated about 16,506 hours at the time of the accident. The most recent inspection, which consisted of phases B, C, and D, was completed on June 21, 2010, at 16,321.4 hours total airframe time. The most recent maintenance action was completed on December 29, 2010, which consisted of replacement of a main landing gear hydraulic actuator.

METEOROLOGICAL INFORMATION

Weather conditions recorded by the SPI Automated Surface Observing System, at 1052, were: wind from 300 degrees at 14 knots, gusting to 19 knots; 10 miles visibility; overcast clouds at 1,600 feet above ground level (agl); temperature -2 degrees Celsius; dew point -6 degrees Celsius; altimeter 29.78 inches of mercury.

At 1101, the two-minute averaged wind was from 289 degrees at 12 knots. The peak wind during that time was from 284 degrees at 15 knots.

According to the CVR transcript, at 1053 as the flight approached SPI, the pilots were notified of icing conditions in the vicinity. Air traffic control informed the pilots that another airplane had reported light rime ice on approach about 10 minutes earlier. The pilot report included cloud tops of 4,300 feet msl and cloud bases at 1,800 feet msl.

AIRPORT INFORMATION

The accident airport (SPI) was served by three hard surface runways. Runway 22, the landing runway, was 8,001 feet long by 150 feet wide and constructed of grooved concrete. A paved shoulder area, about 35 feet wide and 360 feet long, extended from the arrival threshold along each side of runway 22. The touchdown zone elevation was 598 feet.

Runway 22 was supported by an ILS approach that provided pilots with course and glide path guidance to the runway touchdown zone. The ILS approach procedure allowed for descent to 798 feet mean sea level (200 feet agl), with a visibility of one-half mile required to descend below the decision altitude for landing. The glide slope descent angle was 3.00 degrees.

An aircraft arresting system was installed on runway 22. It was located 1,329 feet from the arrival threshold of the runway. At the time of the accident, the arresting cable was stowed below the level of the runway pavement as is the case when the system is not deployed for use. The arresting system included a raised curb area located about 10 feet from the edge of the runway. The raised area provided for a transition of the arresting cable to an anchor point on each side of the runway. Tire skid marks are consistent with the airplane striking the raised curb off the right side of the runway during the accident sequence.

FLIGHT RECORDERS

The airplane was equipped with a CVR. A transcript of the audio recording is included with the docket material associated with this accident case. A flight data recorder was not installed, nor was one required to be installed, in the accident airplane.

WRECKAGE AND IMPACT INFORMATION

The accident site was located on the airport. The airplane came to rest in the grass area northwest of runway 22, near taxiways Foxtrot and Golf. The airplane was upright and oriented on a heading of about 360 degrees. The right tip tank had separated from the wing and was located about 250 feet east of the airplane. Portions of the tip tank, as well as the grass and vegetation surrounding the tip tank, were discolored consistent with fire damage. The right flap had separated from the wing. It was located about 500 feet east of the airplane. All three landing gear assemblies had separated from the airframe and were located along the debris path. The right engine partially separated from the airframe during the accident sequence. It was subsequently removed to facilitate recovery.

Intermittent scrape and paint transfer marks were present on the runway pavement near the threshold. The initial marks were located at the left edge of the runway, adjacent to the threshold markings, and extended into the paved shoulder area off the left side of the runway. The shoulder pavement area ended approximately 340 feet from the runway arrival threshold. Gouges/ruts were located in the grass area left of the runway, past the end of the shoulder pavement. The gouges were initially oriented parallel to the runway. However, they curved back toward the runway, ultimately intersecting the runway pavement about 900 feet from the arrival threshold. From that point, the runway exhibited intermittent scrape, paint transfer, and skid marks beginning at the left side of the pavement. The marks continued across the width of the runway in a gentle right hand arc and exited at the right side about 1,300 feet from the arrival threshold.

The airplane fuselage, including the cockpit and cabin, remained intact. The radome, nose skin,

and nose landing gear doors exhibited scraping and deformation along the lower, left side. Grass and debris remained lodged in the radome and nose landing gear areas. The left wing was bent upward approximately 10 degrees at the outboard end of the aileron; about 3 feet inboard of the tip tank. The wing skin was deformed and buckled in that area. The bottom of the left tip tank was deformed over an 18-inch area near mid-length. No evidence of a postimpact fire was observed on the fuselage or left wing. The right wing exhibited discoloration consistent with the postimpact fire at the separation of the right tip tank. The separation point was located at the outboard end of the right aileron. The remainder of the outboard right wing, about 3 feet in length, remained with the tip tank. The separated right tip tank exhibited scrape marks across the entire bottom side of the tank.

The flight controls remained attached to the airframe. Flight control continuity was confirmed. Actuation of the cockpit controls resulted in corresponding movement of each flight control surface. The left flap remained attached to the wing. As previously noted, the right flap had separated from the airframe during the accident sequence. Both flap actuators were extended approximately 9.5 inches at the time of the examination, which corresponded to a 40-degree (full) flap deflection.

Examination of the wing anti-ice system transverse duct indicated that the accident airplane was in compliance with Learjet service bulletin SB 35/36-30-10.

TEST AND RESEARCH

Functional testing of the left and right engine bleed air modulating valves did not reveal any anomalies consistent with a loss of bleed air to the anti-ice system. The left valve exhibited excessive air leakage at the no. 2 regulator; however, the output air pressure to the anti-ice system was within specifications. The right valve exhibited excessive air leakage between the valve housing sections. Further examination determined that the O-ring was not installed. In addition, the valve transitioned between high pressure and low pressure bleed air sources approximately 6 psi below specification, the no. 2 regulator activated about 5 psi above the specification, and the regulating valve did not fully close at 10 psi during testing. However, the output air pressure to the anti-ice system was within specifications. Both valve assemblies remained attached to the engines; although, the right engine partially separated from the airframe during the accident sequence.

Testing of the wing and horizontal stabilizer temperature indicators determined that the instruments provided correct indications between the cool (yellow) and normal (green) temperature bands. Both indicators provided above standard indications at the normal (green) to hot (red) temperature bands. However, the observed indicator deviations at the normal to hot temperature bands were within approximately 0.06 inch.

A representative weight and balance calculation based on the available information determined that the accident flight was within limitations for the duration of the flight. The landing weight was approximately 13,515 lbs. According to the airplane flight manual, the corresponding landing reference speed was 121 knots and the required landing distance was about 2,700 feet. The expected stall speed for the airplane was about 93 knots.

A vehicle performance study related to the accident flight determined that the airplane descended on a 3.30 degree glide path during the final 8 miles of the approach. The average descent rate was 730 feet per minute. The average ground speed for the airplane during the final 30 seconds of the flight was approximately 116 knots. Calculated airspeeds during that timeframe ranged from about 108 to 114 knots. The calculated angle-of-attack exceeded 10

degrees during the final 30 seconds of the flight and ultimately met the stick shaker threshold of 11.6 degrees (flaps 40 degrees).

ADDITIONAL INFORMATION

The airplane flight manual stated that anti-ice systems should be turned on prior to operation in icing conditions during normal operations. The manual noted that icing conditions exist when the outside air temperature is 10 degrees Celsius to -40 degrees Celsius and visible moisture in any form is present (such as clouds, rain, snow, sleet, ice crystals, or fog with visibility of 1 mile or less). The manual warned that even small accumulations of ice on the wing leading edge can cause an aerodynamic stall prior to activation of the stick shaker and/or stick pusher.

The flight manual also stated that if the presence of ice on the wing leading edge is detected, the normal approach speeds must be increased in accordance with the Wing Heat Failure – Landing procedure. This procedure required that the final approach and landing touchdown speeds be increased by 15 knots. In addition, the required landing distance should be increased by a factor of 1.20, which would have resulted in an approximate landing distance of 3,240 feet for the accident flight. Flight manual performance data indicated that the accident flight was below the weight limit for landing with full anti-ice on.

Additional guidance related to operations with airframe icing was included in the abnormal procedures section of the flight manual. Guidance contained under the Inadvertent Icing Encounter procedure, noted that the anti-ice systems should be activated immediately to preclude ice accumulation. In addition, if an approach and landing must be made with any amount of ice on the airframe, the wing flaps should not be extended beyond 20 degrees and the Wing and Stab Heat Failure -- Landing procedure should be followed. That procedure specified that the approach reference and landing touchdown speeds were to be increased by 25 knots, and the required landing distance increased by a factor of 1.30.

History of Flight

Approach-IFR initial approach	Structural icing
Approach-IFR final approach	Aerodynamic stall/spin (Defining event)
Landing-flare/touchdown	Hard landing
Landing-flare/touchdown	Runway excursion
Landing	Landing gear collapse

Pilot Information

Certificate:	Airline transport	Age:	44, Male
Airplane Rating(s):	Single-engine land; Multi-engine land	Seat Occupied:	Right
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 1 Without waivers/limitations	Last FAA Medical Exam:	September 21, 2010
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	October 28, 2010
Flight Time:	5932 hours (Total, all aircraft), 827 hours (Total, this make and model), 2208 hours (Pilot In Command, all aircraft)		

Co-pilot Information

Certificate:	Airline transport	Age:	25, Male
Airplane Rating(s):	Single-engine land; Multi-engine land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 1 Without waivers/limitations	Last FAA Medical Exam:	March 2, 2010
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	May 24, 2010
Flight Time:	1657 hours (Total, all aircraft), 802 hours (Total, this make and model), 755 hours (Pilot In Command, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	GATES LEARJET CORP.	Registration:	N800GP
Model/Series:	35A	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Transport	Serial Number:	158
Landing Gear Type:	Retractable - Tricycle	Seats:	10
Date/Type of Last Inspection:	June 21, 2010 Continuous airworthiness	Certified Max Gross Wt.:	18300 lbs
Time Since Last Inspection:		Engines:	2 Turbo fan
Airframe Total Time:	16321.4 Hrs as of last inspection	Engine Manufacturer:	GARRETT
ELT:	Installed	Engine Model/Series:	TFE 731 SER
Registered Owner:		Rated Power:	3500 Horsepower
Operator:		Operating Certificate(s) Held:	On-demand air taxi (135)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	SPI, 598 ft msl	Distance from Accident Site:	1 Nautical Miles
Observation Time:	10:52 Local	Direction from Accident Site:	0°
Lowest Cloud Condition:		Visibility	10 miles
Lowest Ceiling:	Overcast / 1600 ft AGL	Visibility (RVR):	
Wind Speed/Gusts:	14 knots / 19 knots	Turbulence Type Forecast/Actual:	/
Wind Direction:	300°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	29.78 inches Hg	Temperature/Dew Point:	-2° C / -6° C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Chicago, IL (MDW)	Type of Flight Plan Filed:	IFR
Destination:	Springfield, IL (SPI)	Type of Clearance:	IFR
Departure Time:	10:34 Local	Type of Airspace:	

Airport Information

Airport:	Abraham Lincoln Capital SPI	Runway Surface Type:	Concrete
Airport Elevation:	598 ft msl	Runway Surface Condition:	Dry
Runway Used:	22	IFR Approach:	ILS
Runway Length/Width:	8001 ft / 150 ft	VFR Approach/Landing:	Full stop

Wreckage and Impact Information

Crew Injuries:	1 Minor, 1 None	Aircraft Damage:	Substantial
Passenger Injuries:	1 Minor, 3 None	Aircraft Fire:	On-ground
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 Minor, 4 None	Latitude, Longitude:	39.844165, -89.678054(est)

Administrative Information

Investigator In Charge (IIC):	Sorensen, Timothy
Additional Participating Persons:	T R Proven; FAA-Accident Investigation; Washington, DC Kerry Gambrel; FAA-Springfield FSDO; Springfield, IL Mark Siebert; Bombardier Learjet; Wichita, KS Jason Starke; Priester Aviation; Wheeling, IL
Original Publish Date:	February 27, 2013
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=78117

The National Transportation Safety Board (NTSB), established in 1967, is an independent federal agency mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).