Aviation Investigation Final Report

Location:	Mayport, Florida	**Accident Number:**	ERA19LA072
Date & Time:	December 20, 2018, 09:04 Local	**Registration:**	N307JM
Aircraft:	Piper PA46	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of control in flight	**Injuries:**	2 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot and his pilot-rated passenger departed under instrument flight rules for a personal cross-country flight and climbed first to 19,000 ft mean sea level (msl), then to 23,000 ft msl several minutes later. Weather and air traffic control radar information indicated that the airplane had been operating in an area of heavy precipitation for about 20 minutes before it entered a descending right turn. A section of the right wing separated as the airplane descended, and the airplane impacted water. Performance calculations revealed that, shortly before the airplane began its descent, its airspeed decreased to between 77 and 90 knots indicated (KIAS). The airplane's published stall speed at maximum gross weight was 69 KIAS. Because accumulation of ice on the unprotected areas of the airframe increased the airplane's stall speed, with aerodynamic buffeting occurring up to 19 knots above the normal stall speed, the manufacturer stated that flight in icing conditions should be conducted at a speed not lower than 130 KIAS.

Postaccident examination of the airplane's flight controls and icing protection system components revealed no evidence of preimpact failure or malfunction. While the filament of the stall warning fail and windshield heat fail warning light bulbs were broken and stretched, potentially consistent with illumination at impact, it could not be determined at what portion of the flight the bulb(s) might have illuminated. Based on the environmental conditions at the time, the stall warning system was likely not accurate or reliable. Although fatigue cracks were noted in the right wing spar web, the cracks did not contribute to the inflight break-up.

The pilot received a preflight weather briefing that included a convective SIGMET outlook and an AIRMET for icing between about 14,000 ft and 27,000 ft msl, valid for the area of the accident site about the time of the accident. Although the pilot did not access specific icing forecasts, which likely understated the potential for icing conditions, there was sufficient information available to the pilot to indicate possible icing at his chosen cruise altitude. The airplane was operating above the freezing level near the top of a mature cumulus cloud

formation, which is known to have higher liquid water content, and within a heavy rain shower band. Those conditions likely resulted in an encounter with supercooled large droplet icing conditions, which exceeded the capability of the airplane's icing protection system.

Given this information, it is likely that the flight encountered icing conditions, which resulted in the airframe accumulating ice in excess of that able to be shed by the airplane's icing protection system. It is also likely that, because the pilot was operating the airplane below the minimum icing airspeed, it encountered an aerodynamic stall at an airspeed that was higher than normal, which resulted in a loss of control, an uncontrolled descent, and subsequent inflight break-up.

Probable Cause and Findings

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

An in-flight loss of control following an encounter with supercooled large droplet icing conditions, which ultimately resulted in an uncontrolled descent and subsequent inflight breakup. Also causal was the pilot's failure to maintain an appropriate airspeed for flight in icing conditions.

Findings

Environmental issues	Conducive to structural icing - Response/compensation
Aircraft	Airspeed - Not attained/maintained
Personnel issues	Aircraft control - Pilot

Factual Information

History of Flight

Enroute-cruise	Other weather encounter
Enroute-cruise	Loss of control in flight (Defining event)
Uncontrolled descent	Aircraft structural failure
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On December 20, 2018, about 0904 eastern standard time, a Piper PA-46-350P, N307JM, was destroyed when it was involved in an accident near Mayport, Florida. The private pilot and pilot-rated passenger were fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

According to Federal Aviation Administration (FAA) air traffic control and radar information, after takeoff, the pilot established contact with Orlando Approach and remained in contact with that facility for about 17 minutes before it was transitioned to Jacksonville Air Route Traffic Control Center (ZJX ARTCC).

The pilot was incrementally cleared to climb to 19,000 ft, where he leveled the airplane for about 5 minutes before being cleared to climb to 23,000 ft msl. About 0859, the controller informed the pilot of "…moderate and some heavy precipitation extending along your route of flight for the next two zero zero miles." One of the pilots acknowledged and advised that they would be watching the weather. Review of weather radar information indicated that, about 0859, the airplane was located in an area of light to moderate echoes of 20 to 30 decibels (dBZ). Data from the onboard portable GPS receiver revealed slight deviations of the airplane's flightpath about this time, but the airplane continued in a northerly direction. About 0902, the controller broadcast on the frequency that AIRMETs Tango and Zulu (for turbulence and icing, respectively) were available.

About this time, while flying within an area of base reflectivity returns of 10 to 30 dBZ (light precipitation) at the airplane's altitude and composite reflectivity of 35 to 50 dBZ (classified as heavy precipitation), the airplane began a right turn. Between 0902:03 and 0902:28, the airplane continued the right turn, descending from 23,000 ft to 22,100 ft; between 0902:28 and 0903:12, the airplane continued descending to 14,700 ft msl.

At 0903:08, while at 14,700 ft msl, the controller attempted to contact the airplane, but there was no reply. The controller continued to communicate with the flight, and at 0903:27, in response to one attempt, while about 12,200 ft msl, an occupant advised, "we're not ok we need help." The controller asked the pilot if he was declaring an emergency, to which the occupant immediately replied, "I'm not sure whats happening," followed by "I have anti-ice…everything." At 0903:40, with the airplane at an altitude of 10,400 ft msl, the controller asked if they could

maintain altitude, and an occupant responded that they could not. The controller provided vectors to a nearby airport, but there was no reply from the airplane. At 0904:31, while at about 3,300 ft msl, an occupant advised the controller that the airplane was inverted and asked for assistance. Radar contact was lost shortly thereafter. Air and water searches for the airplane were performed by multiple U.S. Coast Guard aircraft and vessels, but the wreckage was not located. The search was suspended on December 22, 2018.

Pilot Information

Certificate:	Private	**Age:**	51,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	September 15, 2018
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	December 14, 2018
Flight Time:	390 hours (Total, all aircraft), 30 hours (Total, this make and model), 290 hours (Pilot In Command, all aircraft)		

Pilot-rated passenger Information

Certificate:	Private	**Age:**	18,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	3-point
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 Without waivers/limitations	**Last FAA Medical Exam:**	March 25, 2017
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	April 20, 2018
Flight Time:	(Estimated) 74.6 hours (Total, all aircraft), 11.5 hours (Pilot In Command, all aircraft)		

FAA records indicated that, on January 2, 2018, the pilot received notice of disapproval of application for the flight portion of his instrument rating practical test. The FAA designated examiner indicated that he failed to maintain altitude within 100 ft during level flight and failed to maintain airspeed within 10 knots during a precision approach. On June 20, 2018, the pilot completed the practical test, which comprised 1.8 hours flight in a Piper PA-32-301 airplane. At that time, he reported 289 total hours of flight experience, of which 70 were instrument.

The pilot obtained ground and flight training in the accident airplane between December 10, 2018, and December 14, 2018, to meet an insurance requirement of 25 hours of dual flight instruction. The training was performed by a flight instructor who was an FAA designated pilot examiner (DPE). During that training, the pilot received endorsements for a flight review and instrument proficiency. A review of the training records revealed that the pilot received training in operating within icing conditions and the use of the airplane's ice protection system.

According to notes from the flight instructor/DPE, the accident pilot needed to review the missed approach procedure and work on his instrument flight rules phraseology, but was "good" with autopilot use. The instructor stated that, as part of his ground training, he discussed cumuliform and cumulonimbus cloud types, the amount of precipitation that would occur in each, and the icing hazards associated with each. He also discussed and trained what airspeed (130 to 140 knots) to maintain during climb and cruise when operating in icing conditions to avoid ice accumulating on the bottom of wing.

According to the report submitted by the pilot's attorney, at the time of the accident, the pilot had a total flight experience of 390 hours, of which 290 were as pilot-in-command, and his total time in the accident airplane make and model was 30 hours.

Aircraft and Owner/Operator Information

Aircraft Make:	Piper	**Registration:**	N307JM
Model/Series:	PA46 350P	**Aircraft Category:**	Airplane
Year of Manufacture:	2000	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	4636253
Landing Gear Type:	Retractable - Tricycle	**Seats:**	6
Date/Type of Last Inspection:	July 27, 2018 Annual	**Certified Max Gross Wt.:**	4300 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	3785.9 Hrs as of last inspection	**Engine Manufacturer:**	Lycoming
ELT:	C91A installed, not activated	**Engine Model/Series:**	TIO-540-AE2A
Registered Owner:	On file	**Rated Power:**	350 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

The airplane was equipped with an enhanced digital display indicator, annunciator panel, a portable Garmin 496 GPS map receiver, vertical profile weather radar system, and stormscope.

The ice protection system was designed and tested to allow for continuous maximum and intermittent maximum icing specified in 14 *CFR* Part 25, Appendix C. The system comprised pneumatic wing and empennage boots, a wing ice detection light, electrothermal propeller deice pads installed on each propeller blade, an electrically heated windshield, heated lift detector, heated pitot head, two operating alternators, two vacuum pumps and the alternate static source. The surface deice system was manually engaged by a switch on the environmental/deice switch panel, which provided power to the solid-state timer.

According to the manufacturer of the solid-state timer, it was not possible to determine positional information such as where it was in a cycle, nor did it contain any non-volatile memory.

Although the enhanced digital display indicator was retained, no attempt was made to download any nonvolatile memory. The environmental/deice switch panel was examined by NTSB Materials Laboratory personnel, but the internal mechanisms of the switch panel were too damaged to determine switch position at impact.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	NRB,15 ft msl	**Distance from Accident Site:**	2 Nautical Miles
Observation Time:	08:52 Local	**Direction from Accident Site:**	255°
Lowest Cloud Condition:	Scattered / 4000 ft AGL	**Visibility**	6 miles
Lowest Ceiling:	Overcast / 10000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	9 knots /	**Turbulence Type Forecast/Actual:**	Convective / Convective
Wind Direction:	140°	**Turbulence Severity Forecast/Actual:**	Moderate / Moderate
Altimeter Setting:	29.76 inches Hg	**Temperature/Dew Point:**	19°C / 18°C
Precipitation and Obscuration:	Moderate - None - Mist		
Departure Point:	Orlando, FL (ISM)	**Type of Flight Plan Filed:**	IFR
Destination:	Princeton, NJ (39N)	**Type of Clearance:**	IFR
Departure Time:	08:21 Local	**Type of Airspace:**	Class A

The pilot received a preflight weather briefing at 0717, which included a convective SIGMET "outlook" valid for the accident site area, which implied the possibility for severe or greater turbulence, severe icing, and low-level wind shear if a convective SIGMET was subsequently issued. He did not request the current icing potential (CIP) or forecast icing potential (FIP). The CIP issued about 9 minutes before the pilot requested weather information and again at 0808 revealed that, in the airplane's last location at 22,000 to 23,000 ft, the icing probability, icing severity, and potential for supercooled large droplets (SLD) were 0% to 10%, light, and unknown, respectively.

The briefing information provided to the pilot also included icing AIRMET Zulu update 1, which specified moderate ice between the freezing level (between 11,000 ft msl and 14,000 ft msl) and 27,000 ft, which was valid for the route of flight. The airplane was operating within clouds/precipitation above 14,000 ft msl from about 0842 until the departure from controlled flight about 0902.

Center weather advisory (CWA) 201 issued at 0822 and valid until 0922 for the area of the accident site warned of a developing area of thunderstorms moving from 200° at 40 knots. Thunderstorm tops were to 30,000 ft with heavy rainfall and an increasing trend.

The FIP issued at 0900, indicated higher FIP icing values associated with the abundant cumuliform precipitation along the route of flight and between a 10% to 40% probability of light to moderate icing at 19,000 to 23,000 ft above the airplane's last radar return. The FIP did not indicate any probability of SLD over the area around the accident time.

At the accident airplane's altitude before descent, the temperature was about -16°C. The Geostationary Operational Environmental Satellite (GOES) visible imagery indicated an extensive layer of cumuliform cloud cover in the area of the airplane's last radar return, with the cloud cover moving from southwest to northeast. Based on the brightness temperatures above the accident site and the vertical temperature profile about the time of the loss of control, the approximate cloud-top heights were 33,000 ft.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	1 Fatal	**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	30.400554,-81.384445

A second search located the wreckage on February 5, 2019, about 525 ft north-northwest of the last radar target with altitude. The wreckage was recovered and transported to a salvage facility for examination.

Examination of the airframe revealed that the fuselage crown in the cabin area near the aft seats was displaced down. The aft fuselage was separated at fuselage station (FS) 280. The following components were separated from the airplane: firewall with attached engine mount and nose landing gear; engine assembly with attached propeller; horizontal stabilizer; elevators; vertical stabilizer; rudder; section of right wing; outboard 1.5-foot section of left

wing; left aileron; left flap; majority of right aileron; nose baggage door; and fuselage upper crown over the cockpit and cabin area. Components that were not recovered consisted of: emergency fuel pump, gascolator, baggage door, right wing inboard stall strip, inboard area of the right aileron, horizontal stabilizer; right elevator and section of left elevator; vertical stabilizer; and rudder. The nose landing gear was extended. The firewall was impact damaged, but there was no evidence of fire on it or any observed components.

Both wings exhibited extensive impact damage, spar fractures, and deformation. The aft spar of the left wing was fractured consistent with overstress and displaced down at WS 128, while the spars of the right wing were fractured between WS 83 and 93. The fracture surfaces of the right-wing spars were excised and retained for further examination by NTSB. Examination of the aileron flight control system and flap system for both wings revealed no evidence of preimpact failure or malfunction. The speedbrakes of the left and right wings were fully and partially deployed, respectively. The landing gear were extended, and the radar pod of the right wing was separated. The blade of the lift transducer was restricted due to impacted sand.

Both cabin doors were present. Both primary static ports were clear of obstruction on the exterior, while the alternate static port and static port of the pressurization outflow valve were blocked on the exterior consistent with sand found in the fuselage.

Examination of the aft fuselage revealed that the forward attach point of the vertical stabilizer was fractured/pulled up. The vertical stabilizer aft spar remained attached and was bent in multiple directions with a portion of rudder attach bolt attached. The left and right main spars of the horizontal stabilizer were fractured in the down direction. Excised sections of the structural pieces of the vertical stabilizer, and horizontal stabilizers were retained for examination by the NTSB. Examination of the elevator and rudder flight control system revealed no evidence of preimpact failure or malfunction. The elevator trim barrel assembly was extended 1.0 inch, consistent with a neutral elevator trim setting.

Examination of the pneumatic deice pressure control valves and pressure switches revealed that all the deice valves appeared to be in an unpowered state. The solenoid of the upper deice pressure control valve (A416) was separated and not located. All wires related to the deice control valves were cut consistent with recovery forward of the P402 connector, including the pressure switch wiring. Due to the condition of the control valves and pressure switches caused by the prolonged saltwater submersion, they were not tested.

Examination of tail deice system components revealed that sections of deice boot remained attached to the left and right inflation and deflation hoses for the horizontal stabilizer. The vertical stabilizer deice “T” fitting was fractured, but hoses remained attached at both sides of the “T” fitting.
Operational testing of each wing pneumatic deice boot was performed by using compressed air blown into the respective line that inflated the upper and lower chambers of each wing deice boot. Aside from impact-damaged areas of the boots from both wings and/or pneumatic lines, the upper and lower chambers of the deice boots of both wings inflated normally.

Examination of the electrical wires of the wings and tail deice system components, pitot heat, and stall warning heat revealed no preimpact discrepancies.

The airplane's annunciator panel was significantly damaged by impact forces, though many of the light bulbs within the panel were present and relatively intact. The individual bulbs were removed to facilitate examination. The individual intact bulbs were x-rayed to determine the condition of the filament inside. Both of the bulbs from the fuel imbalance and starter engage annunciations were intact and stretched. Only one of the two bulbs each for the stall warning fail, flaps, and windshield heat fail were intact and stretched. The second bulb for each of these the three annunciators was broken, and the respective filaments were missing.

the filament of the stall warning fail and windshield heat fail warning light bulbs were broken and stretched

According to the NTSB Materials Laboratory factual report pertaining to the structural members, except for the web of the right wing spar, all fracture surfaces were on a slant plane with coarse fracture features consistent with overstress separation. Two adjoining fatigue cracks that emanated from the aft face of the right wing spar web were noted. The cracks intersected two holes in the spar web. The examination of the P409 plug and ground pin revealed the fractured end of a copper cable was attached (crimped) to the barrel portion of the pin. Multiple strands of the cable were fully inserted into the barrel portion and were fractured on a slant plane consistent with overstress separation outside of the crimped portion of the barrel.

All engine mount legs were fractured, and the engine remained partially attached to the firewall by hoses and cables. The oil sump was corroded away, and the air induction box was not located within the recovered wreckage. The crankshaft could initially only be rotated through about 10° of rotation, but following removal of the rear mounted accessories, propeller governor, pushrods, and the engine accessory case, the crankshaft was rotated and compression and suction was observed from all cylinders. Continuity of the crankshaft and camshaft to the accessory case was confirmed. The interiors of the cylinders were viewed using a lighted borescope and no anomalies were noted except sand and water intrusion. Examination of the lubrication, fuel metering, ignition, and turbocharger system components of the engine revealed no evidence of preimpact failure or malfunction. The right exhaust bypass valve assembly was impact separated and not recovered.

Examination of the vacuum system revealed that the upper engine-driven vacuum pump was impact separated from the engine and hanging by the hoses. Disassembly revealed that the carbon rotor was fractured, but the carbon vanes were intact. The composite drive coupling remained attached and was unbroken. The lower engine-driven vacuum pump remained attached to the engine. The pump was removed and disassembled; the carbon rotor and vanes were intact and the composite drive assembly was unbroken.

All three composite propeller blades remained secured in the propeller hub and could not be rotated by hand. The spinner was impact crushed on one side. One propeller blade was fractured about mid-span and deflected aft about 90°. The second propeller blade exhibited a trailing edge fracture about 4 inches outboard of the propeller hub, and there was no damage to the remaining blade.

Medical and Pathological Information

Forensic toxicology on specimens of the pilot was performed by the FAA Forensic Sciences Laboratory. The report indicated that unquantified amounts of N-Butanol and Propanol were detected in the liver and muscle specimen, while 62 mg/dL and 59 mg/dL were detected in the liver and muscle specimens, respectively. Ethanol is water soluble, and after absorption it quickly and uniformly distributes throughout the body's tissues and fluids. The distribution pattern parallels water content and blood supply of the tissue. A small amount of ethanol can be produced after death by microbial activity, sometimes in conjunction with other alcohols, such as isopropanol, butanol, and n-propanol.

Additional Information

Pilot's Operating Handbook and FAA Approved Airplane Flight Manual (POH/AFM)

The published design maneuvering speed at gross weight was 133 KIAS and the stall speed at maximum gross weight no bank angle with flaps and gear retracted was 69 KIAS.

The POH/AFM limitations section contained a warning that, "Severe icing may result from environmental conditions outside of those for which the airplane is certified. Flight in freezing rain, freezing drizzle, or mixed icing conditions (supercooled liquid water and ice crystals) may result in ice build-up on protected surfaces exceeding the capability of the ice protection system, or may result in ice forming aft of the protected surfaces. This ice may not be shed using the ice protections systems, and may seriously degrade the performance and controllability of the airplane." The warning further stated, "During flight, severe icing conditions that exceed those for which the airplane is certificated shall be determined by the following visual cues. If one or more of these visual cues exists, immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the icing conditions."

According to Supplement 3 of the POH/AFM, when icing conditions are encountered during climb, the cruise airspeed should be increased to 130 knots. A caution in the supplement indicated that if cruise airspeed dropped below 130 knots in icing conditions increase power to

maintain that speed. If maximum continuous power was required to maintain 130 knots, immediate action should be taken to exit icing conditions. The supplement also indicated that when ice had accumulated on the unprotected surfaces of the airplane, aerodynamic buffet would commence 5 to 19 knots before the stall. A "substantial margin of airspeed should be maintained above the normal stall speed, since the stall speed will increase in prolonged icing encounters. For the same reason, stall warning devices are not accurate and should not be relied upon." The supplement referred to FAA Advisory Circular (AC) 91-51, which was superseded by AC 91-74B.

Accident Flight Performance Data

Calculation to determine airspeed during the later portion of the flight were performed by personnel of Piper Aircraft utilizing radar and weather data provided by NTSB, as well as weight calculations. The airspeed during the climb to 19,000 ft (described as first climb), the level portion flown at 19,000 ft, and during the climb from 19,000 to 23,000 ft (described as second climb) were calculated. The report indicated that the airplane was operated below the published minimum icing airspeed for about 5 minutes during the first climb, with the calculated airspeed reaching a minimum value between 108 and 122 knots calibrated airspeed (KCAS) or 110 and 124 KIAS, respectively. Between the first and second climbs, when flying level at 19,000 ft, the indicated airspeed was above the published minimum icing speed nearly the entire time. During the second climb from about 0856 until about 0902, the airspeed was decreasing, and the airplane was operated below the published minimum icing airspeed, reaching a minimum value between 75 and 88 KCAS (77 and 90 KIAS, respectively). While descending following the departure from controlled flight, the airspeed increased to above 150 KIAS, which was above the maximum maneuvering speed. The average rate of climb during the first and second climbs was about 630 to 640 feet per minute.

Advisory Circular 91-74B

AC 91-74B, Pilot Guide: Flight in Icing Conditions" dated October 8, 2015, indicated that tops of clouds often contain the most liquid water and largest drops, because the drops that reach the tops have undergone the most lifting. It also indicated that cumulous clouds which often form because of vigorous convection, can have high liquid water content. If the temperatures are cold enough at the tops (below or around -15°C [5°F]), ice particles will usually start to form that tend to deplete the liquid water.

AC 00-45H

AC 00-45H, Aviation Weather Services, indicated that Convective SIGMETs are issued in part for embedded thunderstorms, or a line of thunderstorms, and that any Convective SIGMET implies severe or greater turbulence, severe icing, and low-level windshear. The AC also indicated that supercooled large drops are defined as being larger than 50 micrometers in diameter, are outside the icing certification envelopes of 14 CFR Part 25 appendix C and can be particularly hazardous to some aircraft.

Administrative Information

Investigator In Charge (IIC):	Monville, Timothy
Additional Participating Persons:	Rob Lasky; FAA/FSDO; Orlando, FL Damian Galbraith; Piper Aircraft; Vero Beach, FL J M Childers; Lycoming Engines; Williamsport, PA Ryan M. Sebek; FAA/FSDO; Orlando, FL
Original Publish Date:	April 21, 2022
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=98795