



National Transportation Safety Board Aviation Accident Final Report

Location:	Harrison, Michigan	Accident Number:	CEN10FA063
Date & Time:	December 4, 2009, 18:45 Local	Registration:	N85EM
Aircraft:	Piper PA-31T2	Aircraft Damage:	Destroyed
Defining Event:	Loss of control in flight	Injuries:	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Executive/Corporate		

Analysis

Shortly after takeoff in the pressurized twin-engine airplane, the pilot was cleared to climb and maintain 16,000 feet. The pilot reported passing through instrument conditions with heavy snow and that he cleared the tops of the clouds at 7,000 feet. The pilot was then cleared to climb and maintain flight level (FL) 230. Radar data showed the airplane's altitude and course varied throughout the flight after having reached FL 230. Several times during the flight the air traffic controller questioned the pilot regarding his altitude and/or course. Each time the pilot responded that he was at the correct altitude and/or course. The radar data showed that after each of these conversations, the airplane would return to the assigned altitude and/or course. The controller then informed the pilot that, because radar showed the airplane's altitude fluctuating between FL 224 and FL 237, he was going to have to descend out of positive controller airspace. The pilot acknowledged this transmission. The controller instructed the pilot to descend to 17,000 feet. The last transmission from the pilot was when he acknowledged the descent. Radar data showed that one minute later the airplane was at FL 234. During the last minute and 12 seconds of radar data, the airplane reversed its course and descended from FL 233 to FL 214, at which time radar data was lost. Witnesses reported hearing loud engine sounds and seeing the airplane in a spiraling descent until ground impact. Postaccident inspection of the engines did not identify any anomalies that would have precluded normal operation. Most of the fuselage was consumed by fire; however, flight control continuity was established. Given the pilot's experience and the flight's altitude and course variations the investigation considered that the pilot may have suffered from hypoxia; however, due to the postimpact fire the functionality of the airplane's pressurization system could not be observed and no conclusive determination could be made that the pilot was impaired.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: A loss of aircraft control for undetermined reasons.

Findings

Not determined

(general) - Unknown/Not determined

Factual Information

HISTORY OF FLIGHT

On December 4, 2009, at 1845 eastern standard time, a Piper PA-31T2, N85EM, collided with the terrain following an in flight loss of control in Harrison, Michigan. The airline transport rated pilot suffered fatal injuries. The airplane was destroyed by impact forces and a post impact fire. Visual meteorological conditions prevailed and an instrument flight rules (IFR) flight plan was filed. The business flight was being operated under 14 Code of Federal Regulations Part 91. The flight departed the Charlevoix Municipal Airport (CVX), Charlevoix, Michigan, at 1811, en route to the Seneca County Airport (16G), Tiffin, Ohio.

The pilot departed from 16G earlier in the evening and flew to CVX to drop off a passenger. He was returning to 16G when the accident occurred. Another pilot who knew the pilot of N85EM stated he landed at CVX approximately 5 minutes before N85EM. According to the times provided by this pilot, N85EM was on the ground at CVX for approximately 30 minutes. He stated N85EM was on the other side of the airport from where he was so he did not see the pilot of N85EM, but they conversed on the aircraft radio while on the ground. He stated that the pilot of N85EM did not mention having any problems with the airplane. He departed CVX about 5 minutes after N85EM, en route to Toledo, Ohio. The pilot stated the cloud tops were around 8,000 feet with a trace of rime ice in the clouds. He stated he overheard radio conversation between the pilot of N85EM and air traffic control. He stated the pilot responded accordingly to the radio transmissions and that there were no "signs of distress."

The pilot of N85EM picked up his IFR clearance while on the ground at CVX. At 1816:13, he contacted the Minneapolis Air Route Traffic Control Center (ARTCC) stating that he was out of 1,800 feet climbing to 6,000 feet. The controller then cleared N85EM to climb and maintain 16,000 feet. Radar contact with N85EM was established at 1817:35. At this time the pilot reported climbing out of 5,600 feet and being in solid IFR conditions with heavy snow. At 1838:19, the pilot reported being on top of the clouds in clear weather at 7,000 feet. At 1820:58, N85EM was cleared to climb to and maintain flight level (FL) 230. The pilot acknowledged this clearance.

Radar data indicated that during the climb to FL 230 there were slight variations in the aircraft course, but overall the aircraft maintained a south-southeasterly course of about 170 degrees. Around 1828, the aircraft turned to a south-southwesterly course of about 190 degrees and entered a descent. At 1829:13, the controller asked the pilot what altitude he was at. The pilot reported being at FL 230 feet to which the controller responded that radar was showing him as being at FL 224. The pilot acknowledged this transmission. The radar data showed the airplane began to climb and at 1830:18, the controller stated that the radar was now showing the airplane back level at FL 230.

At 1831:36, the controller asked the pilot how the ride was at FL 230. The pilot responded that the ride was smooth and there was no ice. Around 1834, the airplane again turned to a south-southwesterly course of about 230 degrees, entering a descent. At 1834:46, the controller contacted the pilot informing him that the radar was showing him as being on a southwesterly

course. The controller asked the pilot if he was showing himself as being on course, to which the pilot answered "yes sir." The controller then stated that the radar was showing that he was 300 feet below his assigned altitude. The pilot responded, "we're shown twenty three hundred twenty three thousand ah twenty nine ninety two." The radar showed the airplane then turned back to a course of about 170 degrees. The course of the airplane gradually changed back to a heading of about 190 degrees as the airplane climbed to FL 242. The radar track indicates that around 1838, the airplane's course changed to about 130 degrees and the altitudes continued to fluctuate.

At 1838:37, the controller stated that the mode C readout was showing the airplane's altitude fluctuating between FL 224 and FL 237. The pilot responded that he would get it checked when he got on the ground. The controller then informed the pilot that because the altitude readout was fluctuating, he could not let him fly in positive control airspace. The controller instructed the pilot to descend and maintain 17,000 feet. The pilot responded, "okay ah stop the altitude squawk for (unintelligible)." At 1838:53, the controller again instructed the pilot to descend and maintain 17,000 feet. At 1839:15, the pilot replied, "(unintelligible) leaving two four --- (for one seven thousand)." This was the last transmission from N85EM. The radar data showed the airplane was at FL 242 when this last transmission occurred. The airplane maintained an altitude between FL 242 and FL 240 until 1839:48.

The radar data indicated that at 1840, the airplane was on a southerly course at FL 234. At 1840:12, the course was about 140 degrees at an altitude of FL 233. The airplane maintained this course until 1840:24 when it switched to a northerly course. At 1840:51, the course changed to a track of about 070 degrees and the altitude data indicated an altitude of FL 223. Nine seconds later, the course changed to one of about 015 degrees. The last recorded radar was at 1841:24 at an altitude of FL 214. The location of the last radar contact was approximately 0.7 miles northwest of the accident site.

There were four witnesses identified who heard and saw the airplane prior to the accident. All of the witnesses reported that they heard the airplane prior to seeing it and it was the sound of the engines that caught their attention. Three of the witnesses reported hearing loud engine sounds. One of which reported that the only change in engine sound was from the change in the airplane's direction and not from a change in engine operation. The fourth witness reported hearing the engines, followed by silence, which was followed by more engine sounds.

Two of the witnesses reported seeing the airplane spiraling in a "flat" attitude prior to the nose dropping and the airplane impacting the terrain. Another of the witnesses reported seeing the lights on the airplane as it made approximately 10 spirals while descending. This witness stated the airplane was not in a "flat" spin. The fourth witness stated that it sounded as if the airplane was flying back and forth over her house. She stated the airplane was flying level prior to it nosing down and impacting the terrain. The witnesses reported that they did not see smoke or flames coming from the airplane prior to it impacting the terrain.

PERSONNEL INFORMATION

The pilot, age 58, held an airline transport pilot (ATP) certificate with an airplane multi-engine land rating. The certificate contained commercial pilot privileges with an airplane single-

engine land rating. The pilot's ATP certificate also contained a type rating for Cessna CE-500 airplanes. The pilot's last Federal Aviation Administration medical examination was completed on October 16, 2009, when he was issued a second-class medical certificate. The medical certificate contained the limitation, "Must wear corrective lenses." The application for this medical examination indicated that the pilot did not take any medications. The pilot's previous application for a medical certificate dated October 6, 2008, indicated that the pilot was taking the medication Crestor. On this application, the pilot indicated that he had 13,000 hours of flight time.

The pilot's logbooks were not located during the investigation. An application for insurance dated October 14, 2009, indicated that the pilot's last biennial flight review and instrument check was completed on August 20, 2009. The application indicated that the pilot had 4,000 hours of pilot-in-command flight time in Piper PA-31TIIXL airplanes. In addition, he listed 2,650 hours of pilot-in-command time in PA-31-350 airplanes. The pilot's total pilot-in-command time in 3 different airplanes listed on the form was 9,900 hours.

One of the owners of N85EM stated that the pilot worked for him for 8 or 9 years. He stated the pilot had about 25,000 hours of flight time.

A family member of the pilot reported that he was in fairly good health. This family member also stated that the pilot was a smoker and that he took Crestor and another medication for a thyroid condition.

AIRCRAFT INFORMATION

The accident airplane was a 1982 Piper PA-31T2, serial number 31T-8166055. The twin-engine airplane had a pressurized cabin and was certified for flight into known icing conditions. The maximum takeoff weight of the airplane was 9,540 pounds. The total time on the aircraft at the time of the accident was not determined. However, according to calculations derived from times in the aircraft logbook, as of the last logbook entry dated November 24, 2009, the airplane had a total time of 9,436.4 hours and a tachometer time of 2,257.1 hours. This entry was for the completion of a 12 month avionics inspection. An event 2 inspection was completed on September 2, 2009, as part of the Approved Airworthiness Inspection Program (AAIP) for the operator. The last event 1 inspection was completed on January 9, 2009, at an aircraft total time of 9,286.3 hours.

The airplane was equipped with Pratt & Whitney PT6A-135 engines. According to engine logbook records, the left engine, serial number 92518, was overhauled and installed on N85EM on March 5, 2001. At that time, the engine had a total time of 7,096.5 hours. The last inspection of the engine was recorded as being an event 2 inspection on September 2, 2009. The engine time since overhaul at the last inspection was recorded as being 2,195 hours with 7,768 cycles.

The right engine, serial number 92507, was overhauled and installed on N85EM on January 10, 2001. At that time, the engine had a total time of 7,096.5 hours. The last inspection of the engine was recorded as being an event 2 inspection on September 2, 2009. The engine time since overhaul at the last inspection was recorded as being 2,195 hours with 7,768 cycles.

According to the avionics logbook, the last altimeter/static system, transponder, and encoder test was performed on October 11, 2008.

The airplane was equipped with a Garmin GNS530W navigation/communication/global positioning system (GPS) which was augmented by a Wide Area Augmentation System (WAAS).

The airplane was topped off with 274.5 gallons of Jet A fuel on December 2, 2009, and it had not been flown until the pilot departed for CVX on the day of the accident.

METEOROLOGICAL INFORMATION

The nearest weather reporting station was located at the Mount Pleasant Municipal Airport (MOP), Mount Pleasant, Michigan, about 25 miles south of the accident site. The airport is equipped with an Automated Weather Observing System (AWOS).

At 1836, the following weather conditions were reported by the MOP AWOS: wind 220 at 9 knots; visibility 10 statute miles with light snow; overcast ceiling at 4,500 feet; temperature minus 2 degrees Celsius; dewpoint minus 4 degrees Celsius; altimeter 30.07 inches of mercury.

At 1855, the following weather conditions were reported by the MOP AWOS: wind 220 at 11 gusting to 16 knots; visibility 10 statute miles; overcast ceiling at 4,300 feet; temperature minus 2 degrees Celsius; dewpoint minus 5 degrees Celsius; altimeter 30.07 inches of mercury.

During the flight, the pilot reported being on top of the cloud layer and in clear conditions at 7,000 feet. Another pilot who was flying in the same general direction as N85EM reported being on top of the clouds at 8,000 feet.

WRECKAGE AND IMPACT INFORMATION

The wreckage was located in a heavily wooded area approximately 9 miles southwest of the Clare County Airport. The Global Positioning System (GPS) coordinates recorded at the accident site were 43 degrees 59.617 minutes North latitude and 084 degrees 45.342 minutes West longitude. The terrain contained trees that ranged from approximately 2 to 24 inches in diameter. The airplane came to rest on a heading of 192 degrees on terrain that sloped about 20 degrees. Five branches that were freshly cut at an angle of about 30 degrees were found on the ground near the wreckage. These branches ranged between 4 and 5 inches in diameter. A post impact fire ensued. There was a strong odor of fuel at the accident site.

All of the airframe structural components and flight control surfaces were located at the accident site. The fuselage came to rest right side up. The nose cone was partially buried in the terrain. The nose landing gear was in the retracted position. The portion of the fuselage from the cockpit to the empennage was destroyed by fire. All of the cockpit instrumentation and navigational equipment was destroyed by impact forces and the post impact fire.

The left wing sustained both impact and fire damage. The majority of the left wing located

inboard of the engine nacelle was consumed by fire. The section of the left wing located about 3-feet outboard of the nacelle to 1-foot inboard of the wingtip was also burned. The flap and inboard section of the aileron remained attached to the wing. The outboard section of the aileron was separated and found lying just behind the wing. The tip tank was separated from the wing and it was located about 30 feet south of the main wreckage. The upper wing skin, outboard of the engine, was consumed by fire. The left main landing gear was in the retracted position.

The entire length of the right wing sustained heat damage. The upper section of the wing over the landing gear was completely consumed by fire. The landing gear appeared to be in the retracted position. The leading edge of the wing, outboard of the engine, was crushed rearward. The flap and aileron were burned, but remained attached to the wing. The top skin on the leading edge of the wing was consumed by fire. The bottom skin sustained heat damage. The tip tank was burned and the forward section of the tip tank was buried in the terrain at an angle of about 30 degrees. Three and a half threads were visible on the inner shaft of the aileron trim drum. The extension equated to a neutral aileron trim setting.

The vertical stabilizer, rudder, horizontal stabilizer, and both the left and right elevators remained attached to each other. The leading edge of the vertical stabilizer sustained heat damage. The top portion of the rudder, including the balance weight, was separated and found near the main wreckage. The right side of the vertical stabilizer and rudder contained more heat damage than the left side. The soot was heavier on the upper half of the vertical stabilizer and rudder a section that was not shielded by the horizontal stabilizer and elevator. The bottom surface of the right horizontal stabilizer and rudder contained soot. The top surfaces did not. The horizontal stabilizer and elevators sustained impact and heat damage. The left horizontal stabilizer and elevator contained soot on the lower inboard section of the surfaces. Four threads were visible on the inner shaft of the elevator trim drum. The extension equated to a 2 degree nose down elevator trim setting.

Control cable continuity was established between the cockpit flight controls and all of the flight control surfaces.

The left engine remained attached to the wing. Two of the propeller blades were partially visible. The third blade was completely buried in the ground. The engine sustained impact damage. The front of the engine was buried in an impact crater approximately 2-feet deep. The aft portion of the engine cowling exhibited heat damage. The inside of the engine cowling did not exhibit any heat damage. The left engine anti-ice actuator was in the extended position, indicating the system was turned off at the time of impact.

The right engine sustained impact and fire damage. Portions of the engine were destroyed by fire. Two propeller blades were partially visible. The third blade was buried in the ground. The front and rear portions of the engine cowling sustained heat damage. The inside of the right engine cowling sustained heat damage. There was no soot streaking noticeable on the inside surface of the cowling. The right engine anti-ice actuator was not located.

The propellers were examined further upon removal from the site. Neither of the propellers were in the feathered position. The blades on each propeller were randomly identified as A, B,

and C for descriptive purposes. The left propeller remained secured to the left engine and the right propeller was completely separated from the right engine at the propeller shaft.

Left Propeller

Blade A- The blade was separated from the propeller hub. This blade had been completely buried in the ground. A 10-inch section of the blade tip was missing. The leading edge of the blade at the point of separation was rolled under and aft. Leading edge nicks and chordwise scratches were visible on both the front and back of the blade. The leading edge of the blade was twisted.

Blade B – The blade was secured in the hub and exhibited twisting. About 3-inches of the blade tip was missing. The leading edge on the outboard 8-inches of the remaining portion of the blade was ripped and curled rearward. Chordwise scratches were visible along the leading edge and on the back of the blade.

Blade C – Although loose, the blade remained in the hub. About 13-inches of the outboard end was missing. The leading edge of the blade at the point of separation was rolled under and aft. The outboard leading edge of the blade was twisted back. Leading edge nicks and scrapes were visible along the blade.

Right Propeller

Blade A – The blade contained light chordwise scuffing on the face of the blade. There was an "S" bend along the mid-span on the blade.

Blade B - No chordwise scratches/scuffing was noted. The outboard half of the blade sustained heat damage. The blade was bent aft at a point one-third the blade length from the hub end of the blade. The outboard two-thirds of the blade exhibited "S" bending.

Blade C – Minor chordwise scuffing was visible on the inboard third of the blade. The blade tip exhibited heat damage. The outboard half of the blade exhibited "S" bending and the outboard third of the blade was bent rearward.

MEDICAL AND PATHOLOGICAL INFORMATION

On December 5, 2009, an autopsy was performed on the pilot at the Stocking Funeral Home, Harrison, Michigan. The pilot's cause of death was "Multiple fractures including upper, lower extremities, skull and facial bones" and "Postmortem thermal injuries." The autopsy also noted "Focal coronary artery atherosclerosis."

The FAA's Civil Aeromedical Institute in Oklahoma City, Oklahoma, performed toxicology tests on the pilot. The results were negative for all tests that were performed.

TESTS AND RESEARCH

Both engines were subsequently torn down at the Pratt & Whitney facility in Bridgeport, West Virginia, under the supervision of the Safety Board.

Left Engine

The left engine had a hole punctured in the accessory gearbox from impact damage. The accessory gearbox contained evidence of oil. The main oil filter was removed and found to be free of debris. The accessory gears were intact and continuity was established through the gear input drive shaft. The oil pump gears were intact. The fuel controller and fuel pump were removed. The fuel controller shaft was intact as was the coupling to the fuel pump. The fuel pump rotated freely by hand.

Continuity was established between the compressor and the compressor turbine. The compressor bleed valve was removed and found to be intact and operational. The compressor blade retention rivets were all rubbed in the same direction. The fuel spray nozzles were removed and no anomalies were noted. The power turbine housing assembly was pushed forward from impact forces and rotational scoring was visible in the compressor turbine.

Rotational scoring was visible on the power turbine baffle. All of the power turbine blades were separated from the bases of the blades. The blades were found inside the power turbine section of the engine.

The first stage sun gear was intact. Rotational scoring was visible on the first stage reduction gear carrier. Scoring was visible around the rear face of the second stage carrier indicative of the first stage reduction gear carrier being pushed into it during the impact sequence.

Settings on the propeller governor and fuel controller could not be determined as the linkages were fractured and pulled during the impact sequence.

Neither exhaust stack exhibited indications of turbine blades having exited through the stacks.

Right Engine

The engine sustained heavy fire and impact damage. The first stage sun gear was intact as were the gear teeth. Rotational scoring was visible on the first stage reduction gear carrier. Scoring was present around the rear face of the second stage carrier indicative of the first stage reduction gear carrier being pushed into it during the impact sequence.

The accessory gearbox was consumed by fire.

The compressor turbine was intact. Rotation damage was visible on the turbine disk flange. Half of the disk blades showed impact and minor rotational damage. The compressor blade retention rivets were all rubbed in the same direction. The number 1 compressor bearing was free to turn. The first stage compressor was intact. Blue paint was rubbed off of the compressor stator by the first stage compressor. No significant rotational scraping noted in this area.

Approximately half of the power turbine blades were missing. The power turbine shaft was bent and the power turbine was oriented approximately 70 degrees from its normal position. The exhaust case was molded around the power turbine as a result of impact.

The fuel pump and fuel control were separated from the engine as a result of the gearbox being

melted by the post impact fire.

As a result of impact damage, continuity between the compressor and the turbine could not be established.

Both engines exhibited indications of rotation at impact. No anomalies were identified that would have precluded normal operation of the engines.

History of Flight

Enroute-descent	Loss of control in flight (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

Pilot Information

Certificate:	Airline transport; Commercial; Flight instructor	Age:	58, 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:	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	Toxicology Performed:	Yes
Medical Certification:	Class 2 With waivers/limitations	Last FAA Medical Exam:	October 16, 2009
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	August 20, 2009
Flight Time:	13000 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Piper	Registration:	N85EM
Model/Series:	PA-31T2	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Normal	Serial Number:	31T-8166055
Landing Gear Type:	Retractable - Tricycle	Seats:	
Date/Type of Last Inspection:	November 24, 2009 AAIP	Certified Max Gross Wt.:	9540 lbs
Time Since Last Inspection:		Engines:	2 Turbo prop
Airframe Total Time:	9436 Hrs as of last inspection	Engine Manufacturer:	P&W CANADA
ELT:	Installed, not activated	Engine Model/Series:	PT6A-60A
Registered Owner:		Rated Power:	620 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:	Night
Observation Facility, Elevation:	MOP, 755 ft msl	Distance from Accident Site:	25 Nautical Miles
Observation Time:	23:55 Local	Direction from Accident Site:	180°
Lowest Cloud Condition:		Visibility	10 miles
Lowest Ceiling:	Overcast / 4300 ft AGL	Visibility (RVR):	
Wind Speed/Gusts:	11 knots / 16 knots	Turbulence Type Forecast/Actual:	/
Wind Direction:	220°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	30.06 inches Hg	Temperature/Dew Point:	-2° C / -5° C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Charlevoix, MI (CVX)	Type of Flight Plan Filed:	IFR
Destination:	Tififn, OH (16G)	Type of Clearance:	IFR
Departure Time:	18:11 Local	Type of Airspace:	

Wreckage and Impact Information

Crew Injuries:	1 Fatal	Aircraft Damage:	Destroyed
Passenger Injuries:		Aircraft Fire:	On-ground
Ground Injuries:	N/A	Aircraft Explosion:	On-ground
Total Injuries:	1 Fatal	Latitude, Longitude:	43.988887,-84.753051(est)

Administrative Information

Investigator In Charge (IIC):	Sullivan, Pamela
Additional Participating Persons:	John Parrish; FAA-GRR-FSDO; Grand Rapids, MI Tom Kozura; FAA-GRR-FSDO; Grand Rapids, MI Mike McClure; Piper Aircraft; Vero Beach, FL Paul Crosby; Pratt & Whitney; Bridgeport, WV
Original Publish Date:	March 16, 2011
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=75131

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](#).