Aviation Investigation Final Report

Location:	Knoxville, Tennessee	**Accident Number:**	ERA16LA003
Date & Time:	October 7, 2015, 05:30 Local	**Registration:**	N449CT
Aircraft:	Beech S35	**Aircraft Damage:**	Substantial
Defining Event:	VFR encounter with IMC	**Injuries:**	2 Serious
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The airplane had been topped off with fuel the day before the accident flight. Early the following day, the pilot arrived at the airport for the visual flight rules flight and completed a preflight inspection, then he and his passenger boarded the airplane. According to the pilot, while taxiing to the runup area for the runway, he listened to the automated weather observation system (AWOS) at the airport and thought he heard that the ceiling was about 200 ft, even though he could "look up at the sky and see stars." He also stated that this was also not compatible with his weather briefings from the night before or earlier the morning of the accident. According to the passenger, the morning of the accident was dark and foggy, and he could not see the sky. He remembered asking the pilot about instrument procedures as he believed the pilot was instrument qualified. The pilot and passenger could only remember the preflight, the engine warmup, the takeoff, and the landing gear retraction. After departure, the airplane impacted trees and vegetation about 10 ft above ground level about 600 ft from the departure end of the runway. The airplane then impacted in an open field in a level attitude with the wing flaps retracted and the landing gear in the up position. Both the pilot and passenger were seriously injured during the impact sequence.

The airport's line service manager arrived at the airport about 20 minutes after the accident occurred and stated that he could not see anything and that it was "zero/zero." The traffic patrol pilot for the local radio station tried to take off to try to locate the airplane, but the visibility was too bad.

There was no record of the pilot receiving a formal weather briefing. Review of the weather conditions before the accident revealed that the National Weather Service had been forecasting fog and low clouds for at least 5 hours before the time of the accident, the AWOS had been reporting 1/4 mile visibility for at least 15 minutes before the accident, and the sun had not yet risen. If the pilot had delayed his departure until midmorning, he would have been able to depart in visual meteorological conditions.

Postaccident examination of the airframe, engine, and recorded engine data did not reveal any preimpact

failures or malfunctions that would have precluded normal operation. Examination of the accident site and airplane revealed that the impact with the ground was at high speed with the engine at takeoff power, indicative of the pilot not climbing the airplane after takeoff. It is likely that, during the takeoff from the well-lit runway into a dark sky with no ambient light, the pilot experienced a somatogravic illusion in which he likely sensed that the sudden linear acceleration of the airplane created a pitch-up sensation, when instead the airplane was not climbing or climbing shallowly. It is likely that, with no other visual cues, the pilot became spatially disoriented and pushed the nose down to avoid what he sensed was pitching up too high and impacted the trees at the end of the runway.

Probable Cause and Findings

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

The pilot's inadequate preflight weather planning and his improper decision to attempt a visual flight rules flight in night instrument metrological conditions, which resulted in spatial disorientation and subsequent collision with terrain.

Findings

Personnel issues	Weather planning - Pilot
Personnel issues	Decision making/judgment - Pilot
Personnel issues	Aircraft control - Pilot
Personnel issues	Spatial disorientation - Pilot
Aircraft	(general) - Not attained/maintained
Environmental issues	Below VFR minima - Decision related to condition
Environmental issues	Below VFR minima - Effect on personnel
Environmental issues	Dark - Effect on personnel

Factual Information

History of Flight

Prior to flight	Preflight or dispatch event
Initial climb	VFR encounter with IMC (Defining event)
Initial climb	Loss of visual reference
Initial climb	Controlled flight into terr/obj (CFIT)

On October 7, 2020, about 0530 eastern daylight time, a Beech S35; N449CT, was substantially damaged when it was involved in an accident near Knoxville, Tennessee. The pilot and passenger were seriously injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The airplane had been topped off with 23.2 gallons of 100LL aviation gasoline on the day before the accident flight. According to the pilot, he arrived at Knoxville Downtown Island Airport (DKX), Knoxville, Tennessee the following morning around 0505 to preflight the airplane for their flight to Moore-Murrell Airport (MOR), Morristown, Tennessee. About 0530, the pilot and his passenger boarded the airplane and fastened their seatbelts. The pilot then "gave my briefing to my passenger."

The pilot started the airplane and inserted his updated data cards. He then taxied to the run-up area for runway 8. While taxiing he listened to DKX's automated weather observation system (AWOS). He advised that he thought that the AWOS was transmitting that the ceiling was at 200 feet, "or something to that effect," which he stated that he, "found to be untrue" since he could "look up at the sky and see stars." He also stated that, this was also not compatible with his weather briefings from the night before or earlier the morning of the accident.

Upon reaching the run-up area he performed a run-up, checked the magnetos, and performed the propeller checks. The flight controls were free and correct. Once the engine oil temperature was acceptable, he transmitted over the common traffic advisory frequency that he was departing runway 8 and then taxied to the runway. After lining up on the runway he advanced power until "all was green," continued to full power and then took off. Once the airplane was airborne, and when the entire usable runway was behind him, he raised the landing gear, and checked his climb attitude and trim. The pilot stated that this was all he could remember about the accident flight.

According to the passenger, he did not remember being briefed by the pilot about use of the shoulder harness, so he did not have it on during the accident flight. On the morning of the accident it was dark and foggy, and he could not see the sky. He remembered asking the pilot about instrument procedures as he believed the pilot was instrument qualified. He could remember the preflight, the engine warmup, the takeoff, and the landing gear going up (retracting). After that he could not remember anything except when he was being placed on a spine board at the accident scene, and afterwards being in the hospital.

According to the airport's line service manager, he arrived at the airport about 0550. He stated that he could not see anything and that it was "zero/zero." About 0612, he was notified that an emergency locator transmitter signal was being picked up. The traffic patrol pilot for the local radio station tried to take off to see if he could locate the airplane but the visibility was too bad. The fog cleared around 1000.

Around 0630 the Morristown, Tennessee 911 communications center received a telephone call from the pilot reporting that he had crashed sometime after departure from DKX. After determining that the air traffic control tower at Mc Ghee Tyson Airport (TYS) Knoxville, Tennessee was not in contact with the airplane, the pilot was asked to hang up and dial 911. The pilot did so, and the call was received by the Knox County, Tennessee 911 communications center. The communications personnel at the center were then able to ping the pilot's cellular telephone and determine the location of the call. First responders were then able locate the accident site and provide medical assistance to the pilot and his passenger who were both seriously injured.

Pilot Information

Certificate:	Private	**Age:**	51,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Lap only
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 Without waivers/limitations	**Last FAA Medical Exam:**	October 23, 2014
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	October 13, 2014
Flight Time:	300.7 hours (Total, all aircraft), 190 hours (Total, this make and model), 259.6 hours (Pilot In Command, all aircraft), 29.5 hours (Last 90 days, all aircraft), 6.8 hours (Last 30 days, all aircraft)		

The pilot held a Federal Aviation Administration (FAA) private pilot certificate with ratings for airplane single-engine land, and instrument airplane. His most recent FAA third-class medical certificate was issued on October 23, 2014. He reported that he had accrued approximately 300 total flight hours. 190 of which were in the accident airplane make and model,129 of which were at night, 33 of which in actual instrument conditions, and 26 of which were in simulated instrument conditions.

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N449CT
Model/Series:	S35	**Aircraft Category:**	Airplane
Year of Manufacture:	1965	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	D-7912
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	May 14, 2015 Annual	**Certified Max Gross Wt.:**	3300 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	4563.3 Hrs as of last inspection	**Engine Manufacturer:**	Continental
ELT:	C126 installed, activated, did not aid in locating accident	**Engine Model/Series:**	IO-550-B (B2)
Registered Owner:	On file	**Rated Power:**	285 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Narrative aircraft info place holder

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	DKX,833 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	05:30 Local	**Direction from Accident Site:**	270°
Lowest Cloud Condition:		**Visibility**	0.25 miles
Lowest Ceiling:	Overcast / 200 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:		**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	30.04 inches Hg	**Temperature/Dew Point:**	13°C / 13°C
Precipitation and Obscuration:	Heavy - Patches - Fog		
Departure Point:	Knoxville, TN (DKX)	**Type of Flight Plan Filed:**	None
Destination:	Morristown, TN (MOR)	**Type of Clearance:**	None
Departure Time:	05:30 Local	**Type of Airspace:**	Class G

Review of the weather conditions for the day of the accident revealed that:

- At 0127, an Area Forecast Discussion (AFD) directed toward aviation was issued by the National Weather Service (NWS) Weather Forecast Office (WFO) in Morristown, Tennessee (MRX) which stated in part: "MAIN CONCERN IS HOW MUCH FOG/LOW CLOUDS DEVELOP THIS MORNING. WILL CONTINUE WITH MVFR/IFR FLIGHT CONDITIONS AT ALL TAF SITES THIS MORNING."

- At 0255, an AFD was issued by the NWS MRX WFO which stated in part: "SHORT TERM (TODAY AND TONIGHT)...CLEAR SKY...CALM WIND WILL ALLOW PATCHY DENSE FOG TO DEVELOP THIS MORNING...ESPECIALLY NEAR AREA LAKES AND STREAMS...DUE TO STEAM FOG."

- At 0349, a Hazardous Weather Outlook that addressed portions of Blount County and advised of patchy dense fog was issued by the NWS MRX WFO which stated in part: "PATCHY DENSE FOG THIS MORNING REDUCING VISIBILITIES TO ONE-QUARTER MILE OR LESS. DRIVE WITH CAUTION AND SLOW. THE FOG WILL DISSIPATE BY MID-MORNING GIVING WAY TO SUNNY SKIES."

- At 0445, an Airmen's Meteorological Information (AIRMET) advisory SIERRA for instrument flight rules (IFR) conditions was issued and was active for the accident location at the accident time.

- The 0500 NWS Surface Analysis Chart indicated that a northeast/southwest-oriented trough extended from southwestern Virginia to southeastern Mississippi through the accident site.

- At 0502, approximately 28 minutes before the accident, the recorded weather at TYS located approximately 11 nautical miles southwest of the accident site, included: calm winds, 10 miles visibility, patches of fog, few clouds at 100 feet, temperature 15 degrees C, dew point 14 degrees C, and an altimeter setting of 30.03 inches of mercury.

- At 0553, the recorded weather at TYS, approximately 23 minutes after the accident, also included, calm winds, 10 miles visibility, patches of fog, few clouds at 100 feet, temperature 15 degrees C, dew point 14 degrees C, and an altimeter setting of 30.03 inches of mercury.

United States Naval Observatory data indicated that Moonrise occurred at 0245 and was a waning Crescent with 24 percent of the Moon's visible disk illuminated. Civil twilight began at 0710, with sunrise occurring 26 minutes later at 0736.

Screenshots of data retrieved from the Automated Weather Observing System (AWOS) located at DXK were provided by the DKX airport manager.

At 0530, the AWOS at DKX reported calm winds, ¼ mile visibility, overcast at 200 feet, temperature 14°C, dew point 13°C, and an altimeter setting of 30.04 inches of mercury.

Review of the data retrieved by the airport manager from the AWOS at DKX also indicated that the AWOS also had been reporting ¼ mile visibility for at least 15 minutes prior to the 0530 report.

Further review of the AWOS data retrieved by the airport manager also revealed that the AWOS ay DKX was fully configured and had been providing continuous, real time information and reports on airport weather conditions both by telephone and by radio.

Information requested from Lockheed Martin Flight Services (LMFS) indicated that the pilot had not contacted either LMFS or accessed the Direct User Access Terminal Service (DUATS) for weather information or flight plan processing.

Airport Information

Airport:	KNOXVILLE DOWNTOWN ISLAND DKX	**Runway Surface Type:**	Asphalt
Airport Elevation:	833 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	8	**IFR Approach:**	None
Runway Length/Width:	3499 ft / 75 ft	**VFR Approach/Landing:**	None

Knoxville Downtown Island Airport was owned by the Knoxville Metro Airport Authority, and was located 3 miles east of Knoxville, Tennessee. It was classified by the FAA as a publicly owned, uncontrolled, public use airport.

The airport elevation was 833 feet above mean sea level. It was configured in an 8/26 configuration. Runway 8 was asphalt, in good condition. The total length was 3,499 feet long by 75 feet wide, with a 0.1% gradient. The runway was equipped with medium intensity runway edge lights, runway end identifier lights, and was marked with nonprecision markings in good condition. Obstructions existed in the form of a 30 foot tree, 963 feet from the departure end of the runway, 31 feet left of centerline.

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Serious	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Serious	**Latitude, Longitude:**	35.95,-85.854446(est)

According to a Federal Aviation Administration (FAA) inspector, after departure the airplane had impacted trees and vegetation at an altitude of approximately 10 feet above ground level about 600 feet

from the departure end of the runway. The airplane then impacted in an open field in a level attitude with the wing flaps retracted and the landing gear in the up position and slid on its belly for another 500 feet before coming to rest. The wings, empennage, nose section, engine, propeller, and windscreen were substantially damaged. All four engine mounts and the firewall sustained impact damage. The trim tab was found intact and was measured at 0.8 inches, which correlated to 10° tab trailing edge down. Further examination also revealed that the airplane was equipped with shoulder harnesses, though neither the pilot nor passenger had used them.

Examination of the propeller and propeller governor revealed that the propeller remained attached to the crankshaft propeller flange. All four blades exhibited twisting, leading edge gouging, and scratching. Each propeller blade was bent in the aft direction near the hub. The spinner was intact. The propeller governor control arm moved freely from stop to stop, the drive gear turned freely, and oil was observed being discharged. The gasket screen was free of obstructions.

Examination of the engine revealed that the upper spark plugs electrodes exhibited normal wear and light color combustion carbon deposits, each were unremarkable. The cylinders were inspected with a lighted borescope, and no anomalies were observed. The drivetrain was rotated, and continuity was confirmed from the front to the back of the engine, and thumb compression was confirmed on all 6 cylinders.

The engine driven fuel pump drive coupling was intact, the drive turned freely, and the fuel pump was function tested, with no anomalies found. The fuel screen was free of obstructions. The fuel manifold diaphragm was secure, its fuel screen had a minor amount of obstruction but was mostly clear, and it exuded an odor consistent with 100LL aviation gasoline.

The magnetos had remained attached to their mounting pads and produced spark on all 6 top leads. Impulse coupling engagement was confirmed.

The vacuum pump rotated smoothly by hand, and when disassembled; the vanes and rotors were unremarkable.

Injuries to Persons

Narrative injuries to persons place holder

Damage to Aircraft

Narrative damage to aircraft place holder

Other Damage

Narrative other damage place holder

Communications

Narrative communications place holder

Flight recorders

The airplane was not required under the CFRs to be equipped with either a cockpit voice recorder or a flight data recorder. However, it was equipped with a JP Instruments EDM-930, panel mounted engine data monitor capable of recording multiple engine parameters related to engine operations. Review of engine data downloaded from the EDM-930 did not reveal any preimpact failures or malfunctions of the engine, but did indicate that the event flight duration was only about 5 minutes and 54 seconds.

Medical and Pathological Information

Narrative medical and pathological information place holder

Fire

Narrative fire place holder

Survival Aspects

Narrative survival aspects place holder

Tests and Research

Narrative tests and research place holder

Organizational and Management Information

Narrative organizational and management information place holder

Additional Information

Spatial Disorientation

According to the FAA's General Aviation Safety Enhancement Fact Sheet on Spatial Disorientation, pilots flying under both instrument and visual flight rules are subject to spatial disorientation and optical illusions that may cause a loss of aircraft control. Sight, supported by other senses, allows a pilot to maintain orientation while flying. However, when visibility is restricted (i.e., no visual reference to the horizon or surface detected) the body's supporting senses can conflict with what is seen. When this spatial disorientation occurs, sensory conflicts and optical illusions often make it difficult for a pilot to tell which way is up.

Contributing to these phenomena are the various types of sensory stimuli: visual, vestibular (organs of equilibrium located in the inner ear), and proprioceptive (receptors located in the skin, muscles, tendons, and joints). Changes in linear acceleration, angular acceleration, and gravity are detected by the vestibular system and the proprioceptive receptors, and then compared in the brain with visual information. In a flight environment, these stimuli can vary in magnitude, direction, and frequency, resulting in a sensory mismatch that can produce illusions and lead to spatial disorientation.

According to FAA's Aeromedical Safety Brochure, "Spatial Disorientation: Why You Shouldn't Fly By the Seat of Your Pants", somatogravic illusions involving the utricle and the saccule of the vestibular system are most likely under conditions with unreliable, or unavailable external visual references. These illusions include: "The Head-Up Illusion", which involves a sudden forward linear acceleration during level flight where the pilot perceives the illusion that the nose of the aircraft is pitching up. The pilot's response to this illusion would be to push the yolk (control wheel) or the stick forward to pitch the nose of the aircraft down. A night take-off from a well-lit airport into a totally dark sky (black hole) or a catapult take-off from an aircraft carrier can also lead to this illusion and could result in a crash.

According to the Pilots Handbook of Aeronautical Knowledge (FAA-H-8083-25B), under normal flight conditions, when there is a visual reference to the horizon and ground, the sensory system in the inner ear helps to identify the pitch, roll, and yaw movements of the aircraft. When visual contact with the horizon is lost, the vestibular system becomes unreliable. Without visual references outside the aircraft, there are many situations in which combinations of normal motions and forces create convincing illusions that are difficult to overcome.

According to the Instrument Procedures Handbook (FAA-H-8083-16B), the vestibular sense (motion

sensing by the inner ear) can confuse the pilot. Because of inertia, sensory areas of the inner ear cannot detect slight changes in aircraft attitude nor can they accurately sense attitude changes that occur at a uniform rate over time. Conversely, false sensations often push the pilot to believe that the attitude of the aircraft has changed when in fact it has not, resulting in spatial disorientation.

Useful or Effective Investigation Techniques

Narrative useful or effective investigation techniques place holder

Preventing Similar Accidents

Reduced Visual References Require Vigilance (SA-020)

The Problem

About two-thirds of general aviation accidents that occur in reduced visibility weather conditions are fatal. The accidents can involve pilot spatial disorientation or controlled flight into terrain. Even in visual weather conditions, flights at night over areas with limited ground lighting (which provides few visual ground references) can be challenging.

What can you do?

- Obtain an official preflight weather briefing, and use all appropriate sources of weather information to make timely in-flight decisions. Other weather sources and in-cockpit weather equipment can supplement official information.
- Refuse to allow external pressures, such as the desire to save time or money or the fear of disappointing passengers, to influence you to attempt or continue a flight in conditions in which you are not comfortable.
- Be honest with yourself about your skill limitations. Plan ahead with cancellation or diversion alternatives. Brief passengers about the alternatives before the flight.
- Seek training to ensure that you are proficient and fully understand the features and limitations of the equipment in your aircraft, particularly how to use all features of the avionics, autopilot systems, and weather information resources.
- Don’t allow a situation to become dangerous before deciding to act. Be honest with air traffic controllers about your situation, and explain it to them if you need help.

- Remember that, when flying at night, even visual weather conditions can be challenging. Remote areas with limited ground lighting provide limited visual references cues for pilots, which can be disorienting or render rising terrain visually imperceptible. When planning a night VFR flight, use topographic references to familiarize yourself with surrounding terrain. Consider following instrument procedures if you are instrument rated or avoiding areas with limited ground lighting (such as remote or mountainous areas) if you are not.
- Manage distractions: Many accidents result when a pilot is distracted momentarily from the primary task of flying.

See https://www.ntsb.gov/Advocacy/safety-alerts/Documents/SA-020.pdf for additional resources.

The NTSB presents this information to prevent recurrence of similar accidents. Note that this should not be considered guidance from the regulator, nor does this supersede existing FAA Regulations (FARs).

Administrative Information

Investigator In Charge (IIC):	Gunther, Todd
Additional Participating Persons:	Jim Ruckman; FAA/FSDO; Nashville, TN Chris Lang; Continental Motors Inc.; Mobile, AL Ricardo Asensio; Textron Aviation; Wichita, KS
Original Publish Date:	December 3, 2020
Last Revision Date:	
Investigation Class:	Class 2
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=92133