Aviation Investigation Final Report

Location:	Destin, Florida	**Accident Number:**	ERA16FA279
Date & Time:	August 2, 2016, 20:25 Local	**Registration:**	N2735A
Aircraft:	Cessna 414	**Aircraft Damage:**	Destroyed
Defining Event:	Abrupt maneuver	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The instrument-rated commercial pilot departed from an airport adjacent to the Gulf of Mexico with an instrument flight rules clearance for a cross-country flight in dark night, visual meteorological conditions. The flight continued in a south-southwesterly direction, climbing to about 900 ft over the gulf, where it entered a steep right turn. The airplane then descended at a steep rate and impacted the water in a nose-low attitude. Postaccident examination of the recovered wreckage, including flight controls, engines, and propellers revealed no evidence of preimpact failure or malfunction.

While the outlet fuel line from the left auxiliary fuel pump was found separated and there was evidence that the B-nut was loose and had been only secured by the first 2 threads, recorded data from the engine monitor for the flight revealed no loss of power from either engine. Therefore, the final separation likely occurred during the impact sequence.

Although the accident pilot was instrument rated and had recently completed instrument currency training, the dark night conditions present at the time of the accident combined with a further lack of visual references due to the airplane's location over a large body of water, presented a situation conducive to the development of spatial disorientation. The pilot had been instructed by air traffic control to turn southwest after takeoff; however, the continuation of the turn past the intended course and the airplane's steep bank angle and excessive rate of descent are consistent with a loss of control due to spatial disorientation.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's loss of control due to spatial disorientation shortly after takeoff, while maneuvering over water during dark night conditions.

Findings

Personnel issues	Spatial disorientation - Pilot
Aircraft	(general) - Not attained/maintained
Personnel issues	Aircraft control - Pilot
Environmental issues	Dark - Effect on operation

Factual Information

History of Flight

Initial climb	Abrupt maneuver (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On August 2, 2016, about 2025 central daylight time, a Cessna 414A, N2735A, was destroyed when it impacted the Gulf of Mexico shortly after takeoff from Destin Executive Airport (DTS), Destin, Florida. The commercial pilot was fatally injured. The airplane was privately owned and operated under the provisions of Title 14 *Code of Federal Regulations* Part 91. Dark night visual meteorological conditions prevailed, and an instrument flight rules (IFR) flight plan was filed for the personal flight, which was destined for Abbeville Chris Crusta Memorial Airport (IYA), Abbeville, Louisiana.

Earlier on the day of the accident, the pilot flew one of the co-owners and several other individuals from IYA to DTS, where they landed between 1430 and 1440. Personnel at a fixed base operator (FBO) at DTS reported that, after arriving at DTS, the pilot told them he was going to the pilot's lounge to rest. Later, he borrowed a crew car from the FBO and obtained food, then returned to the FBO. At 2001, one of the pilot's sons spoke with his father; the conversation lasted about 6 minutes.

Video from the FBO recorded the pilot walking to the airplane before departing on the accident flight. At 2014, the navigation and strobe lights illuminated briefly, consistent with engine start. Air traffic control information showed that the pilot contacted Eglin Clearance Delivery to obtain his IFR clearance at 2018:26. The controller provided the clearance and transponder code, which the pilot correctly read back; the controller subsequently instructed the pilot to hold for release. The airplane moved from its parking spot on the ramp about 2019, and at 2022:10, the pilot contacted Eglin Approach Control and advised that he was ready to depart from runway 14. The controller verified the runway, then advised the pilot to turn right on departure to a heading of 240°, and to climb and maintain 2,000 ft mean sea level (msl); the controller then released the airplane for takeoff. The pilot acknowledged, and at 2023:04, the pilot broadcast on the DTS common traffic advisory frequency (CTAF) that the airplane was departing from runway 14 and turning to a heading of 240°.

In response to the pilot's takeoff announcement, the pilot of a helicopter flying eastbound along the coast reported on the CTAF that he was not a factor for the departing airplane. He then informed the pilot that he was 1 mile southwest of DTS on a left base for runway 32 and had the airplane in sight, to which the accident pilot communicated, "do appreciate that." There was no further communication from the accident pilot on the CTAF or Eglin Approach Control.

A pilot who was preparing to depart for a local flight from DTS reported that he had a direct view of runway 14 as the accident airplane departed and that everything "looked and sounded normal." The pilot reported that, as the airplane passed his location, it was 50 to 100 ft above ground level in a "clean configuration." He reported there was nothing unusual or abnormal about the takeoff, and the only other activity in the airport traffic pattern was a tour helicopter.

The pilot of the tour helicopter saw the accident airplane as it departed, and estimated that the airplane was between 200 and 300 ft at the departure end of the runway. It continued climbing over condominiums south of the airport to an estimated altitude of 1,000 ft. During his next two flights with passengers aboard, Eglin Air Force Base Approach Control contacted him via the DTS CTAF and asked if he had visual contact with the accident airplane; he reported that he did not.

Primary and secondary radar returns recorded by Eglin Approach Control recorded several targets associated with the accident airplane. The first four, spanning from 2024:07 to 2024:22, had no associated altitudes but showed the airplane proceeding southeast on runway heading. The fifth radar return, at 2024:41, was located over water west of the extended runway centerline, also with no associated altitude. The next target depicted the airplane at a peak altitude of 900 ft msl and then entering a descending right turn, with the last target at 2025:01 at 300 ft msl on a westerly heading. The average calculated descent rate, rate of turn, and groundspeed between the last 2 radar returns was 4,800 ft per minute, 6.4° per second, and about 252 knots, respectively.

Surveillance footage from a nearby building captured a portion of the flight. About 2024:43, a strobe reflection was noted on the surface of the water immediately adjacent to land. The strobe reflections on the water continued in a westerly direction for about 13 seconds, then the airplane came into view for about 3 seconds. During that time, the strobe light remained illuminated; however, the impact was not captured.

Four witnesses on a beach near the accident site saw the airplane flying in a southerly direction, then enter a right turn; one witness described the airplane's wings as being "near vertical" during the turn. The airplane continued west, parallel to the shore, for a short time as it descended and then impacted the water at an approximate 45° angle. One of the witnesses indicated that the airplane appeared to roll to a wings-level position before it began descending.

The pilot who had watched the accident airplane depart from DTS departed from the same runway about 10 minutes after the accident and reported the moon was not visible, and no stars were visible due to clouds. He reported that, as he initiated a right turn to the west after takeoff, there was a total lack of visual cues out the front windscreen, and he lost all visual references of the coastline over his left shoulder. He also reported that there were no visual references out the right side of the airplane during the first part of the turn, and it was only after about 45° of heading change that he began to see ground lights out the front windscreen.

Pilot Information

Certificate:	Commercial	**Age:**	63,Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-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:**	Yes
Medical Certification:	Class 2 None	**Last FAA Medical Exam:**	August 18, 2014
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	July 24, 2016
Flight Time:	(Estimated) 15000 hours (Total, all aircraft)		

The pilot, age 63, held a commercial pilot certificate with ratings for airplane single-engine land and sea, airplane multiengine land, and instrument airplane. His most recent time-limited Special Issuance Federal Aviation Administration (FAA) second-class medical certificate with a limitation to wear corrective lenses was issued on August 18, 2014; it was not valid for any class after December 31, 2015. The pilot was not issued a subsequent medical certificate.

Family members reported that the pilot had over 15,000 total hours of flight experience, was in good health, and to their knowledge, was not taking any medication. They indicated he was in the process of obtaining a new medical certificate. He was a pilot for the co-owners of the airplane.

According to records provided by SimCom, during a three-day period between July 22 and 24, 2016, the pilot obtained recurrent training at their Orlando, Florida facility. The training consisted of 2 hours each day in a multiengine simulator appropriate for a Cessna 421C, and differences training in the same simulator for the Cessna 414A. The ground training was scheduled for 3 hours each day and covered aircraft systems, including differences training for the Cessna 414A. During this period, the pilot also completed training in instrument flight procedures in the simulator, including two unusual attitude recoveries while in a descending Vne (velocity never exceed speed) condition, and two unusual attitude recoveries while in an ascending stall speed condition. He satisfactorily completed all training and was issued a completion certificate.

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N2735A
Model/Series:	414 A	**Aircraft Category:**	Airplane
Year of Manufacture:	1979	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	414A0463
Landing Gear Type:	Retractable - Tricycle	**Seats:**	
Date/Type of Last Inspection:	January 1, 2016 Annual	**Certified Max Gross Wt.:**	7105 lbs
Time Since Last Inspection:	44 Hrs	**Engines:**	2 Reciprocating
Airframe Total Time:	6202.7 Hrs as of last inspection	**Engine Manufacturer:**	CONT MOTOR
ELT:	Installed	**Engine Model/Series:**	TSIO-520-NB
Registered Owner:	On file	**Rated Power:**	335 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

The low-wing, retractable-gear Cessna 414A airplane, serial number 414A0463, was manufactured in 1980. It was originally equipped with two 310-horsepower Continental Motors TSIO-520-NB engines and McCauley constant-speed propellers, but was subsequently modified in accordance with (IAW) Supplemental Type Certificate (STC) SE4327SW-D, which allowed for operation to 335 horsepower at 38 inches manifold pressure at 2,700 rpm. The airplane was also modified IAW STC SA09971SC-D by installation of Hartzell three-bladed constant speed PHC-C3YF-2UF propellers.

A review of the airframe maintenance records revealed the airplane's last static pressure system, altimeter, and automatic pressure reporting system tests were on January 23, 2015. The airplane's last annual inspection was completed on January 1, 2016. At that time, the airplane's total time was 6,202.7 hours. The airplane had accrued about 44 hours since the annual inspection.

The co-owner who had flown with the pilot earlier in the day reported there were no airplane issues during the flight. After landing, there was no reported maintenance performed to the airplane. The airplane was serviced at DTS with 100 gallons of 100LL aviation fuel. Eight other aircraft were fueled from the same truck and there were no reported fuel-related issues; all postaccident samples were reported to be clear and bright.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night/dark
Observation Facility, Elevation:	DTS,22 ft msl	**Distance from Accident Site:**	
Observation Time:	19:53 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	/ Unknown
Wind Direction:	330°	**Turbulence Severity Forecast/Actual:**	/ Unknown
Altimeter Setting:	30.03 inches Hg	**Temperature/Dew Point:**	29°C / 25°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Destin, FL (DTS)	**Type of Flight Plan Filed:**	IFR
Destination:	Abbeville, LA (IYA)	**Type of Clearance:**	IFR
Departure Time:	20:24 Local	**Type of Airspace:**	

The 1953 automated surface observation at DTS reported wind from 330° at 5 knots, 10 miles visibility, and clear skies. The temperature and dew point were 29°C and 25°C, respectively, and the altimeter was 30.03 inches of mercury.

Data from the GOES-13 infrared image at 2030 indicated scattered low to midlevel stratiform clouds. The radiative cloud top temperature corresponded to cloud tops near 5,000 ft.

According to data from the US Naval Observatory for the accident site area, the end of civil twilight was 2005, and, at the time of the accident, the sun was 10.9° below the horizon at an azimuth of 298°. The moon set at 1931 and was more than 15° below the horizon with no illumination; dark nighttime conditions prevailed at the time of the accident.

Airport Information

Airport:	Destin Executive DTS	**Runway Surface Type:**	
Airport Elevation:	22 ft msl	**Runway Surface Condition:**	Unknown
Runway Used:	14	**IFR Approach:**	None
Runway Length/Width:	5001 ft / 100 ft	**VFR Approach/Landing:**	None

DTS was located 1 mile east of Destin, Florida, at an elevation about 22 ft msl. It was equipped with a single asphalt runway designated 14/32, which was 5,001 ft long and 100 ft wide.

Published NOTAM (12/003) specified an obstruction (320-ft-tall crane) located 1.5 nautical miles southeast of the airport. Further plotting of the location indicated it was located about .8 nautical mile and 142° from the departure end of runway 14. The effective date of the NOTAM was December 5, 2015 and it was in effect on the accident date.

According to the building superintendent associated with the crane, it was lowered and the boom was pointed to the southeast corner of the building at the end of every work day, but remained over the building. He reported that procedure was followed at the end of the day on August 2nd. Postaccident examination of the crane at night 2 days after the accident revealed an operating single red flashing light. No debris associated with the airplane was observed around the crane or reported by the superintendent.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	30.373888,-86.470832

The airplane crashed in the Gulf of Mexico in about 55 ft of water about 1.23 nautical miles and 191° from the departure end of runway 14 at DTS.

According to one of the divers who assisted with recovery of the wreckage, the fuselage was inverted, and the bottom of the fuselage was torn away. The nose landing gear was extended. Both wings remained attached by the control cables, but the right wing was resting on the left side of the airplane. The left main landing gear was extended. The left engine and propeller remained attached to the wing; the right engine and propeller was separated from the wing but found in close proximity to the main wreckage. The aft fuselage/empennage, and horizontal stabilizer were later recovered. All recovered wreckage was taken to a secure facility for further examination.

Examination of the fuselage revealed all structure forward of fuselage station (FS) 43.00 was not recovered. Both wings remained attached to the center section by the forward and aft attach points, and both spars of both wings were fractured at various locations with no evidence of preimpact failure or malfunction. No wing structure just outboard of the engine nacelles was recovered. There was no fire damage to any component of the wreckage. The vertical stabilizer, rudder, and rudder trim tab remained attached to the separated aft fuselage/empennage; the horizontal stabilizer was separated. The rudder counterweight was not located. The right horizontal stabilizer, elevator, and elevator trim tab were intact. The left horizontal stabilizer leading edge and inboard portion of the left elevator remained attached; the outboard portion of the left elevator from the center hinge was separated and not located.

All rudder, elevator, and aileron flight control cables remained attached at their respective cockpit attach points. Aileron flight control cable continuity was confirmed from the cockpit to each wing aileron bellcrank through cable separations that exhibited either tensile overload or cut signatures, and a bent and fractured balance cable turnbuckle. Rudder and elevator flight control cable continuity was confirmed from the cockpit to the control surface bellcranks through cable separations that exhibited either tensile overload or cut signatures or bending overload of the aft left rudder bellcrank. The elevator push/pull rod was separated from the control surface yoke which was bent and fractured; no evidence of preimpact failure or malfunction was noted. Examination of the flap motor revealed the left and right

flap chains had 3 pins from the sprocket, consistent with a flaps-retracted position. One cable for the right flap exhibited tension overload while the other cable was cut. The rudder trim actuator was extended 1.625 inches, consistent with a 10° tab trailing edge left deflection (left deflection limit is 17°). The elevator trim tab actuator was extended 0.750 inches, consistent with a 21° tab trailing edge down deflection (down limit is 21°).

Examination of the left auxiliary fuel pump revealed that the outlet fuel line was not connected to the fitting on the pump, but the opposite end remained secured to the fuel selector valve. There were no fuel stains in the area of the auxiliary fuel pump. The line that was found separated at one end and the fitting were retained for further examination. The right auxiliary fuel pump was not located.

The pilot's seat remained attached to its rails and the lap belt was buckled; the shoulder harness was not attached. The landing gear selector was in the up position, and the left and right auxiliary fuel pump switches were each in the off position. Close examination of the left engine fuel pump switch revealed it was displaced to the right, and a linear mark and smear was noted on the right ramp in the uppermost position. Examination of the right engine fuel pump switch revealed a slight linear mark on the right ramp in the upper most position. None of the filaments for the landing gear down and locked light bulbs were stretched. Examination of the throttle quadrant revealed that the left and right throttle controls were about 3/4 forward; however, the left was about 1/2 knob aft of the right. The left propeller control was about 1 inch forward of the decrease detent, while the right was about 3/4 full forward. The left mixture control was about 1/2 inch aft of full rich, while the right was full rich. Close examination of the throttle quadrant revealed no evidence of impact signatures of the levers or slots. The pilot's attitude indicator depicted an 80° right bank and approximately 40° nose-low attitude, while the co-pilot's attitude indicator depicted a 45° right bank and 30° nose low attitude. The suction gauge was off scale low and water was noted inside the instrument.

The left engine remained attached by the front engine mounts. The mixture and throttle control arms were in the full forward position, while the propeller governor control arm was found in the mid-range position. The engine-driven fuel pump remained attached, and all of the fuel lines and fittings were intact. The engine-driven fuel pump turned freely by hand and discharged a small amount of fuel. The fuel lines contained fuel. The crankshaft was rotated by hand at the propeller and continuity to the accessory section was noted; operation of the impulse couplings could be heard. The engine and turbocharger components were removed from the wing structure, preserved, and shipped to the manufacturer's facility for test run.

According to the FAA inspector who witnessed the engine examination and test run, both magnetos were timed within 2° of specification. The magnetos were removed, cleaned, dried, and re-installed at the as-found timing. Cracked through bolt nuts were replaced, and with a test club propeller installed, the engine was started and ran full throttle, producing 2,100 rpm maintaining 38 inches manifold pressure. It was noted that the engine was operating in a manner consistent with a lean fuel-to-air ratio. The engine-driven fuel pump was placed on a test bench, and the pressure at 2,700 rpm and 200 pounds-per-hour fuel flow was less than specified due to internal corrosion in and around the anode, which prevented the opening of the high side fuel flow. A slave engine-driven fuel pump was installed, and the engine was operated to full throttle, producing 2,456 rpm maintaining 38 inches manifold pressure. The readings were noted despite a manifold pressure leak between the inter-cooler and throttle body.

Examination of the right engine revealed that the turbocharger, wastegate, throttle body and metering unit were separated from the engine and airframe. The propeller governor control arm and the mixture control arm were found in the full forward position. The throttle control arm was near full forward. The engine-driven fuel pump was removed and the drive coupling was intact. The engine-driven fuel pump drive turned freely by hand and the fuel pump discharged a small amount of water. Two of the fuel line fittings were fractured. The crankshaft was rotated and continuity to the accessory section was confirmed; operation of the impulse couplings could be heard during rotation. The engine and separated turbocharger components, throttle body and metering unit were preserved and shipped to the manufacturer's facility. Disassembly inspection of the magnetos, engine-driven fuel pump, and fuel manifold valve revealed internal corrosion consistent with salt water submersion. Several through bolt nuts were cracked, or the through bolts with attached nuts were backed away from the cylinder flange. Disassembly of the engine revealed no evidence of fretting on the crankcase bearing bosses. The vacuum pump revealed rotor and vanes were intact. No mechanical issues or failures were observed during the teardown of the engine.

Examination of the left propeller revealed all blades were retained within the hub but were free to rotate; all counterweights remained attached. Each propeller blade was marked with A-C indiscriminately. Examination of the blade marked A revealed a gently sweeping aft bend beginning midspan of the de-ice boot and leading edge twisting towards low pitch. The blade marked B exhibited a gentle sweeping forward bend and leading edge twisting towards low pitch. The blade marked C exhibited a gentle sweeping forward bend beginning about the outer portion of the de-ice boot. The cylinder was separated from the hub. The propeller was removed from the engine and the separated cylinder assembly was unthreaded from the pitch change link. Complete disassembly of the feathering spring was not performed due to safety concerns. The propeller hub halves were separated and all propeller blade pitch change knob were fractured; there was no evidence of preimpact failure or malfunction of the pitch change knobs. Internal marks in the hub halves indicated contact marks consistent with forces in the thrust direction. Examination of the preload plates on the butt end of each blade revealed impacts mark for blade A correlated to propeller blade angle of 15°, while impact marks for blades B and C each correlated to propeller blade angle of 9°. By design, the propeller low pitch is 13.0° +- 0.1°. The low pitch stop exhibited an impact mark from the adjacent pitch stop cap screw.

Examination of the right propeller revealed all blades were retained within the hub but were free to rotate. All blade counterweights were accounted for. Each propeller blade was marked with A-C indiscriminately. Examination of the blade marked A revealed a gentle sweeping aft bend and leading-edge twisting towards low pitch. The blade marked B exhibited a gentle sweeping aft bend, while the blade marked C exhibited a gentle sweeping forward bend about midspan of the de-ice boot and the blade tip was bent aft. The cylinder was separated from the hub. The propeller was removed from the engine and the separated cylinder assembly was unthreaded from the pitch change link. Complete disassembly of the feathering spring was not performed due to safety concerns. The propeller hub halves were separated and each propeller blade pitch change knob was fractured; there was no evidence of preimpact failure or malfunction of the pitch change knobs. Internal marks in the hub halves indicate contact marks consistent with forces in the thrust direction. Examination of the preload plates on the butt end of each blade revealed impacts mark for blades A and B; no marks were noted for blade C. The marks for blades A and B correlated to propeller blade angle of 9° and 13°, respectively. The low pitch stop exhibited an impact mark from the adjacent pitch stop cap screw. A smudge on the preload plate for blade C indicated a propeller blade angle operating range between 13° and 30°. By design, the propeller

low pitch is 13.0° +- 0.1°.

Medical and Pathological Information

The District One Medical Examiner's Office, Fort Walton Beach, Florida, performed a postmortem examination of the pilot. According to the autopsy report, the cause of death was drowning, with a contributory cause of blunt impact of head and chest.

The FAA Bioaeronautical Sciences Research Laboratory (FAA), Oklahoma City, Oklahoma, performed toxicological testing of specimens of the pilot. The toxicology report indicated negative results for carbon monoxide and volatiles; 319.5 ug/ml acetaminophen was detected in the urine, and an unquantified amount of the same drug was detected in the submitted blood specimen.

Tests and Research

Nonvolatile Memory

The airplane was equipped with a portable Garmin GPS receiver, a Shadin Avionics fuel flow indicator, and a J.P. Instruments EDM 760 engine monitor. These components were retained for download by the NTSB's Vehicle Recorder Division. Although the GPS did record and retain flights, the accident flight was not recorded. No data was recovered from the fuel flow indicator.

According to the NTSB specialist's factual report concerning the EDM 760, the device was set to record, in part, exhaust gas temperature (EGT), cylinder head temperature (CHT), and total inlet temperature (TIT) for both engines. The data was sampled every 6 seconds, and data associated with the accident flight contained 115 points of data covering the entire flight (11 minutes, 24 seconds). Due to the loss of functionality of the unit's internal clock, the data could not be correlated to real time. The data indicated that from 6 minutes 48 seconds elapsed recorded time until the end of recorded data at 11 minutes 24 seconds elapsed time, all CHT and EGT readings for both engines were consistent with normal parameters.

Auxiliary Fuel Pump Outlet Line and Fitting

Metallurgical examination of the separated hard aluminum fuel line and fitting revealed about 90° arc of the partial first thread of the fitting was fractured consistent with overstress shearing toward the tube. Close examination of the second thread of the fitting revealed fretting wear scars to the flare side flank of the thread. The fretting wear damage completely penetrated the blue anodized coating over an approximate 90° arc. The flare portion of the fitting exhibited features consistent with fretting wear. Examination of the internal portion of the flare of the tube revealed fretting wear, which matched the general shape of the fretting on the fitting. Additionally, the first threads of the B-nut for the tube revealed crest damage around about 270°. The thread was sheared in overstress toward the union in that

location. The outward facing flank of the second thread had fretting wear damaged in two locations, which approximates the location of fretting wear scars noted on the threads of the fitting.

Annunciator Panel Bulb Filaments

The annunciator panel was sent to the NTSB Materials Laboratory to determine whether any of the bulb filaments exhibited stretching. X-ray examination revealed that none of the bulb filaments was stretched.

Spatial Disorientation

According to FAA Safety Team literature, 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.

Administrative Information

Investigator In Charge (IIC):	Monville, Timothy
Additional Participating Persons:	Nina McBride; FAA/FSDO; Vestavia Hills, AL Ernest C Hall; Textron Aviation; Wichita, KS Christopher Lang; Continental Motors, Inc.; Mobile, AL Les Doud; Hartzell Propeller, Inc.; Piqua, OH Jack Clark; FAA/FSDO; Vestavia Hills, AL
Original Publish Date:	April 17, 2018
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=93748