Aviation Investigation Final Report

Location:	Moscow, Tennessee	**Accident Number:**	ERA12FA438
Date & Time:	July 11, 2012, 08:52 Local	**Registration:**	N764RV
Aircraft:	CIRRUS DESIGN CORP SR20	**Aircraft Damage:**	Substantial
Defining Event:	VFR encounter with IMC	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The non-instrument rated pilot departed the airport in instrument meteorological conditions with no flight plan filed for the personal flight. Prior to the flight, an employee at the departure airport who talked to the pilot reported that the pilot stated he was in a "hurry to depart due to possible bad weather in the area." A review of radar data indicated that a radar target identified as the accident airplane flew for about 25 minutes after takeoff at a relatively constant altitude of about 1,000 feet mean sea level (msl). Then, the radar target began to climb at 0849:55 with intermittent descents of one to two hundred feet. The last radar return at 0852:27 indicated an altitude of 2,600 feet msl, which was in the vicinity of the accident location. Postaccident analysis of position information recovered from an enhanced ground proximity warning system (EGPWS) showed that last 10 seconds of recorded data exhibits a steadily increasing negative vertical speed rate. The last two seconds of data recorded a 5,000 foot per minute descent up to a 15,000 foot per minute descent. The roll rate of the airplane in the last 10 seconds of recorded data varied from a 24 degree roll to the right to a 28 degree roll to the left. During the final moments of the recorded flight data, ground speed peaked around 140 knots, and then decreases to 20 knots in two seconds. Examination of the wreckage revealed no evidence of any pre-impact mechanical malfunctions or failures. Analyses of weather information and witness statements were consistent in depicting conditions likely to have produced restricted visibility at the time of the accident. Therefore, it is likely that the restricted visibility conditions and the airplane's turning ground track would have been conducive to the development of spatial disorientation. Subsequently, the rapid descent and steep bank angle could have resulted from the pilot losing control of the airplane due to spatial disorientation.

Probable Cause and Findings

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

The non-instrument rated pilot's continued VFR flight into IMC conditions, which resulted in spatial disorientation, loss of airplane control, and impact with trees and terrain.

Findings

Personnel issues	Spatial disorientation - Pilot
Personnel issues	Aircraft control - Pilot
Personnel issues	Decision making/judgment - Pilot
Environmental issues	Low ceiling - Contributed to outcome

Factual Information

History of Flight

Enroute-cruise	VFR encounter with IMC (Defining event)
Enroute-cruise	Loss of visual reference
Enroute-cruise	Loss of control in flight
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On July 11, 2012, about 0852 central daylight time, a Cirrus SR20, N764RV, was substantially damaged from tree and terrain impact near Moscow, Tennessee. The airplane was registered to Vaughn Aviation LLC and operated by an individual, under the provisions of Title 14 Code of Federal Regulations, Part 91, as a personal flight. The non-instrument rated pilot was fatally injured. Instrument meteorological conditions prevailed and no flight plan was filed. The flight originated from Millington Regional Jetport Airport (NQA), Millington, Tennessee, about 0825, with the intended destination of Pensacola Regional Airport (PNS), Pensacola, Florida.

According to an employee at NQA who talked to the pilot prior to departing on the accident flight, the pilot stated that he was in a "hurry to depart due to possible bad weather in the area." In addition, there was a weather briefing station located inside the fixed based operator at the departure airport; however, no airport personnel recalled the pilot using it on the day of the accident.

A review of radar data provided by Memphis Terminal Radar Approach Control (TRACON) indicated that a radar target identified as the accident airplane flew for about 25 minutes after takeoff from NQA at a relatively constant altitude of about 1,000 feet mean sea level (msl). Then, the radar target began to climb at 0849:55 with intermittent descents of one to two

hundred feet. The last radar return at 0852:27 indicated an altitude of 2,600 feet msl, which was in the vicinity of the accident location.

Several witnesses around the accident site heard the “engine revving up” before the sound of an explosion. Smoke was seen coming from an open meadow area and the authorities were notified of a possible airplane crash. One witness, located approximately one-third of a mile southwest of the accident site, observed the airplane descending, at a wings level attitude. The airplane was about 100 feet above the ground when it caught his attention. The airplane was traveling at high rate of speed and flying from the west to the northeast moments before the explosion was heard. Authorities and first responders reported low cloud ceilings and drizzling rain around the time of the accident.

Pilot Information

Certificate:	Private	**Age:**	48
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 Without waivers/limitations	**Last FAA Medical Exam:**	July 28, 2010
Occupational Pilot:	UNK	**Last Flight Review or Equivalent:**	
Flight Time:	285 hours (Total, all aircraft)		

The pilot, age 48, held a Federal Aviation Administration (FAA) private pilot certificate with rating for airplane single-engine land. He was issued a third-class medical certificate on July 28, 2010, with no limitations. At that time he reported a total time of 285 flight hours. On an insurance form dated in July 2011, he reported 340 total flight hours, of which, 280 hours were

in the same make and model as the accident airplane.

Aircraft and Owner/Operator Information

Aircraft Make:	CIRRUS DESIGN CORP	**Registration:**	N764RV
Model/Series:	SR20	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	1687
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:	August 13, 2011 Annual	**Certified Max Gross Wt.:**	
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	422 Hrs as of last inspection	**Engine Manufacturer:**	CONT MOTOR
ELT:	C91A installed, not activated	**Engine Model/Series:**	IO-360-ES
Registered Owner:	On file	**Rated Power:**	210 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

The airplane was a four-seat, fixed tricycle landing gear airplane that was manufactured in 2006. It was equipped with a Teledyne Continental, 210-horsepower, IO-360-ES, horizontally-opposed six-cylinder engine. Review of the airplane logbooks revealed that the last annual inspection was conducted on August 13, 2011, at a recorded time of 422.3 total hours.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	NQA,319 ft msl	**Distance from Accident Site:**	38 Nautical Miles
Observation Time:	08:35 Local	**Direction from Accident Site:**	131°
Lowest Cloud Condition:	Thin Overcast / 900 ft AGL	**Visibility**	6 miles
Lowest Ceiling:	Overcast / 900 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.98 inches Hg	**Temperature/Dew Point:**	24°C / 22°C
Precipitation and Obscuration:	In the vicinity - None - Mist		
Departure Point:	Millington, TN (NQA)	**Type of Flight Plan Filed:**	None
Destination:	Pensacola, FL	**Type of Clearance:**	Unknown
Departure Time:	08:25 Local	**Type of Airspace:**	Unknown

Around the time of departure, the NQA 0835 recorded weather observation indicated variable wind at 4 knots; visibility 6 statute miles, mist, overcast clouds at 900 feet above ground level (agl), temperature 24 degrees C; dew point 22 degrees C; altimeter 29.99.

The 0854 recorded weather observation at Memphis International Airport (MEM), located approximately 29 miles west of the accident location, included wind from 080 degrees at 7 knots, 9 miles visibility, overcast clouds at 600 feet agl, temperature 24 degrees C, dew point 22 degrees C; barometric altimeter 29.99 inches of mercury.

The GOES-13 infrared image for 0902 CDT image depicted a large area of low stratiform clouds over the accident site with cloud tops near 8,000 feet. In addition, the image depicted multiple layers of clouds over the area that produced an overcast cloud cover of stratiform clouds over the region and the accident site. Cumulus congestus

type clouds associated with vertical development and rain showers can be identified east, with additional development southwest of Memphis.

There were a significant number of pilot reports made in the vicinity of McKellar-Sipes Regional Airport (MKL), Jackson, Tennessee, which was 41 nautical miles north east of the accident location, and reported overcast clouds with bases between 1,200 and 1,600 feet msl (or approximately 800 and 1,200 feet agl) with tops between 2,000 and 5,000 feet msl surrounding the period.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	35.056388,-89.38639(est)

The aircraft struck trees and impacted terrain on the edge of an open meadow on an estimated 035-degree heading. The airplane’s initial collision was with the top of an approximately 40 foot tall tree, with a ground elevation of 498 feet msl. The airplane impacted terrain about 70 feet beyond the impacted tree. The descent angle between the tree and terrain equated to about 60-degrees. The initial ground impact crater measured approximately 6 feet square and consisted of a ground scar approximately 20-feet-wide by 15-feet-long, which were consistent in size and dimension to the right leading edge of the wing, the right main landing gear, and left main landing gear. This was also consistent with a right wing low attitude at impact. The debris field extended outward approximately 115 feet-wide by 480 feet-long from the crater.

The engine was encased in three individual cowling pieces. The upper engine cowling, which was located in the debris field, exhibited impact damage. The left and right engine cowlings were not located. Several large fragments of the fuselage skin were located in the debris field. The left and right cabin doors were separated from the fuselage and fractured into several pieces. All of the seats were separated from the fuselage. Both airbag seatbelts, installed on the front seats, were deployed.

Several sections of the upper and lower wing skins were located in the debris field. All flight control surfaces were separated from the wing. The separated wing spar was located in the debris field. The aileron control cable was separated from the wing. The roll trim motor was located in full right roll trim position. The flap actuator was located and correlated to the flaps “UP” position.

The nose landing gear assembly was separated from the engine mount and located in the debris field. The left and right main landing gear assemblies were separated from the wing and were located in the debris field.

The vertical stabilizer was separated from the fuselage. The rudder remained attached to the vertical stabilizer. The horizontal stabilizer was separated from the fuselage. The left and right elevators remained attached to the horizontal stabilizer. The pitch trim motor was located in an approximate neutral pitch trim position.

The on-site examination of the Cirrus Airframe Parachute System (CAPS) components reveled evidence consistent with a CAPS activation that was due to ground impact forces. The CAPS safety pin was not installed in the handle and was not located. The activation handle was found separated from the cable in the debris field. The activation cable remained intact from the handle holder to the firing pin actuator. The rocket motor was separate from the D-Bag with the rocket motor expended. The packed parachute assembly was found extracted from the airplane. The packed parachute was found in the D-Bag and all harnesses remained attached.

The inspection of the engine did not reveal any anomalies that would have prevented the ability to produce rated horsepower. The engine was separated from the airframe and located approximately 10 feet from the cockpit. The throttle cable remained attached to the engine and exhibited damage. The engine was found inverted and the oil sump was fractured from the engine. The propeller and forward section of the engine crankshaft were separated from the engine and located approximately 10 feet forward and to the left of the engine. The forward portion of the crankcase and lower, aft portion of the crankcase exhibited damage consistent with impact forces. All of the cylinders remained attached to the crankcase. All engine accessories, except the propeller governor and starter adaptor, were separated from the engine and located in the debris field. All damage observed was consistent with impact forces.

Medical and Pathological Information

The Office of the Chief Medical Examiner, Memphis, Tennessee, conducted an autopsy on the pilot on July 12, 2012. The autopsy findings included "multiple blunt traumatic injuries," and the report listed the specific injuries.

Forensic toxicology was performed on specimens from the pilot by the FAA Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma. The toxicology report stated no ethanol or drugs were detected.

Additional Information

Multi-Function Display and Primary Function Display

A multi-function display (MFD) and primary flight display (PFD) were recovered from the cockpit and forwarded to the NTSB Vehicle Recorders Laboratory, Washington, DC, for data download. Due to the excessive damage and fragmentation of the memory devices, no viable data was extracted from the MFD or PFD.

Enhanced Ground Proximity Warning System

An enhanced ground proximity warning system (EGPWS) was also retained by the NTSB for data download. A review of the data revealed that heading, GPS position, GPS altitude, and vertical speed were recorded. Ground speed was derived from aircraft position information. The highest recorded altitude of the airplane was about 2700 feet msl, which was about 10 seconds prior to the end of the recording. In addition, the last 10 seconds of recorded data exhibits a steadily increasing negative vertical speed rate. The last two seconds of recorded data indicated a 5,000 foot per minute descent up to a 15,000 foot per minute descent. The roll rate of the airplane in the last 10 seconds of recorded data varied from a 24 degree roll to the right to a 28 degree roll to the left. The recorded ground speed peaks 2 seconds prior to the end of the recorded data around 140 knots, and then decreases to 20 knots in two seconds.

According to the downloaded data, the airplane experienced two EGPWS alerts during the accident sequence. A Mode 1 “Sink Rate” caution occurred at system time 511:53:35. A Mode 1 “Pull Up” warning occurred at system time 511:53:36. According to the manufacturer's pilot's guide:

“Initially, the voice alert “Sink Rate” will be heard, and the yellow caution alert annunciator lamp will illuminate. If the aircraft continues in the high rate of descent, the “Sink Rate-Sink Rate” voice alert will be repeated at an increasing frequency. Should the aircraft penetrate the warning boundary, the voice alert “Pull Up” will be heard continuously and the red warning annunciator lamp will illuminate. In both cases, as the pilot reacts to decrease the high rate of descent and the aircraft flight path exits the alerting/warning envelope, the annunciator lamp will extinguish and the voice alerts will cease.”

More details about the EGPWS examination can be found in the "EGPWS Factual Report" located in the public docket for this accident.

FAA Advisory Circular 60-4A Pilot's Spatial Disorientation

According to FAA Advisory Circular 60-4A "Pilot's Spatial Disorientation," "Surface references and the natural horizon may at times become obscured, although visibility may be above visual flight rule minimums. Lack of natural horizon or surface reference is common on over-water flights, at night, and especially at night in extremely sparsely populated areas or in low visibility conditions. A sloping cloud formation, an obscured horizon, a dark scene spread with ground lights and stars, and certain geometric patterns of ground lights can provide inaccurate visual information for aligning the aircraft correctly with the actual horizon. The disoriented pilot may place the aircraft in a dangerous attitude."

FAA's Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25)

The FAA's Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25), also states that 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 airplane. When visual contact with the horizon is lost, the vestibular system becomes unreliable. Without visual references outside the airplane, there are many situations where combinations of normal motions and forces can create convincing illusions that are difficult to overcome. In a classic example, a pilot may believe the airplane is in level flight, when, in reality, it is in a gradual turn. If the airspeed increases, the pilot may experience a postural sensation of a level dive and pull back on the stick, which tightens the turn and creates increasing G-loads. If recovery is not initiated, a steep spiral will develop. This is sometimes called the graveyard spiral, because if the pilot fails to recognize that the airplane is in a spiral and fails to return the airplane to wings-level flight, the airplane will eventually strike the ground. If the horizon becomes visible again, the pilot will have an opportunity to return the airplane to straight-and-level flight, and continued visual contact with the horizon will allow the pilot to maintain straight-and-level flight. However, if contact with the horizon is lost again, the inner ear may fool the pilot into thinking the airplane has started a bank in the other direction, causing the graveyard spiral to begin all over again.

Administrative Information

Investigator In Charge (IIC):	Obregon, Jose
Additional Participating Persons:	Daniel P Merrell; FAA; Memphis, TN Chris Lang; Continental Motors, INC; Mexico, MT Brannon D Mayer; Cirrus; Duluth, MN
Original Publish Date:	December 2, 2013
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=84266