Aviation Investigation Final Report

Location:	LAFAYETTE, Louisiana	**Accident Number:**	CEN20MA044
Date & Time:	December 28, 2019, 09:21 Local	**Registration:**	N42CV
Aircraft:	Piper PA 31T	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of control in flight	**Injuries:**	5 Fatal, 2 Serious, 2 Minor
Flight Conducted Under:	Part 91: General aviation - Executive/Corporate		

Analysis

The personal flight departed from Lafayette Regional Airport/Paul Fournet Field (LFT), Lafayette, Louisiana, and entered the clouds when the airplane was at an altitude of about 200 ft above ground level. Before takeoff, the controller issued an instrument flight rules clearance to the pilot, instructing him to turn right onto a heading of 240° and climb to and maintain an altitude of 2,000 ft mean sea level (msl) after takeoff. Automatic dependent surveillance-broadcast (ADS-B) data for the accident flight started at 0920:05, and aircraft performance calculations showed that the airplane was climbing through an altitude of 150 ft msl at that time. The calculations also showed that the airplane then turned slightly to the right toward the assigned heading of 240° and climbed at a rate that varied between 1,000 and 2,400 ft per minute and an airspeed that increased from about 151 to 165 knots.

At 0920:13, the airplane started rolling back toward wings level and, 7 seconds later, rolled through wings level and toward the left. At that time, the airplane was tracking 232° at an altitude of 474 ft and an airspeed of 165 knots. The airplane's airspeed remained at 165 knots for about 10 seconds before it started increasing again, and the airplane continued to roll steadily to the left at an average roll rate of about 2° per second.

The aircraft performance calculations further showed that, at 0920:40, the airplane reached a peak altitude of 925 ft msl. At that time, the airplane was tracking 200°, its bank angle was about 35° to the left, and its airspeed was about 169 knots. The airplane then started to descend while the left roll continued. At 0920:55, the airplane reached a peak airspeed of about 197 knots, which then started decreasing. At 0920:57, the airplane descended through 320 ft at a rate of descent of about 2,500 ft per minute and reached a bank angle of 75° to the left.

At 0920:58, the controller issued a low altitude alert, stating that the pilot should "check [the airplane's] altitude immediately" because the airplane appeared to be at an altitude of

300 ft msl. The pilot did not respond, and no mayday or emergency transmission was received from the airplane. The last ADS-B data point was recorded at 0920:59; aircraft performance calculations showed that, at that time, the airplane was descending through an altitude of 230 ft msl at a flightpath angle of about -7°, an airspeed of 176 knots, and a rate of descent of about 2,300 ft per minute. (The flightpath angle is in the vertical plane—that is, relative to the ground. The ground track, as discussed previously, is in the horizontal plane—that is, relative to north.)

The airplane struck trees and power lines before striking the ground, traveled across a parking lot, and struck a car. The car rolled several times and came to rest inverted at the edge of the parking lot, and a postcrash fire ensued. The airplane continued to travel, shedding parts before coming to rest at the far end of an adjacent field. At the accident site, the surviving passenger told a local police officer that “the plane went straight up and then straight down.”

Weight and balance calculations showed that the airplane’s total weight and center of gravity were within limits, with the center of gravity near the aft limit.

The pilot likely obtained weather information for the flight about 0736 on the day of the accident. This information indicated that low-visibility conditions would be present at the time of takeoff. The pilot would most likely have been aware of these conditions because, according to his wife, he had mentioned (on the night before the accident flight) that cloud ceilings would be “low” during takeoff. In addition, the pilot told the controller that he had the current automatic terminal information service report, which was based on the 0853 automated surface observing system observation. That observation indicated a visibility of 0.75 mile in mist and a vertical visibility of 200 ft above ground level. These weather conditions were conducive to the development of spatial disorientation.

The surviving passenger also recalled that the airplane “pitched up like the pilot was trying to get above or over the clouds” and that a “harder than normal pitching movement” had occurred. Thus, the pilot had likely become spatially disoriented at this point in the initial climb due to the lack of visual references and the airplane’s increasing pitch attitude. Another indication that the pilot had become spatially disoriented was the airplane’s continuing and tightening turn to the left away from the intended course.

The pilot’s most recent recurrent training in the airplane occurred in April 2019, but the training was conducted by a pilot whose Federal Aviation Administration-issued flight instructor certificate had expired in February 2019. No Federal Aviation Administration records indicated that the flight instructor’s certificate had been reinstated at the time of the training event. (The National Transportation Safety Board [NTSB] recognizes that the accident pilot might not have been aware that the flight instructor’s certificate had expired.) The flight instructor stated that the accident pilot’s training was conducted in visual meteorological conditions and that he did not simulate instrument conditions by having the pilot wear a hood (a view-limiting device). Further, the available pilot logbook evidence did not note the accident pilot’s recent flight experience or flight time in instrument meteorological conditions. As a result, the NTSB was unable to determine if the accident pilot met the regulatory requirements in Title 14 *Code of Federal Regulations* 61.57(c)(1) for instrument experience.

The left and right engines were impact and fire damaged. The damage to the turbine engine blades and shrouds was consistent with operation at the time of impact. No anomalies were found that would have precluded normal operation of both engines.

The damage to the propellers was symmetrical and consistent with impact forces. In addition, surveillance cameras at two private residences captured the sounds of the accident airplane as it passed overhead. No abnormal propeller sounds were heard on either recording. The NTSB's sound spectrum analysis of the audio recording from one of these residences found that the recorded passing frequency was consistent with a four-bladed propeller rotating between 2,000 and 2,100 rpm, which was just below the propeller's maximum continuous and takeoff allowable speed of 2,200 rpm.

Aircraft performance calculations showed that each engine's horsepower began decreasing from 500 horsepower at 0920:55, consistent with the decrease in airspeed after that time. The left engine torque gauge needle, as found in the wreckage, pointed to a value of about 525 lb-ft. This torque level, at a propeller speed between 2,000 and 2,100 rpm, would produce about 200 horsepower, indicating a power reduction on both engines during the last 5 seconds of flight. At that time, the airplane would have been descending through the clouds. The performance calculations indicated that the power applied to the airplane after 0920:56 would have been negligible.

The airplane was not equipped, and was not required to be equipped, with a flight data recorder or a cockpit voice recorder. As a result, to determine the operational status of the autopilot during the accident flight, the NTSB conducted examinations of the annunciator panel and the autopilot servos. An analysis of light bulb filaments from the annunciator panel showed that none of the filaments from the autopilot, yaw damper, and flight director light bulbs were stretched, indicating that these annunciators were likely not illuminated at the time of impact. None of the examined autopilot servo components had failed, and no witness marks were noted on the gear teeth of the autopilot roll servo, indicating that the servos were not engaged at the time of impact. The annunciator panel and autopilot servo evidence was consistent with information provided by pilots who were familiar with the accident pilot. Specifically, the company owner reported that the accident pilot would hand fly the airplane up to an altitude of at least 2,000 ft, and the flight instructor stated that the accident pilot "was not an autopilot pilot" because he enjoyed hand flying the airplane. These statements, along with the physical evidence, indicated that the autopilot was likely not engaged during the accident flight.

Even though there were no maintenance writeups or reported anomalies with the flight deck display system before the accident flight, the NTSB considered whether the airplane's attitude heading and reference system (AHRS) unit failed or malfunctioned during the accident flight, which could have caused erroneous attitude and heading information to be displayed to the pilot. The AHRS manufacturer successfully completed initial continuity tests of the AHRS. However, after the unit was connected to the test bench and power was applied, the test equipment was unable to communicate with the AHRS to conduct additional tests, which precluded a determination about the AHRS' functionality at the time of the accident. Further, the information that was recorded and stored in the AHRS had been overwritten by the test equipment. Afterward, the NTSB conducted a visual inspection of the AHRS and discovered a dislodged internal connector, which was not detected during the NTSB's initial inspection of the unit (before the manufacturer's testing). The internal connector, which likely became dislodged as a result of impact forces, might have contributed to the manufacturer's inability to conduct AHRS bench testing.

Because no recorded data were available to show the functionality of the AHRS unit, the NTSB was unable to determine the attitude and heading information displayed to the pilot during the flight. However, if an internal AHRS sensor had failed and a loss of attitude and heading information had occurred, red "X" flags would have appeared on the flight deck displays to prevent the pilot from referencing erroneous data. In that case, the standby digital attitude indicator, which was located directly beneath the flight deck displays, would have provided independent attitude and heading information to the pilot.

Because the left and right elevator trim tabs were found in their full airplane-nose-up setting, the pitch trim servo was bench tested to determine if the servo was functioning properly. The servo actuator passed the manual and auto-trim tests of the manufacturer's acceptance test procedure but did not pass the torque test. During that test, the actuator rotated but skipped because the solenoid plunger did not fully engage with the gears. No evidence showed actuator gear teeth wear due to the teeth not engaging fully, indicating that the actuator was likely not skipping during the accident flight.

The left and right horizontal stabilizers and their respective elevators were found fragmented throughout the debris field. When these structures separated from the airplane, the elevator trim cables and elevator trim tabs were likely pulled in the airplane-nose-up direction. Thus, the elevator trim tabs were found in their full airplane-nose-up position likely as a result of the airplane's impact and subsequent breakup.

The angle-of-attack sensor and the stability augmentation system computer failed portions of their respective functional tests. Although the manufacturer stated that the test results were typical of incoming in-use units, the NTSB was unable to determine the systems' functionality at the time of the accident. However, these components likely did not contribute to the loss of control; the stability augmentation system is a pitch stability system, and the aircraft performance calculations showed that the airplane's bank angle progressed continuously from about 13° right at 0920:13 to about 75° left at 0920:57. (Note: the stability augmentation system is further discussed in the NTSB Systems Group Chairman's Factual Report in the docket for this accident.)

The stall margin indicator needle (part of the stability augmentation system) was found pointing to the red and black stall warning area. However, the needle had likely moved to that position during the impact sequence given the results of the aircraft performance calculations. Specifically, the flaps-up lift coefficient calculations for the accident flight showed that the airplane remained below the maximum flaps-up lift coefficient (the value of the lift coefficient just before the wing stalls and loses lift) during the period in which ADS-B data were recorded, indicating that an aerodynamic stall did not occur.

In summary, postaccident examination of the airplane structures and systems revealed no anomalies that would have precluded normal operation. The weather conditions at the time of takeoff were conducive to the development of spatial disorientation. The lack of visual references and the airplane's increasing pitch attitude likely caused the pilot to become spatially disoriented during the initial climb, as evidenced by the airplane's continuing and tightening turn to the left away from the intended course. Thus, the pilot's spatial disorientation led to his loss of control of the airplane.

Probable Cause and Findings

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

The pilot's loss of airplane control due to spatial disorientation during the initial climb in instrument meteorological conditions.

Findings

Personnel issues	Aircraft control - Pilot
Personnel issues	Spatial disorientation - Pilot
Environmental issues	Low visibility - Effect on personnel

Factual Information

History of Flight

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

On December 28, 2019, about 0921 central standard time, a Piper PA-31T airplane, N42CV, impacted terrain shortly after takeoff from Lafayette Regional Airport/Paul Fournet Field (LFT), Lafayette, Louisiana. The commercial pilot and four passengers were fatally injured, and one passenger was seriously injured. One person in a nearby car sustained serious injuries, and two people in a nearby building sustained minor injuries. The airplane was destroyed by impact forces and a postimpact fire. The personal flight was conducted under the provisions of Title 14 *Code of Federal Regulations* (*CFR*) Part 91. Instrument meteorological conditions prevailed at the time of the accident.

At 0913:16, the pilot contacted the local controller at the LFT air traffic control tower and requested an instrument flight rules (IFR) clearance to the flight's destination, Dekalb-Peachtree Airport (PDK), Atlanta, Georgia. The controller issued the clearance to the pilot and instructed him to climb to and maintain an altitude of 2,000 ft mean sea level after departure. (All altitudes in this report are expressed as mean sea level unless otherwise indicated.) The controller then instructed the pilot to taxi the airplane to runway 22L. At 0918:26, the pilot advised the controller that the airplane was ready for takeoff, and the controller cleared the airplane to depart and instructed the pilot to turn right onto a heading of 240°. After takeoff, the controller provided the pilot with a frequency change; at 0920:26, the pilot established communications with the departure controller and stated that the airplane was at an altitude of 700 ft. The controller then instructed the pilot to climb the airplane to 10,000 ft and turn right onto a heading of 330°. At 0920:36, the pilot acknowledged this instruction. No further transmissions were received from the airplane.

The Federal Aviation Administration (FAA) provided automatic dependent surveillance-broadcast (ADS-B) data for the accident flight. These data were used to calculate the airplane's performance, including its true altitude. (See the Tests and Research section of this report for more information.) The ADS-B data started at 0920:05 as the airplane climbed through an altitude of 150 ft. The airplane then began a slight right turn immediately afterward toward its assigned heading of 240°. The airplane reached a peak altitude of 925 ft from about 0920:37 to 0920:40 and then started a continuous descent toward the ground.

At 0920:58, the controller issued a low altitude alert, stating that the pilot should "check [the airplane's] altitude immediately" because the airplane appeared to be at an altitude of 300 ft. The pilot did not respond, and no mayday or emergency transmission was received from the airplane. The last ADS-B data point, at 0920:59, showed the airplane descending through an altitude of 230 ft. Figure 1 shows the airplane's flight track and key points based on aircraft performance calculations and radio transmission information.

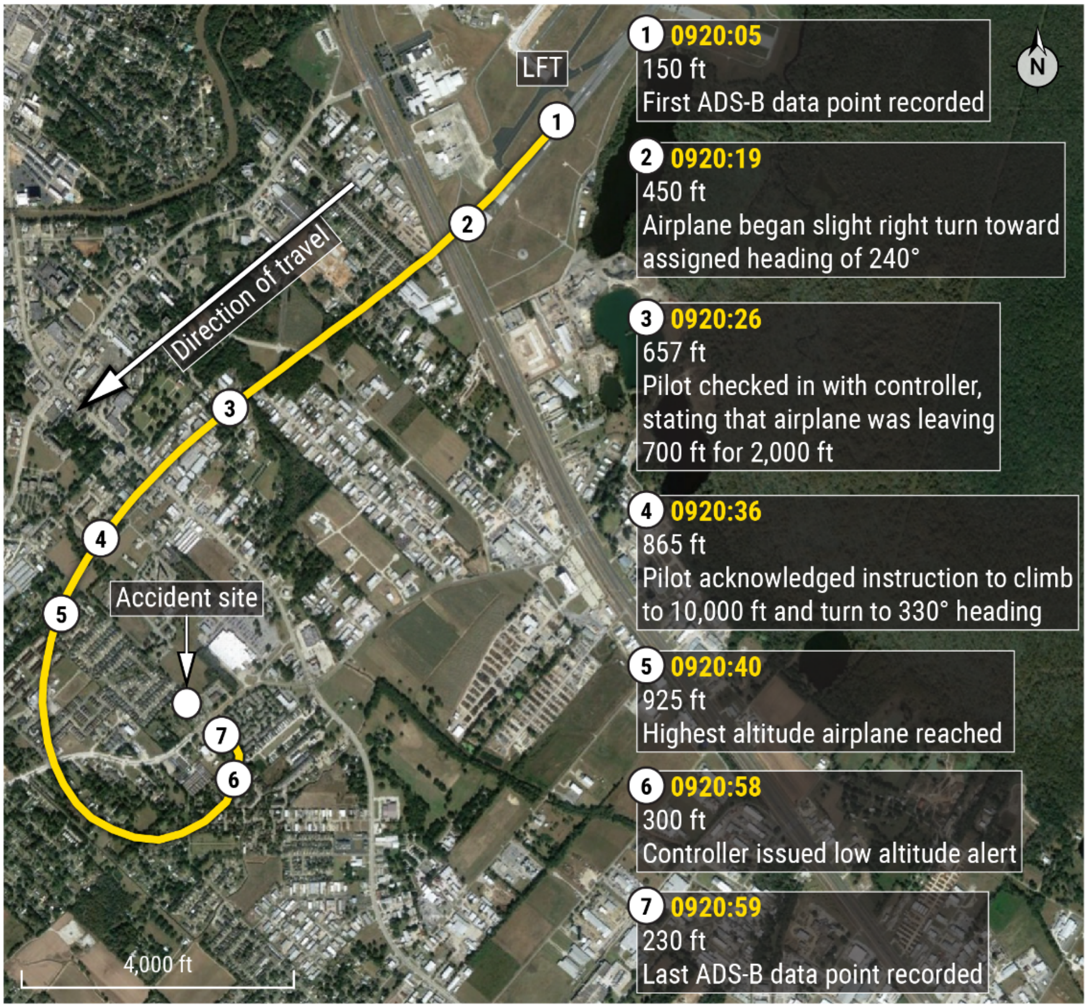

Figure 1. Flight track overview.

Multiple witnesses on the ground heard an airplane flying overhead at a low altitude. Several of these witnesses stated that the engines sounded as if they were operating at "full throttle." Multiple witnesses also observed the airplane descending through low clouds while in a steep left turn. One witness stated that the airplane was in "a very steep left diving turn" before rolling wings level and striking trees and power lines. The airplane then struck the road and continued across a parking lot, and a postcrash fire ensued. An officer from the Lafayette Police Department spoke briefly with the surviving passenger at the accident site. According to the police officer, the passenger recalled only that "the plane went straight up and then straight down."

One person was seriously injured after the airplane struck her car in the parking lot. The car then rolled several times before it came to rest inverted; a postimpact fire ensued that consumed the car. Two people inside a building sustained minor injuries from glass that shattered during the impact sequence.

Pilot Information

Certificate:	Commercial; Private	**Age:**	51,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Unknown
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	November 14, 2019
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	March 12, 2017
Flight Time:	(Estimated) 1531 hours (Total, all aircraft), 730 hours (Total, this make and model)		

The pilot held a commercial pilot certificate with an airplane multiengine land rating. The pilot also held a second-class medical certificate, dated November 14, 2019, with a limitation that required him to wear corrective lenses. According to FAA medical records, the pilot wore bifocal glasses "all the time."

On his most recent medical application, dated November 4, 2019, the pilot reported 1,531 hours of total flight experience, 46 hours of which were accumulated during the preceding 6 months. The pilot also had about 730 hours of flight experience in the accident airplane make and model. The pilot's most recent logbook was not located. The last entry in the pilot's previous logbook showed that he had 1,194 hours of total flight experience and 910 hours of flight experience in a multiengine airplane as of July 25, 2017.

The owner of the company for which the pilot worked stated that he and the accident pilot would generally hand fly the airplane up to an altitude of at least 2,000 ft (rather than engage the autopilot soon after takeoff). The company owner also stated that the accident pilot was "proficient" in the airplane.

According to the owner of the airplane (who was also a pilot), the accident pilot had "a lot of involvement" with the airplane and "wanted to be the very best that he could be" at operating it. The airplane owner stated that the accident pilot was involved in selecting and installing the airplane's flight instruments and that he was "very meticulous" about understanding the flight instruments.

The pilot's most recent recurrent training in the airplane occurred on April 22, 2019. The training was conducted by a pilot whose FAA-issued flight instructor certificate had expired in February 2019, and no FAA records indicated that his certificate had been renewed or reinstated at the time of the training. The flight instructor reported that the accident pilot's most recent recurrent training was conducted at the same time as the airplane owner's recurrent training.

The flight instructor stated that ground training included using the airplane manuals and discussing any anomalies that either pilot had experienced during the previous 12 months. The flight instructor stated that, according to the pilots, no "big anomalies" had occurred during that timeframe. During flight training, the pilots performed stall recovery maneuvers at the first indication of an impending stall, steep turns at 5,000 ft, and go-arounds with a simulated failed engine at 4,000 ft. After the maneuvers were completed, the pilots returned to the airport to conduct instrument landing system and VOR approaches. (A VOR approach uses a very-high-frequency omnidirectional radio range system for navigation.)

The flight instructor stated that all the training was conducted in visual meteorological conditions. He did not simulate instrument conditions by having the pilots wear a hood (a view-limiting device) but stated that he could "load a pilot up enough so he would not have a chance to look outside." The flight instructor also stated that the accident pilot was a "great stick and rudder guy" and that he "was not an autopilot pilot as he enjoyed [manually] flying the airplane."

The accident airplane's flight log showed that, on April 22, 2019, the airplane flew from LFT to David Wayne Hooks Memorial Airport, Spring, Texas, for the pilots' training and then returned to LFT. The entry included the accident pilot's initials and showed a total flight time of 2.7 hours. As stated above, the accident pilot's most recent logbook was not found, and the accident pilot's previous logbook did not include a flight review endorsement for this training. The last flight review endorsement recorded in that logbook was dated March 12, 2017.

The airplane owner's logbook did not include a flight review endorsement but showed the training event; the logbook entry stated, "Recurrent training per FAR [*Federal Aviation Regulation*] Part 91. Steep turns, Engine out, Emergency and Normal procedures." The entry also included the signature of the flight instructor and his pilot certificate number, but "CFI" (certificated flight instructor) and the CFI certificate expiration date did not appear after his pilot certificate number, as required for flight reviews.

Aircraft and Owner/Operator Information

Aircraft Make:	Piper	**Registration:**	N42CV
Model/Series:	PA 31T	**Aircraft Category:**	Airplane
Year of Manufacture:	1980	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	31T-8020067
Landing Gear Type:	Retractable - Tricycle	**Seats:**	6
Date/Type of Last Inspection:	October 16, 2019 Annual	**Certified Max Gross Wt.:**	9000 lbs
Time Since Last Inspection:		**Engines:**	2 Turbo prop
Airframe Total Time:	5954.6 Hrs as of last inspection	**Engine Manufacturer:**	Pratt & Whitney Canada
ELT:	C91 installed, activated, did not aid in locating accident	**Engine Model/Series:**	PT6A-28
Registered Owner:		**Rated Power:**	715 Horsepower
Operator:		**Operating Certificate(s) Held:**	None

The accident airplane, which was owned by Cheyenne Partners LLC, was equipped with two Pratt & Whitney Canada PT6A-28 turbopropeller engines with two Hartzell constant-speed, four-bladed propellers. The airplane was configured with pilot and copilot seats, an aft-facing seat and a forward-facing seat on both the left and right sides of the airplane, and a side-facing seat opposite the left-side main entry door.

The airplane was equipped with a King (now Honeywell) autopilot and a KAP 315 annunciator panel that displayed vertical and lateral flight director and autopilot system modes. The airplane was also equipped with a Garmin G600 integrated avionics display system that presented primary flight instrumentation, a full-color moving map with navigation information, and supplemental data. A Garmin GRS 77H attitude heading and reference system (AHRS) unit provided attitude and heading information to the airplane's Garmin G600 flight deck displays. The *Garmin G500/G600 Pilot's Guide* stated, "any failure of the internal AHRS inertial sensors results in loss of attitude and heading information. This is indicated by red 'X' flags over the corresponding flight instruments." There were no maintenance writeups or reported anomalies with the display system before the accident flight. A standby digital attitude indicator was located directly beneath the Garmin G600 flight deck displays.

In addition, the airplane was equipped with a Collins Aerospace stability augmentation system (SAS), which was designed to improve the static longitudinal stability of the airplane by providing variable elevator forces through tension changes to the elevator down spring. A major component of the SAS is the angle-of-attack (AOA) sensor vane, which is mounted on the right side of the airplane's nose. The SAS computer uses the information from the AOA sensor vane to drive the servo actuator, which is attached to the elevator down spring.

The SAS includes a stall margin indicator that is mounted on the upper left side of the instrument panel. This indicator receives a signal from the AOA vane to provide a pilot with a visual representation, via the indicator needle, of the ratio of airspeed to stall speed. The indicator face presents (from top to bottom) a red "stall" area, a red and black barber pole stall warning area, a yellow "slow" area, a white "1.3 V_S" (stall speed) area, and a green (cruise) area.

The last entry recorded in the airplane's flight log was a flight from West Houston Airport, Houston, Texas, to LFT on December 18, 2019. The accident airplane was stored in a hangar at LFT, and the manager of that hangar reported that he added about 200 gallons of Jet A fuel to the airplane after it arrived on December 18.

The airplane's total weight was 8,869 pounds, which was less than the maximum takeoff weight of 9,000 pounds. The calculated center of gravity was 137.3 inches aft of datum; the center-of-gravity aft limit was 138.0 inches aft of datum.

The airplane was not equipped, and was not required to be equipped, with a cockpit voice recorder or flight data recorder.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KLFT,40 ft msl	**Distance from Accident Site:**	2 Nautical Miles
Observation Time:	08:53 Local	**Direction from Accident Site:**	45°
Lowest Cloud Condition:		**Visibility**	0.75 miles
Lowest Ceiling:	Indefinite (V V) / 200 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	120°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.97 inches Hg	**Temperature/Dew Point:**	19°C / 19°C
Precipitation and Obscuration:	Light - None - Mist		
Departure Point:	Lafayette, LA (LFT)	**Type of Flight Plan Filed:**	IFR
Destination:	Atlanta, GA (PDK)	**Type of Clearance:**	IFR
Departure Time:	09:20 Local	**Type of Airspace:**	Class C

LFT had an automated surface observing system located about 2 miles north-northeast of the accident location. The 0853 observation indicated a visibility of 0.75 mile in mist and a vertical visibility of 200 ft above ground level (agl). At 0913:16, the pilot told the controller that he had the current automatic terminal information service report, which was based on the 0853 observation.

Weather radar imagery revealed no pertinent radar returns near the accident location at the time of the accident. Satellite imagery depicted clouds over the accident region with cloud top heights at an altitude of about 9,000 ft. An AIRMET that was issued at 0845 on the day of the accident (and was valid until 1500 that day) described IFR conditions in fog and mist for an area that included the accident location.

The National Weather Service's weather forecast office in Lake Charles, Louisiana, issued two terminal aerodrome forecasts (TAF) for LFT during the 2.5 hours preceding the accident time. A TAF issued at 0700 indicated, for the accident time, a visibility of 4 miles, mist, and an overcast ceiling at 300 ft agl. A TAF issued at 0905 indicated, for the accident time, a visibility of 0.75 mile, mist, and an overcast ceiling at 200 ft agl. This TAF also stated that, between 0900 and 1000, temporary conditions (fluctuations to forecast conditions) would be a visibility of 2 miles, mist, scattered clouds at 200 ft agl, and a ceiling overcast at 700 ft agl.

During a postaccident interview, the pilot's wife stated that, on the night before the accident, the pilot told her that the ceilings would be "low" for takeoff. In addition, Leidos (a flight management and briefing services source) provided the National Transportation Safety Board (NTSB) with three documents that outlined weather information for the planned flight, including the low-visibility conditions at the time of takeoff. Each document, titled "Route

Standard Briefing at Dec 28, 1336Z for N42CV KLFT to KPDK," was retrieved by a third-party vendor about 0736 local time.

Airport Information

Airport:	Lafayette Regional Apt LFT	**Runway Surface Type:**	
Airport Elevation:	41 ft msl	**Runway Surface Condition:**	
Runway Used:	22L	**IFR Approach:**	None
Runway Length/Width:	8000 ft / 150 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	4 Fatal, 1 Serious	**Aircraft Fire:**	On-ground
Ground Injuries:	1 Serious, 2 Minor	**Aircraft Explosion:**	None
Total Injuries:	5 Fatal, 2 Serious, 2 Minor	**Latitude, Longitude:**	30.176111,-92.007499

The airplane impacted trees and transmission lines on the south edge of a road. A scar on the first tree that was struck indicated that the airplane's attitude was right wing low. The first ground scar was located on the north edge of the road. The wreckage path, which included fragmented and burned pieces of the airplane and tree debris, extended 789 ft from the trees and transmission lines along a bearing of about 315°. The accident site encompassed the parking lot of a post office, as shown in figure 2, and an adjacent open field, as shown in figure 3. The aft fuselage came to rest at the end of the wreckage path, which was located about 1.5 miles from the departure end of LFT runway 22L.

Figure 2. Initial impact point and direction of travel across post office parking lot.

Figure 3. Wreckage path in field adjacent to post office.

Several windows in the front of the post office building were shattered during the impact sequence, and broken glass was found on the sidewalk in front of the building. A car, which was originally parked in front of the building, was found at the edge of the parking lot (see figure 3). The car was inverted, the roof of the car was crushed, and all the windows were broken. The car exhibited heat and fire damage.

The fuselage was fragmented and exhibited exposure to heat and fire. The right wing, outboard left wing, left and right engines, left and right elevator controls, rudder, instrument panel, and forward cabin separated from the fuselage. The cabin seats and the fragmented remains of the instrument panel were distributed throughout the debris field. The throttle quadrant was located on the right side of the debris field near the inverted and burnt car. The throttle quadrant was impact and fire damaged and did not provide any reliable throttle positions or indications.

The left and right wings were found fragmented with impact and fire damage. The inboard left wing, including part of the left flap and left nacelle, was located adjacent to the fuselage and empennage. The inboard right wing was located near the inverted and burnt car. The left and right main landing gear remained attached to their respective wing and within their wheel well.

The left engine cowling and the left aileron tip exhibited witness marks and a circular indentation consistent with impact with a tree. The left and right aileron cables exhibited broomstraw signatures consistent with impact and overload. Left and right control cable continuity could not be confirmed. No threads were visible on the left and right flap jackscrews, which was consistent with the flaps being retracted.

The empennage remained attached to the aft fuselage and came to rest at the end of the debris field and adjacent to the inboard left wing and left engine. The empennage was damaged by impact forces and fire.

The left and right horizontal stabilizers and their respective elevators were fragmented, and the fragments were distributed throughout the debris field. One elevator control cable was continuous from the elevator control bellcrank to the ball swage. This swage had separated from the elevator control quadrant attached to the control yokes in a manner that was consistent with impact damage. The other elevator control cable had a broomstraw separation near the control quadrant. The left and right elevator trim tab actuators were extended about 1.25 inches, which was consistent with the elevator trim tabs positioned 20° trailing edge down (the full airplane-nose-up setting).

Both engines had separated from their respective wing. The left propeller had separated from the left engine and was located about 563 ft from the initial impact point. All four propeller blades remained attached to the propeller hub. Three blades exhibited aft spanwise bending in the direction opposite rotation, and the leading edge was twisted slightly toward low pitch. The other blade was bent forward spanwise with no twisting. In addition, three blades exhibited chordwise/rotational scoring.

The right propeller remained attached to the right engine, and three full-length propeller blades remained attached to the propeller hub. The fourth blade had fractured and was found in the post office parking lot. All four blades exhibited spanwise bending in the direction opposite rotation, and the leading edges were twisted slightly toward low pitch. The four blades also exhibited chordwise/rotational scoring.

Disassembly and examination of both the left and right engines found no evidence of an engine case uncontainment or preimpact catastrophic internal engine failures, and no thermal distress was noted in the combustion, compressor turbine, or power turbine sections. The compressor turbine outer shrouds exhibited intermittent rubbing that was consistent with contact with the compressor turbine blades (left engine) or rotational circumferential scoring resulting from contact with the compressor turbine blades (right engine). No anomalies were found that could have precluded normal operation of either engine.

The impact marks on the preload plates for the left propeller translated to propeller blade angles consistent with the expected normal operating range for the propeller; no evidence indicated that the left propeller was feathered or in reverse at the time of impact. No anomalies were found that could have precluded normal operation of the left propeller.

The impact marks on the preload plates for the right propeller translated to blade angles in the reverse pitch range, which was contrary to the bending and twisting orientation and spanwise rotational scoring observed on the propeller blades. The pitch change rod for the right propeller was fractured, and the fracture location was used to define the position of the pitch change rod at the time of fracture. This measurement was then used to estimate the equivalent blade angle, which was calculated to be in the normal operating range near the flight idle position (that is, not in reverse or feather). No anomalies were found that could have precluded normal operation of the right propeller.

Two audio recordings, both of which were from surveillance cameras at private residences, captured the sounds of the accident airplane as it passed overhead. No abnormal propeller sounds were heard in either recording. The airplane overflew the location of one of the residences just before the crash. The NTSB performed a sound spectrum analysis of the audio recording from this residence. The sound spectrum analysis indicated that the recorded passing frequency was consistent with a four-bladed propeller rotating between 2,000 and 2,100 rpm. According to the Piper PA-31T type certification data sheet, the maximum continuous and takeoff allowable propeller speed is 2,200 rpm.

Several airplane systems that were recovered at the accident site also underwent examination, as indicated below.

<u>Annunciator Panel</u>

The annunciator panel was provided to the NTSB's Materials Laboratory for examination of the filaments in the two light bulbs for each flight director and autopilot system mode. The examination found that one filament from the autopilot, yaw damper, and flight director light bulbs was broken but not stretched and that the other filament was intact and not stretched. A filament that is not stretched is consistent with an annunciator mode that was not illuminated.

<u>Attitude Heading and Reference System Unit</u>

An on-scene visual inspection of the AHRS unit found that the unit appeared to be structurally intact, and none of its components appeared to be loose. The unit's electrical connector also appeared to be structurally intact. An internal visual inspection of the AHRS was performed at the NTSB's Vehicle Recorders Laboratory to check for any broken or damaged components that would prevent the unit from being electrically tested by the manufacturer. As part of the visual inspection, only the unit's cover (which was fractured and partially missing on one side) was removed, and no internal anomalies were found.

Garmin personnel confirmed electrical continuity of the AHRS unit, and no internal shorts or other anomalies were found. The AHRS was then connected to Garmin's test bench for further electrical continuity tests. During the tests that were conducted with power applied, the unit appeared to electrically reset (reboot) every few seconds. Garmin personnel were able to download the unit's nonvolatile data, which were then decoded, but no data related to the accident flight were found. Garmin subsequently notified the NTSB that the nonvolatile data retrieved from the AHRS contained no information about any flight because all the existing nonvolatile data had been overwritten during the attempted bench testing.

Afterward, the NTSB's Vehicle Recorders Laboratory performed another internal inspection of the AHRS unit to verify that the unit had no broken or damaged components that could have interfered with the manufacturer's electrical testing. During that inspection, the connector for the ribbon cable that ran between the top two circuit cards was found dislodged. (The loose connector was not noted during the previous inspection because the connector was not visible at that time.) No other anomalies were noted.

Autopilot Servos

Bench testing of the pitch and yaw servos found that the servos appeared to be operational. The roll servo sustained impact damage that precluded it from being bench tested. After the roll servo outer case was cut away from the chassis, the internal gear train could be moved by hand. No witness marks were noted on the gear teeth.

Pitch Trim Servos

Bench testing of the actuator for the pitch trim servo found that the actuator passed the manual trim and auto-trim tests but not the torque test. When the servo actuator was tested for proper torque output and disengagement while under a load of 60 inch-pounds, the actuator rotated but skipped because the gear teeth did not fully engage with the gears. For the gear teeth to be fully engaged, the solenoid plunger needed to be pushed downward far enough to fully engage the gears. Visual examination of the gear teeth found no evidence of wear due to the teeth not engaging fully.

Stability Augmentation System

Visual examination of the AOA sensor showed that it had sustained damage to the vane hub and the vane shaft. Because of this damage, only some parts of the acceptance test procedure could be performed on the AOA sensor. The testing found that the AOA sensor was out of tolerance, which could have been the result of its age; Collins Aerospace estimated, using engineering drawing documents and production data records, that the AOA sensor was manufactured between 1980 and 1990.

Visual examination of the SAS computer found that the circuit card assemblies were in good condition. The SAS computer acceptance test procedure was performed, and the computer failed several of the performed tests, including an AOA functional test. According to Collins Aerospace, the testing showed that the calibration of the SAS computer was out of tolerance but that the overall results were typical of an incoming in-use unit.

The stall margin indicator was found in the wreckage with impact damage. The glass on the face of the indicator was broken, and the portion of the indicator needle that remained was positioned slightly into the red and black barber pole (stall warning) area just above the yellow (slow) area.

Spatial Disorientation

The FAA Civil Aeromedical Institute's publication titled "Introduction to Aviation Physiology" defines spatial disorientation as a "loss of proper bearings; state of mental confusion as to position, location, or movement relative to the position of the earth." Factors contributing to spatial disorientation include changes in acceleration, flight in IFR conditions, frequent transfer between visual flight rules and IFR conditions, and unperceived changes in aircraft attitude.

The FAA's *Pilot's Handbook of Aeronautical Knowledge* (FAA-H-8083-25B), chapter 17, Aeromedical Factors, states the following regarding spatial disorientation:

> *A rapid acceleration, such as experienced during takeoff, stimulates the otolith organs* [which detect changes in linear acceleration and gravity] *in the same way as tilting the head backwards. This action may create what is known as the 'somatogravic illusion' of being in a nose-up attitude, especially in conditions with poor visual references. The disoriented pilot may push the aircraft into a nose-low or dive attitude.*

The FAA's *Airplane Flying Handbook* (FAA-H-8083-3C) describes hazards associated with flying when the ground or horizon is obscured. The handbook states, in part, the following:

> *The vestibular sense (motion sensing by the inner ear) can and will confuse the pilot…false sensations are often generated, leading the pilot to believe the attitude of the airplane has changed when, in fact, it has not. These false sensations result in the pilot experiencing spatial disorientation.*

As a result, the pilot "needs to believe what the flight instruments show about the airplane's attitude regardless of what the natural senses tell."

Pilot-in-Command Instrument Experience

Title 14 *CFR* 61.57(c)(1) states the following:

> *A person may act as pilot in command under IFR or weather conditions less than the minimums prescribed for VFR* [visual flight rules] *only if…within the 6 calendar months preceding the month of the flight, that person performed and logged at least the following tasks and iterations in an airplane…for the instrument rating privileges to be maintained in actual weather conditions, or under simulated conditions using a view-limiting device that involves having performed the following—*
>
> *(i) Six instrument approaches.*
> *(ii) Holding procedures and tasks.*

> *(iii) Intercepting and tracking courses through the use of navigational electronic systems.*

Title 14 *CFR* 61.57(c)(2) states that "a pilot may accomplish the requirements in paragraph (c)(1) of this section in a full flight simulator, flight training device, or aviation training device."

Flight Review Endorsements

Title 14 *CFR* 61.189 requires flight instructors to sign the logbook of each person to whom the instructor has given flight or ground training. That section also requires flight instructors to maintain a record of endorsements given to each person. Title 14 *CFR* 61.193 authorizes a person who holds a flight instructor certificate to train and issue endorsements for various certificates and ratings. The FAA's *Aviation Instructor's Handbook* (FAA-H-8083-9A), Appendix C, "Certificates, Ratings and Endorsements," states that "typical endorsements include but are not limited to flight reviews [and] instrument proficiency checks."

Title 14 *CFR* 61.56(c) states the following:

> …no person may act as pilot in command of an aircraft unless, since the beginning of the 24th calendar month before the month in which that pilot acts as pilot in command, that person has -
> (1) Accomplished a flight review given in an aircraft for which that pilot is rated by an authorized instructor and
> (2) A logbook endorsed from an authorized instructor who gave the review certifying that the person has satisfactorily completed the review.

Flight Instructor Certification

Title 14 *CFR* 61.19(d) states that a flight instructor certificate expires 24 months from the month in which it was issued, renewed, or reinstated. Title 14 *CFR* 61.197 provides the renewal requirements for a flight instructor certificate that has not expired, and section 61.199 provides the requirements that a holder of an expired flight instructor certificate must meet for the certificate to be reinstated.

Guidance to Pilots About Proper Endorsements

The FAA's Safety Program Airmen Notification System (referred to as SPANS) sent a message to users in June 2020, stating that each endorsement in a pilot's logbook "must include the instructor's signature, date of signature, CFI or certificated ground instructor certificate number, and certificate expiration date (if applicable)" to be a "legitimate and legal accounting" of the pilot's qualifications and experience.

Medical and Pathological Information

The Louisiana Forensic Center, Broussard, Louisiana, performed an autopsy on the pilot. His cause of death was blunt force injuries. Toxicology testing performed at the FAA Forensic Sciences Laboratory detected no carboxyhemoglobin, ethanol, or drugs of abuse in the pilot's blood specimens.

Survival Aspects

About 6 weeks after the accident, the NTSB interviewed the surviving passenger, who stated that he had been a passenger aboard the airplane between 8 and 10 times during the preceding few years and that the accident pilot had flown the airplane each of those times. The surviving passenger stated that he was in the aft forward-facing seat on the left side of the airplane during the accident flight. He reported that the takeoff roll and rotation "seemed completely normal" but that the airplane then "pitched up like the pilot was trying to get above or over the clouds." He stated that, during some of the previous flights, the pilot would "stabilize the airplane and then climb aggressively" after takeoff but that, during the accident flight, a "harder than normal pitching movement" occurred. He recalled looking out the window and seeing the ground briefly, even though the airplane felt as if it were climbing.

Tests and Research

Aircraft Performance Calculations

The NTSB reviewed the recorded ADS-B data, which showed the airplane's GPS position, GPS altitude, and pressure altitude, and then made performance calculations based on those data. The calculations included the airplane's true altitude; speed and rate of climb; pitch, roll, and heading angles; lift coefficient; and engine power. The ADS-B data recorded pressure altitudes using the standard-pressure altimeter setting of 29.92 inches of mercury, whereas the pressure altitudes derived from the aircraft performance calculations were corrected for the altimeter setting at the time of the 0953 automated surface observing system observation

(32 minutes after the accident), which was 29.96 inches of mercury. Thus, the calculated altitudes better reflected the airplane's true altitudes.

The performance parameters computed from the ADS-B data showed that, at 0920:05, the airplane turned slightly to the right toward the assigned heading of 240° while climbing through an altitude of 150 ft. The airplane climbed at a rate that varied between 1,000 and 2,400 ft per minute and at an airspeed that increased from about 151 to 165 knots. At 0920:13, the airplane started rolling toward wings level from a bank angle of about 13° to the right and, 7 seconds later, rolled through wings level and toward the left. At this time, the airplane was tracking 232° while at an altitude of 474 ft and an airspeed of 165 knots. The airplane's airspeed remained at 165 knots for about 10 seconds before it started increasing again, and the airplane continued to roll steadily to the left at an average roll rate of about 2° per second.

At 0920:40, while the airplane was at 925 ft (the peak altitude attained), the airplane was tracking 200°, its bank angle was about 35° to the left, and its airspeed was about 169 knots. The airplane then started to descend while the left roll continued. At 0920:51 (the estimated time that surveillance cameras captured the sounds of the accident airplane passing overhead), the airplane's true airspeed was about 193 knots. At 0920:55, the airplane reached its peak airspeed of about 197 knots, which then started decreasing. At 0920:57, the airplane reached a bank angle of 75° to the left while descending through 320 ft at a rate of descent of about 2,500 ft per minute. When the ADS-B data ended about 0920:59, the airplane was descending through an altitude of 230 ft with a calculated flightpath angle of about -7°, an airspeed of 176 knots, and a rate of descent of about 2,300 ft per minute. (The flightpath angle is in the vertical plane—that is, relative to the ground. The ground track is in the horizontal plane—that is, relative to north.)

The flaps-up lift coefficient calculations for the flight indicated that the airplane remained below the maximum flaps-up lift coefficient, which was based on the stall speeds published in the Piper PA-31T airplane flight manual. (The lift coefficient is a nondimensional measure of the aerodynamic lift produced by an airplane or its wing. The maximum lift coefficient is the value of the lift coefficient just before the wing stalls and loses lift.)

The computed horsepower required throughout the flight was calculated based on drag characteristics estimated from the geometry of the airplane as well as engine power and flaps-up rate-of-climb data published in the Piper PA-31T airplane flight manual. During the initial climb, the average horsepower per engine ranged between 300 and 600 horsepower. Just before the decrease in airspeed after 0920:55, the average horsepower per engine was about 500 horsepower. The calculated horsepower values during the final descent (from 0920:56 to the end of the recorded ADS-B data about 3 seconds later) indicated that the power that was being applied during this time was negligible.

Propeller Manufacturer Calculations

Hartzell Propeller made calculations to estimate the horsepower and thrust that each propeller produced about the time of the accident. These calculations were based on the flight and atmospheric conditions at that time and included an estimated airspeed of 193 knots; an estimated propeller speed of 2,000 rpm; and the propeller blade angle, as indicated by impact marks on the left propeller preload plates (which were more distinctive than those on the right propeller). Three of the four left propeller blade preload plates had impact marks consistent with an equivalent blade angle of 30°, so this value was used to determine that each propeller was producing about 250 horsepower and 325 pounds of thrust.

The NTSB compared the estimated horsepower with evidence from the wreckage. The left engine torque gauge needle pointed to a value in the middle of the tick marks indicating 500 and 550 lb-ft, which represented a value of about 525 lb-ft. (No information was obtained from the right engine torque gauge because of damage.) According to the left engine torque value, the propeller would have been producing 200 horsepower at a propeller speed of 2,000 rpm at the time of impact.

Administrative Information

Investigator In Charge (IIC):	Rodi, Jennifer		
Additional Participating Persons:	Todd Gentry; FAA AVP; Washington, DC Paul Marks; FAA FSDO; Baton Rouge, LA Kathryn Whitaker; Piper Aircraft Inc.; Phoenix, AZ Les Doud; Hartzell Propeller; Piqua, OH Beverly Harvey; Transportation Safety Board of Canada Jeffery Davis; Pratt and Whitney Canada Tom Carr; Garmin; Olathe, KS Patricia Leite; Transport Canada		
Original Publish Date:	May 26, 2022	**Investigation Class:**	2
Note:	The NTSB traveled to the scene of this accident.		
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=100739		

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.