National Transportation Safety Board
Aviation Accident Final Report

Location:	Yorba Linda, California	**Accident Number:**	WPR19FA079
Date & Time:	February 3, 2019, 13:45 Local	**Registration:**	N414RS
Aircraft:	Cessna 414	**Aircraft Damage:**	Destroyed
Defining Event:	VFR encounter with IMC	**Injuries:**	5 Fatal, 2 Serious
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The commercial pilot departed for a cross-country, personal flight with no flight plan filed. No evidence was found that the pilot received a preflight weather briefing; therefore, it could not be determined if he checked or received any weather information before or during the accident flight. Visual meteorological conditions existed at the departure airport; however, during the departure climb, the weather transitioned to instrument meteorological conditions (IMC) with precipitation, microburst, and rain showers over the accident area. During the takeoff clearance, the air traffic controller cautioned the pilot about deteriorating weather conditions about 4 miles east of the airport. Radar data showed that, about 5 1/2 minutes after takeoff, the airplane had climbed to about 7,800 ft above ground level before it started a rapid descending right turn and subsequently impacted the ground about 9.6 miles east of the departure airport.

Recorded data from the airplane's Appareo Stratus 2S (portable ADS-B receiver and attitude heading and reference system) revealed that, during the last 15 seconds of the flight, the airplane's attitude changed erratically with the pitch angle fluctuating between 45° nose-down and 75°nose-up, and the bank angle fluctuating between 170° left and 150° right while descending from 5,500 to 500 ft above ground level, indicative of a loss of airplane control shortly after the airplane entered the clouds. Several witnesses located near the accident site reported seeing the airplane exit the clouds at a high descent rate, followed by airplane parts breaking off. One witness reported that he saw the airplane exit the overcast cloud layer with a nose down pitch of about 60°and remain in that attitude for about 4 to 5 seconds "before initiating a high-speed dive recovery," at the bottom of which, the airplane began to roll right as the left horizontal stabilizer separated from the airplane, immediately followed by the remaining empennage. He added that the left wing then appeared to shear off near the left engine, followed by the wing igniting. An outdoor home security camera, located about 0.5 mile north-northwest of the accident location, captured the airplane exiting the clouds trailing black smoke and then igniting.

Examination of the debris field, airplane component damage patterns, and the fracture surfaces of separated parts revealed that both wings and the one-piece horizontal stabilizer and elevators were separated from the empennage in flight due to overstress, which resulted from excessive air loads. Although the airplane was equipped with an autopilot, the erratic variations in heading and altitude during the last 15 seconds of the flight indicated that the pilot was likely hand-flying the airplane; therefore, he likely induced the excessive air loads while attempting to regain airplane control.

Conditions conducive to the development of spatial orientation existed around the time of the in-flight breakup, including restricted visibility and the flight entering IMC. The flight track data was consistent with the known effects of spatial disorientation and a resultant loss of airplane control. Therefore, the pilot likely lost airplane control after inadvertently entering IMC due to spatial disorientation, which resulted in the exceedance of the airplane's design stress limits and subsequent in-flight breakup. Contributing to accident was the pilot's improper decision to conduct the flight under visual flight rules despite encountering IMC and continuing the flight when the conditions deteriorated.

Toxicology testing on specimens from the pilot detected the presence of delta-9-tetrahydrocanninol (THC) in heart blood, which indicated that the pilot had used marijuana at some point before the flight. Although there is no direct relationship between postmortem blood levels and antemortem effects from THC, it does undergo postmortem redistribution. Therefore, the antemortem THC level was likely lower than detected postmortem level due to postmortem redistribution from use of marijuana days previously, and it is unlikely that the pilot's use of marijuana contributed to his poor decision-making the day of the accident. The toxicology testing also detected 67 ng/mL of the sedating antihistamine diphenhydramine. Generally, diphenhydramine is expected to cause sedating effects between 25 to 1,120 ng/mL. However, diphenhydramine undergoes postmortem redistribution, and the postmortem heart blood level may increase by about three times. Therefore, the antemortem level of diphenhydramine was likely at or below the lowest level expected to cause significant effects, and thus it is unlikely that the pilot's use of diphenhydramine contributed to the accident.

Probable Cause and Findings

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

The pilot's failure to maintain airplane control after entering instrument meteorological conditions (IMC) while climbing due to spatial disorientation, which resulted in the exceedance of the airplane's design stress limits and subsequent in-flight break-up. Contributing to accident was the pilot's improper decision to conduct the flight under visual flight rules and to continue the flight when conditions deteriorated.

Findings

Aircraft	Dynamic load - Not attained/maintained
Aircraft	(general) - Capability exceeded
Personnel issues	Spatial disorientation - Pilot
Personnel issues	Aircraft control - Pilot
Personnel issues	Decision making/judgment - Pilot
Environmental issues	Clouds - Effect on personnel

Factual Information

History of Flight

Initial climb	VFR encounter with IMC (Defining event)
Initial climb	Loss of control in flight
Uncontrolled descent	Part(s) separation from AC
Post-impact	Collision with terr/obj (non-CFIT)

On February 3, 2019, at 1345 Pacific standard time, a Cessna 414 airplane, N414RS, was destroyed when it was involved in an accident near Yorba Linda, California. The pilot and four people on the ground sustained fatal injuries, and two people on the ground sustained serious injuries. The airplane was operated as a 14 *Code of Federal Regulations* Part 91 personal flight.

Review of Federal Aviation Administration (FAA) radar and audio communications data revealed that, after departing Fullerton Municipal Airport (FUL), Fullerton, California, about 1339, the pilot initiated a climbing left turn to the east. Visual meteorological conditions (VMC) existed at the departure airport; however, the weather transitioned to instrument meteorological conditions (IMC) with precipitation, microburst, and rain showers over the accident area. During the takeoff clearance, the FUL tower controller cautioned the pilot about deteriorating weather conditions about 4 miles east of FUL. Radar data showed that, about 5 1/2 minutes after takeoff, the airplane was about 7,800 ft above ground level (agl) before it entered a rapid, descending right turn and subsequently impacted the ground. Review of recorded data downloaded from the airplane's Appareo Stratus 2S unit revealed that, at 1344:55, the airplane's altitude was 5,500 ft agl with a right bank angle of about 110° and a pitch angle of about -35° nose down. Between 1345:03 and 1345:10, the pitch angle fluctuated between 45° nose down and 75° nose up, the bank angle fluctuated between 170° left and 150° right, and the airplane had descended to 1,000 ft agl. The last recorded data showed the airplane about 40° nose up with a 30° right bank and about 500 ft agl.

Several witnesses near the accident site reported seeing the airplane exit the clouds at a high descent rate, followed by airplane parts breaking off. One witness reported that he saw the airplane exit the overcast cloud layer with a nose down pitch of about 60°and remain in that attitude for about 4 to 5 seconds "before initiating a high-speed dive recovery," at the bottom of which, the airplane began to roll right as the left horizontal stabilizer separated from the airplane, immediately followed by the remaining empennage. He added that the left wing then appeared to shear off near the left engine, followed by the wing igniting. An outdoor home security camera, located about 0.5 mile north-northwest of the accident location, captured the airplane exiting the clouds trailing black smoke and then igniting.

Pilot Information

Certificate:	Commercial	**Age:**	75,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 Without waivers/limitations	**Last FAA Medical Exam:**	July 7, 2017
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 10235 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N414RS
Model/Series:	414 A	**Aircraft Category:**	Airplane
Year of Manufacture:	1981	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	414A0821
Landing Gear Type:	Tricycle	**Seats:**	
Date/Type of Last Inspection:	April 3, 2019 Annual	**Certified Max Gross Wt.:**	6751 lbs
Time Since Last Inspection:		**Engines:**	2 Reciprocating
Airframe Total Time:	9610.2 Hrs at time of accident	**Engine Manufacturer:**	Continental
ELT:		**Engine Model/Series:**	TSIO-520 SER
Registered Owner:		**Rated Power:**	
Operator:	On file	**Operating Certificate(s) Held:**	None

The airplane was approved for day and night instrument flight rules operations and equipped with deice boots, but it was not certified for flight into known icing conditions. The airplane was equipped with S-Tec System 55x autopilot, which was tested on May 1, 2020, and it was deemed operational.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KFUL,96 ft msl	**Distance from Accident Site:**	10 Nautical Miles
Observation Time:	21:53 Local	**Direction from Accident Site:**	270°
Lowest Cloud Condition:	Scattered / 2200 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Broken / 4100 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	6 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	230°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.87 inches Hg	**Temperature/Dew Point:**	15°C / 11°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Fullerton, CA (FUL)	**Type of Flight Plan Filed:**	None
Destination:	Minden, NV (MEV)	**Type of Clearance:**	None
Departure Time:	13:39 Local	**Type of Airspace:**	

The 1400 High Resolution Rapid Refresh model data depicted a lifted condensation level at 627 ft agl, a free convection level at 632 ft agl and a convective condensation level at 1,608 ft agl. The sounding showed a greater than 90% relative humidity from the surface through 8,000 ft mean sea level. The sounding indicated an unstable to conditionally unstable environment from the surface through 6,500 ft agl with a stable layer above 6,500 through 14,000 ft agl. The sounding also showed the possibility of clouds from 1,100 to about 8,600 ft agl.

The 1330 and 1345 Geostationary Operational Environmental Satellite-17 visible imagery showed broken-to-overcast cloud cover above the accident site at the accident time with the cloud cover moving from southwest to northeast. The visible satellite imagery showed several bands of cumuliform clouds moving across the region and over the accident site during the 15-minute period.

At 1245, an AIRMET advisories Tango and Sierra, which were valid for the area including the accident site, warned of moderate turbulence below 12,000 ft and mountain obscuration conditions due to clouds, precipitation, and mist.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	Both in-flight and on-ground
Ground Injuries:	4 Fatal, 2 Serious	**Aircraft Explosion:**	In-flight
Total Injuries:	5 Fatal, 2 Serious	**Latitude, Longitude:**	33.871944,-117.78666

Examination of the accident site revealed that the wreckage debris was scattered throughout a neighborhood and that the wreckage area was about 1,000 ft long and 800 ft wide on a south-to-north orientation. Sections of the tail were found at the far south end of the debris field. The far north area contained the left engine, left propeller, and the fuselage. About 700 ft northeast from the first recovered piece of debris, the right engine and the right propeller impacted an asphalt road and came to rest in a nearby front yard. The left wing was found about 716 ft north of the first recovered piece of debris, about 140 ft southwest of a burned house. Fragments of the outboard right wing (which also contained a fuel tank) were found in the house. The fuselage with the attached right inboard wing, and the left propeller and left engine were found about 310 ft downhill from the house on a heading of 310°.

The left and right outboard wings had separated near the outboard edge of the nacelles. The right outboard wing was almost entirely consumed by fire, and the left outboard wing exhibited moderate fire damage. The left wing forward spar upper cap was deformed down and aft, and the lower cap was deformed downward at the fracture location. The left inboard wing rear spar upper and lower caps were deformed downward at the fracture location. The right wing inboard forward spar upper cap was deformed down and aft, and the forward spar lower cap was deformed downward at the fracture location. The right inboard wing rear spar upper and lower caps were deformed downward at the fracture location. The left- and right-wing spar fractures all had a dull, grainy appearance consistent with overstress separation.

The one-piece horizontal stabilizer and elevators was separated from the empennage; its left half was deformed downward about 80° forward of the rear spar, and its right half was separated and found mostly intact, including the leading edge, upper and lower skins, and portions of the rear spar. The forward spar was fractured, its center section was separated, and the forward attachment bolts had pulled through the spar web. The forward spar attachment bolts remained installed in the empennage bulkhead. The forward spar upper and lower caps in the center section were separated from the web. The center section lower spar cap exhibited a distinct downward curvature from end to end. The forward spar's separated center section left and right sections of the forward spar, and the mating forward spar fractures were deformed, consistent with the downward failure of the right and left horizontal stabilizer. The left and right elevator counterweights had separated and were not found in the wreckage. A portion of the left elevator remained attached to the horizontal stabilizer and was deformed aft consistent with the damage to the left horizontal stabilizer. A portion of the right elevator and the trim tab

remained attached to the horizontal stabilizer. The elevator torque tube bell crank arm rivets were fractured from the actuator rod.

The right side of the fuselage below the horizontal stabilizer shelf was crushed downward. Paint and rubber transfer marks were found on the fuselage skin below the right side of the stabilizer shelf that matched the transfer marks on the lower surface of the left horizontal stabilizer inboard skin. The left side of the fuselage below the horizontal stabilizer shelf was deformed slightly downward. There was no evidence of repeated contact on the elevator stops in the empennage.

The vertical stabilizer and rudder were separated from the empennage in multiple pieces, and the lower end remained attached to the aft fuselage. The lower portions of the vertical stabilizer forward and rear spars were deformed aft.

The primary flight control cables were traced from the cockpit to their respective flight control surfaces. All cables were broken at different locations consistent with the breaks in the structure. All the cable ends had a splayed, broom-strawed appearance consistent with overload.

The right engine was separated from the wing, and all associated systems except for the fuel manifold valve housing were separated from the engine. The crankcase and crankshaft were fractured in the same area (at the oil transfer collar). All fracture surfaces were consistent with overload. The right magneto was manually rotated, and the impulse coupling made an audible snap. A spark was obtained from the distributor towers during manual rotation of the shaft. The left magneto was fragmented with only the drive shaft and magnet observed. All five of the six remaining sparkplugs exhibited normal combustion deposits and wear. The No. 6 cylinder head was fractured in numerous locations, and its sparkplugs were missing. The engine-driven fuel pump was separated from the engine, and the drive coupling was missing. The pump drive shaft was manually rotated with no binding noted. The throttle body unit and oil pump were disassembled, and no evidence of any anomalies before the in-flight breakup were noted.

The left engine was separated from the wing, and the propeller, left magneto, alternator, vacuum pump, starter motor, and throttle body were separated from the engine. A hole was found in the crankcase over the No. 5 connecting rod area, and it appeared that the case was punctured through from the outside to the inside. Wood debris was observed near the puncture. The crankshaft was fractured at the nose seal, and the fracture surface was consistent with overload. The right magneto was manually rotated, and it produced sparks on all leads. The left magneto was not found at the accident site. All sparkplugs exhibited normal combustion deposits and wear. The engine-driven fuel pump drive coupling was manually rotated, and the pump shaft rotated freely with no binding noted. The throttle body unit and the oil pump were disassembled, and no preaccident anomalies were noted. The oil filter was clean, and no metallic debris was noted. Both the right and left turbochargers were examined, and they exhibited characteristics of normal operation with no evidence of distress before the in-flight breakup.

Examination of the engines and the airframe revealed no evidence of any mechanical malfunctions or failures that would have precluded normal operation.

Additional Information

Spatial Disorientation

The FAA's Civil Aeromedical Institute's publication, "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 instrument meteorological conditions (IMC), frequent transfer between VMC and IMC, and unperceived changes in aircraft attitude.

The FAA's Airplane Flying Handbook (FAA-H-8083-3B) described some hazards associated with flying when the ground or horizon are obscured. The handbook stated, in part, the following:

The vestibular sense (motion sensing by the inner ear) in particular tends to confuse the pilot. Because of inertia, the sensory areas of the inner ear cannot detect slight changes in the attitude of the airplane, nor can they accurately sense attitude changes that occur at a uniform rate over a period of time. On the other hand, 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.

Medical and Pathological Information

The FAA's Forensic Sciences Laboratory conducted toxicology tests on specimens from the pilot, which detected sildenafil, sotalol, telmisartan, and amlodipine in heart blood and urine. Acetaminophen was found in urine. Sildenafil, sotalol, telmisartan, amlodipine and acetaminophen are generally not considered impairing.

In addition, 0.88 ng/mL of delta-9-tetrahydrocanninol (THC), the primary psychoactive component of marijuana, and 2.9 ng/mL of its inactive metabolite, carboxy-delta-9-THC (THC-COOH), were detected in heart blood, and 135.7 ng/mL of THC-COOH, and 13.1 ng/mL of the active metabolite of THC, 11-hydroxy-delta-9-THC (THC-OH), were found in urine. Sixty-seven ng/mL of the diphenhydramine, which is a sedating antihistamine used to treat allergy symptoms and as a sleep aid, was identified in heart blood and urine.

THC has mood-altering effects including euphoria, relaxed inhibitions, disorientation, image distortion, and psychosis. Significant performance impairments are usually observed for at least 1 to 2 hours following marijuana use, and residual effects have been reported up to 24 hours. However, THC and its metabolites are fat soluble and undergo postmortem redistribution, which may significantly increase both central and peripheral levels compared with antemortem findings.

Diphenhydramine carries the following Federal Drug Administration warning:

> *May impair mental and/or physical ability required for the performance of potentially hazardous tasks (e.g., driving, operating heavy machinery). Compared to other antihistamines, diphenhydramine causes marked sedation; it is also classed as a [central nervous system] depressant and this is the rationale for its use as a sleep aid. Altered mood and impaired cognitive and psychomotor performance may also be observed.*

However, diphenhydramine undergoes postmortem redistribution. and it can move back into pooled blood from storage sites. Postmortem central blood levels may increase by about three times.

Administrative Information

Investigator In Charge (IIC):	Smith, Maja
Additional Participating Persons:	Benjamin Harris; Long Beach Flight Standards District Office; Long Beach, CA Nicole Charnon; Continental Motors; Mobile Ricardo Asensio; Textron Les Doud; Hartzell Propeller
Original Publish Date:	May 27, 2021 **Investigation Class:** 3
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=98938

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