Aviation Investigation Final Report

Location:	Sausalito, California	**Accident Number:**	WPR22FA172
Date & Time:	May 6, 2022, 12:10 Local	**Registration:**	N54MG
Aircraft:	Vans RV10	**Aircraft Damage:**	Substantial
Defining Event:	VFR encounter with IMC	**Injuries:**	2 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The non-instrument-rated private pilot and passenger departed their home airport with the intention of flying to an airport on the coast. About 20 minutes before the accident, the pilot contacted air traffic control and requested to perform sightseeing in the San Francisco Bay area before proceeding southwest toward the destination airport. The pilot was instructed to remain clear of the Class B airspace that overlaid the area at an altitude of 3,000 ft mean sea level (msl). About six minutes before the accident, the pilot requested to transition toward his destination. The controller acknowledged and instructed the pilot to remain outside of Class B airspace. About one minute later, the pilot again stated his intent to proceed to the destination, and the controller again acknowledged and instructed the pilot to remain clear of the Class B. The airplane then made a series of turns, climbs, and descents from an altitude of 2,100 ft msl and below over a period of several minutes before it impacted the ground in a nose-down attitude.

Postaccident examination of the airframe and engine did not reveal any preimpact mechanical anomalies that would have precluded normal operation.

There was no record of the pilot obtaining a weather briefing before departing on the flight. According to witnesses, surveillance video, and weather reports, the airplane flew from an area of visual meteorological conditions into instrument meteorological conditions (IMC) as it neared the accident location. These conditions were forecast and would have been apparent to the pilot as he proceeded toward the area of the accident site. Modeling of the conditions in the area of the accident site indicated that the low-lying clouds and fog began about 200 ft above ground level and likely extended up to an altitude about 2,800 ft above ground level.

The pilot had received instrument flight training, but did not hold an instrument rating at the time of the accident. Logbook entries suggested that the pilot had previously operated under instrument flight rules in IMC without an instructor onboard the airplane.

Autopsy of the pilot revealed a dilated, enlarged heart; however, it is unlikely that the pilot's heart disease contributed to the accident. Although toxicology testing indicated that the pilot had used the cannabis products delta-9 THC and cannabidiol, no detectable psychoactive cannabinoids remained in the pilot's postmortem blood, and it is therefore unlikely that effects of his cannabis use contributed to the accident.

The reduced visibility conditions present at the time of the accident in the accident area and the pilot's lack of instrument flight experience presented circumstances conducive to the development of spatial disorientation. The flight track data, which depicted the airplane's erratic flight path before collision with terrain, was consistent with the effects of spatial disorientation. Based on the available information, it is likely that the pilot's decision to proceed into an area of instrument meteorological conditions resulted in his spatial disorientation and a subsequent loss of airplane control.

Probable Cause and Findings

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

The pilot's improper decision to continue a visual flight rules flight into an area of limited visibility conditions, which resulted in spatial disorientation and a loss of airplane control.

Findings

Personnel issues	Decision making/judgment - Pilot
Personnel issues	Spatial disorientation - Pilot

Factual Information

History of Flight

Enroute-cruise	VFR encounter with IMC (Defining event)
Enroute-cruise	Loss of control in flight

On May 6, 2022, about 1210 Pacific daylight time, an experimental, amateur-built Vans RV-10, N54MG, was substantially damaged when it was involved in an accident near Sausalito, California. The pilot and passenger were fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

Flight track data was captured by both automatic dependent surveillance - broadcast (ADS-B) data and information downloaded from onboard avionics. Both sources were consistent for most of the flight, while the ADS-B coverage became intermittent after about 1205:10. The track data showed that the airplane departed Sacramento Executive Airport (SAC), Sacramento, California, about 1129 and transitioned into a climb on a southwesterly heading. The airplane leveled off about 5,500 ft mean sea level (msl) about 6 minutes later. The airplane turned south about 12 minutes later and subsequently entered a descent as it flew along San Pablo Bay towards San Francisco Bay. At 1151, the pilot contacted air traffic control and reported that he was descending from 4,500 ft to 2,500 ft, and advised he would be conducting the “Bay Tour” on his way to Half Moon Bay Airport (HAF). The controller acknowledged and instructed the pilot to remain north and west of the Bay Bridge, outside of the San Francisco Class B airspace (which overlaid the area starting at an altitude of 3,000 ft msl), and to advise when he had obtained the weather information at HAF. The pilot acknowledged.

At 1158, the airplane started a 360° right turn around Alcatraz Island and then resumed a southerly heading for about 1 minute before making a left turn to the north, over Treasure Island. At 1202, the airplane turned southwest after it climbed to about 2,400 ft msl and then began a descent. Two minutes later, the pilot advised the controller he would like to proceed to HAF. The controller acknowledged and instructed the pilot to remain outside of the Class B airspace. At 1205, the pilot advised, “I was gonna go to Half Moon Bay please.” The controller again acknowledged, and instructed the pilot to remain outside of the Class B. The pilot acknowledged and there were no further recorded transmissions.

Over the next five minutes, the airplane made a series of turns at various altitudes below 2,100 ft msl near the north end of the Golden Gate Bridge. In the final 40 seconds of flight, at 1209:07, the airplane began a descent while on a westerly heading from 1,332 ft msl. At 1209:28, the airplane began a right turn to a northerly heading as it continued its descent from 980 ft msl. The track ended at 1209:47, about 300 ft south of the accident site at an altitude

about 821 ft msl. In the final 10 seconds of flight, the airspeed decreased from 79 knots (kts) to 63 kts. Figure 1 depicts the airplane's flight track during the minutes before the accident.

Two witnesses were located about 0.6 nautical miles (nm) east of the accident site around the time of the accident. They both reported that visibility was low and the fog layer was thick; one witness stated that she could not see the top of the north tower of the Golden Gate Bridge. According to the Golden Gate Bridge Highway and Transportation District, the Golden Gate Bridge towers extend 746 ft above the water. The north tower of the Golden Gate Bridge was located about 0.8 nm southeast of the accident site.

Figure 1: Airplane's route of flight

The wreckage was discovered by United States Park Rangers at 1403 on the southwest side of a hill in the Marin Headlands at an elevation of about 800 ft msl.

Pilot Information

Certificate:	Private	**Age:**	57,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	BasicMed None	**Last FAA Medical Exam:**	June 30, 2020
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	November 1, 2020
Flight Time:	321.5 hours (Total, all aircraft), 171 hours (Total, this make and model), 188 hours (Pilot In Command, all aircraft)		

The pilot used a web-based service to maintain a record of his flight activities, which contained entries from March 16, 2016, to May 12, 2022. According to the record, the pilot flew from Sacramento, California, to HAF on five occasions before the accident. Four of these flights took place in 2021 and one flight took place three months before the accident. Listed in the "Additional Comments and Remarks" column of the first recorded flight to HAF, which occurred on January 23, 2021, included the following: "VFR flight to Half Moon Bay. Bay area traffic control. Requested and granted City Tour. Denied entry to Bravo. Flew under Bravo. Next time ask for bay transition. Communications and post flight."

According to the pilot's logbook, he began training for an instrument rating about one month after he received his private pilot certificate in November 2020. The pilot did not possess an instrument rating at the time of the accident. The pilot's instructor remarked that they flew together for about 40 hours to prepare for the pilot's instrument practical test and noted that the pilot was proficient in conducting instrument approaches in the accident airplane. According to the instructor, about one year before the accident, while flying with another student he heard the accident pilot on the radio obtaining an instrument clearance while he was flying without his regular instructor, which concerned him. Entries made on May 17, 2021, and May 19, 2021, indicated that the pilot obtained an instrument clearance without a flight instructor onboard the airplane. The entry on May 17, 2021, stated "fly IFR was in IMC for about 30 min no issue." The pilot's flight instructor further recalled that the pilot was a "little pushy" in the cockpit and was accustomed to being "his own boss."

Aircraft and Owner/Operator Information

Aircraft Make:	Vans	**Registration:**	N54MG
Model/Series:	RV10	**Aircraft Category:**	Airplane
Year of Manufacture:	2017	**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	41688
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:		**Certified Max Gross Wt.:**	
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:		**Engine Manufacturer:**	LYCOMING
ELT:	C126 installed, activated, did not aid in locating accident	**Engine Model/Series:**	YIO-540-D4A5
Registered Owner:	On file	**Rated Power:**	260 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KSFO,18 ft msl	**Distance from Accident Site:**	14 Nautical Miles
Observation Time:	11:56 Local	**Direction from Accident Site:**	155°
Lowest Cloud Condition:	Few / 900 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Broken / 2500 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	60°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.08 inches Hg	**Temperature/Dew Point:**	19°C / 13°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Sacramento, CA (SAC)	**Type of Flight Plan Filed:**	
Destination:	Half Moon Bay, CA (HAF)	**Type of Clearance:**	VFR flight following
Departure Time:	11:29 Local	**Type of Airspace:**	Class E

An NTSB meteorological study was completed with supplemental photographs from the accident flight and surveillance footage from the Golden Gate Bridge to assess the environmental conditions at the time of the accident.

Accident Site Conditions

A model sounding was completed using data provided by the National Oceanic and Atmospheric Administration. The modeling showed multiple layers of clouds over the accident site area from 200 ft above ground level (agl) with tops near 2,800 ft agl and higher broken clouds at 7,000 ft and 20,000 ft agl. Conditions indicated a high potential for the formation of radiation fog and light low level wind shear at 407 ft msl.

A cross section was created using model data and data from selected locations along the airplane's route of flight to estimate the cloud clover during various segments of the accident flight.

Cloud Cover

A report of infrared satellite imagery for 1211 captured low stratiform clouds and/or fog with higher stratiform clouds above the accident site. The low stratiform clouds were noted from about 13 nm south of the accident site off the coast and north. (see Figure 2.)

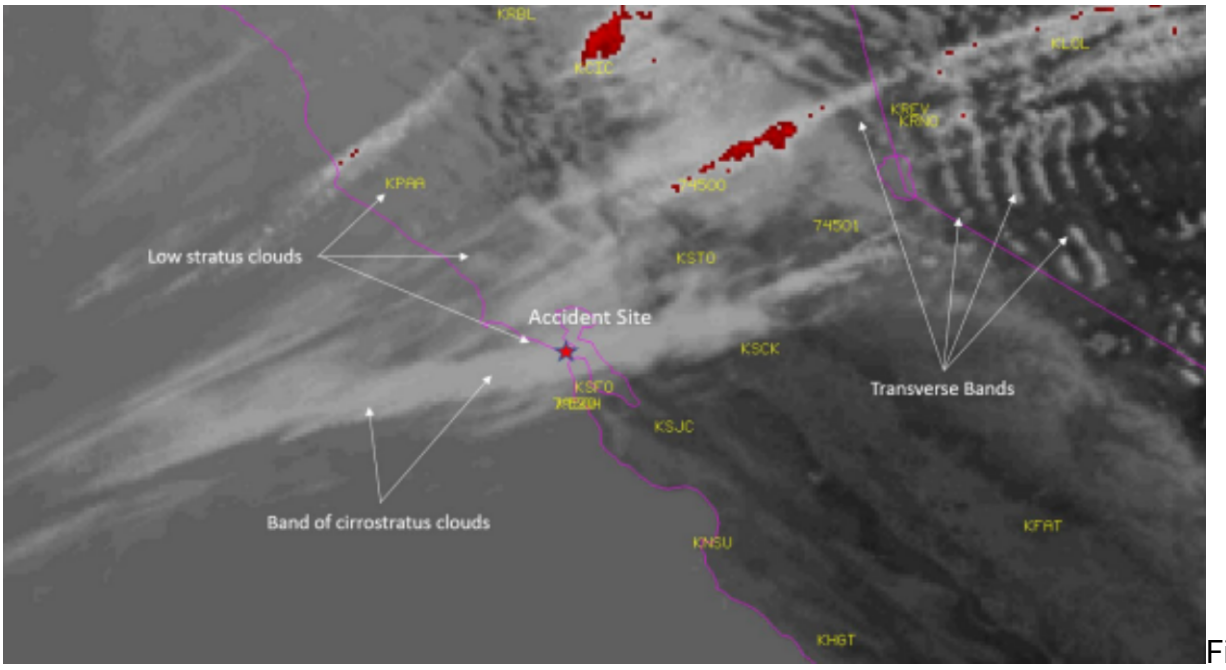

Figure 2: GOES-17 infrared image of cloud cover along route of flight at 1211

Weather Forecasts

According to a National Weather Service Public Zone forecast for the coastal North Bay, issued at 1101, "*REST OF TODAY…Mostly cloudy. Areas of fog. A chance of showers late in the morning. A slight chance of showers in the afternoon.*"

For the San Francisco Peninsula Coast, the forecasted conditions were "*Mostly cloudy. Widespread dense fog in the afternoon.*"

A Graphical Forecast for Aviation (GFA) issued at 0901 and valid at 1100 depicted visibility less than 1 statute mile over the Pacific Ocean. The chart also depicted an AIRMET for IFR conditions over northwestern California and off the California coastal sections immediately bordering the accident site. A GFA cloud forecast issued at 0902 valid at 1100 showed broken to overcast clouds with bases near 300 ft and tops 4,000 ft msl with higher cirrus clouds above the accident site and clear conditions further inland. AIRMET Sierra for mountain obscuration extended over the accident site and over northern California.

There were no SIGMETs, Convective SIGMETs, or Center Weather Advisories issued for the time of the accident flight over the San Francisco area or the accident pilot's route of flight.

Pilot Weather Research

A review of records from Leidos Flight Service and Foreflight did not reveal any evidence that the pilot obtained weather information from either source. Although the pilot possessed an account with Foreflight, he had not viewed any weather imagery within the application prior to the accident flight. He had reviewed the terminal procedures for his originating and destination airports, which would have included METARs, TAFs, and NOTAMs for those stations. It could not be determined if the pilot used another source to obtain current inflight weather advisories, GFAs or any other weather products.

Golden Gate Bridge Stillshots

A still photograph from a camera located on the bridge's north tower facing north showed dense fog that covered the coastline and northern end of the bridge. Another image was captured by a camera located 1.7 nm southeast of the accident near the south abutment overlook at the Golden Gate Bridge Vista Point South, which faced northwest. The image depicted fog advection with an estimated visibility between ¼ to ½ sm, as the south tower of the Golden Gate Bridge and suspension cables were not clearly identifiable in the image.

Photographs Taken During Flight

The passenger took several photographs during the accident flight that were provided by a family member. An image, taken about 10 to 15 minutes before the accident, showed a low band of stratiform clouds off the right side of the airplane near the Golden Gate Bridge and the accident site.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Fatal	**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	37.834268,-122.49105(est)

The airplane came to rest in a nose-down attitude on an easterly heading. All major structural components of the airplane were accounted for at the accident site. The first point of impact was marked by a depression about 15 ft southwest of the main wreckage. A debris path comprised of engine cowling and plexiglass fragments extended to the main wreckage.

Elevator and rudder flight control continuity was traced from the cockpit to the respective flight control surfaces and from the cockpit to both the right and left ailerons.

Mechanical continuity was established throughout the rotating group, valvetrain, and accessory section as the crankshaft was manually rotated at the propeller by hand. Thumb compression was achieved at all six cylinders and the valves displayed normal lift when the crankshaft was rotated. Examination of the cylinders' combustion chamber interior components using a lighted borescope revealed normal piston face and valve signatures and no indications of catastrophic engine failure. The valves were intact and did not display any eyebrow marks on the piston tops.

The two-bladed, constant-speed propeller remained attached at the crankshaft flange. Both blades remained attached to the hub. The fiberglass spinner was fractured. One blade exhibited chordwise striations, leading edge gouges and nicks, trailing edge S bending, and torsional twisting. The propeller governor was attached at its mounting pad and the pitch control rod remained attached at the control arm.

Medical and Pathological Information

Toxicology testing performed on a sample of the pilot's blood by the Federal Aviation Administration Forensic Sciences Laboratory detected the cannabis metabolite 11-hydroxy-

delta-9-THC at 13 ng/mL in the urine, but not in his aortic blood. Additionally, the cannabis metabolite carboxy-delta-9 THC was detected at 3.8 ng/mL in the aortic blood and at 18.1 ng/mL in his urine. Cannabidiol (CBD) and its metabolite 7-carboxy-CBD were detected in both the pilot's aortic blood and urine at unspecified quantities. The CBD metabolite 7-hydroxy-CBD was also detected in the pilot's urine, with inconclusive results in his aortic blood. Rosuvastatin and famotidine were detected in his aortic blood and urine.

11-hydroxy-delta-9-THC is a psychoactive metabolite of delta-9-THC, which is the primary psychoactive chemical in marijuana and hashish, derived from the cannabis plant. Carboxy-delta-9-THC is a non-psychoactive metabolite of 11-hydroxy-delta-9-THC.

Delta-9-THC, which was not detected in this case, is the chemical commonly referred to as THC. The psychoactive effects of THC vary depending on the user, dose, and route of administration, and may impair motor coordination, reaction time, decision making, problem solving, and vigilance. THC is considered unsuitable for pilots by the FAA regardless of state laws.

Rosuvastatin is a prescription cholesterol medication and famotidine is an over-the-counter stomach suppression medication. Neither medication is considered impairing.

The autopsy report described the pilot's heart as hypertrophic and markedly dilated.

Additional Information

The airplane was not required to hold an airplane flight manual; however, some tested stall speeds were provided by the kit manufacturer. According to the "*Summary of Performance Specifications*" section, the airplane's stall speed at gross weight without flaps was 64 KIAS.

Spatial Disorientation

According to the Federal Aviation Administration *Pilot's Handbook of Aeronautical Knowledge* (FAA-8083-H-25C),

Spatial disorientation specifically refers to the lack of orientation with regard to the position, attitude, or movement of the airplane in space. The body uses three integrated systems that work together to ascertain orientation and movement in space.

• Vestibular system—organs found in the inner ear that sense position by the way we are balanced

• Somatosensory system—nerves in the skin, muscles, and joints that, along with hearing, sense position based on gravity, feeling, and sound

• Visual system—eyes, which sense position based on what is seen

All this information comes together in the brain and, most of the time, the three streams of information agree, giving a clear idea of where and how the body is moving. Flying can sometimes cause these systems to supply conflicting information to the brain, which can lead to disorientation. During flight in visual meteorological conditions (VMC), the eyes are the major orientation source and usually prevail over false sensations from other sensory systems. When these visual cues are removed, as they are in instrument meteorological conditions (IMC), false sensations can cause a pilot to quickly become disoriented.

Administrative Information

Investigator In Charge (IIC):	Stein, Stephen
Additional Participating Persons:	Mark Platt; Lycoming Engines; Williamsport, PA Justin Louw; Federal Aviation Administration; Oakland, CA
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Investigation Class:	Class 3
Note:	
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