Aviation Investigation Final Report

Location:	AGUA DULCE, California	**Accident Number:**	WPR18FA088
Date & Time:	February 11, 2018, 10:59 Local	**Registration:**	N52TH
Aircraft:	HASTINGS THOMAS G CIRRUS VK 30	**Aircraft Damage:**	Substantial
Defining Event:	Powerplant sys/comp malf/fail	**Injuries:**	4 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The private pilot, who was the builder of the experimental amateur-built airplane, and three passengers departed on a cross-country flight. A witness about 2 miles from the accident site saw the airplane in cruise flight about 2,000 to 3,000 ft above the ground when the right wing rose, and he heard what he perceived as the engine advancing to full power as the airplane entered a vertical descent that continued to ground contact. The wreckage was mostly contained within an area about 100 ft in diameter except for the left horizontal stabilizer fairing, which was found about 2,500 ft west of the main wreckage.

The airplane's engine was mounted mid-fuselage and drove an aft-mounted, "pusher" configuration, constant-speed propeller. A torque tube (driveshaft) equipped with forward and aft elastomeric couplings was used to transfer power from the propeller flange located on the front of the engine crankshaft to the propeller. The driveshaft was found fractured about 2 ft forward of the propeller. A metallurgical examination revealed that the driveshaft fractured due to overstress loads in torsion and rotational bending. Deformation of the forward side of the fracture was consistent with continued rotation in the clockwise direction relative to the aft portion of the shaft, indicating that the shaft was being powered by the engine at the time of the fracture.

Further examination of the driveshaft revealed that one of eight nuts from the forward coupling and one of two nuts from the aft coupling were backed off (4 mm and 2.11 mm, respectively) of their respective bolts. It is likely that the bolts were under torqued and, at some point, the driveshaft developed a vibration which caused the nuts to back off, which lead to the catastrophic in-flight separation of the driveshaft. Review of the airplane's maintenance records revealed that, about 8 years and 300 flight hours before the accident, the entry indicated that an unspecified coupling was replaced, and the engine drive system was balanced. The entry did not detail the work accomplished. A further review of the records revealed that, 5.1 flight hours before the accident flight, the bolts on the flywheel and couplings were retorqued. The entry did not detail the work accomplished nor indicate the torque values, but it is likely that the nuts were not properly torqued at that time, allowing them to back off during flight.

Following the driveshaft failure, the engine likely began to overspeed, consistent with the increased engine sound reported by the witness. In addition, the forward portion of the driveshaft likely contacted the bottom of the horizontal stabilizer, and the horizontal fairing subsequently separated in flight, resulting in an inflight upset and loss of control.

The three-bladed propeller was found with two of the three blades broken, indicating that at the time of impact, there was no power to the propeller. The propeller spinner remained attached to the propeller and displayed little damage. The left elevator was found about 80 ft from the empennage and red paint transfer marks were found on the trailing edge of the elevator, consistent with propeller tip contact. Thus, it is likely that the propeller blade struck the elevator during the rapid descent, separating both from the airplane.

Although the level of diphenhydramine detected in specimens from the pilot's cavity blood (even accounting for post-mortem redistribution) may have been in a range where it may have resulted in psychoactive effects, there is no direct evidence of impaired judgment or decision-making and no evidence of psychomotor slowing. Therefore, it is unlikely that the pilot's use of diphenhydramine contributed to this accident. In addition, the pilot had moderate coronary artery disease without evidence of ever having an acute cardiac event. Given the circumstances of the accident, the pilot's heart disease was not a contributing factor.

Probable Cause and Findings

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

The driveshaft fracture due to overstress loading and rotational bending as a result of the under-torqued nuts on the elastomeric couplings backing off and the subsequent in-flight separation of the horizontal fairing due to contact with the separated end of the driveshaft, which led to a loss of control. Contributing to the accident was inadequate maintenance.

Findings

Aircraft	Engine/transmission coupling - Failure
Aircraft	Engine/transmission coupling - Incorrect service/maintenance
Personnel issues	Scheduled/routine maintenance - Maintenance personnel

Factual Information

History of Flight

Prior to flight	Aircraft maintenance event
Enroute-cruise	Powerplant sys/comp malf/fail (Defining event)
Enroute-cruise	Inflight upset
Enroute-cruise	Part(s) separation from AC
Enroute-cruise	Loss of control in flight
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On February 11, 2018, about 1059 Pacific standard time, an experimental, amateur-built Cirrus VK-30, N52TH, impacted terrain near Agua Dulce, California. The private pilot and three passengers were fatally injured, and the airplane was substantially damaged. The airplane was registered to the pilot who was operating it as a Title 14 *Code of Federal Regulations* Part 91 personal flight. Visual meteorological conditions existed near the accident site about the time of the accident, and no flight plan was filed for the flight, which originated from Henderson Executive Airport (HND), Las Vegas, Nevada, about 1000.

The pilot's wife reported that she had dropped her husband and three passengers off at HND; they had planned to fly to Van Nuys Airport (VNY), Van Nuys, California. She added that this was a trip that her husband had flown multiple times.

A witness hiking in a park about 2 miles north of the accident site reported that he saw the airplane about 2,000 to 3,000 ft above the ground. He added that, as the airplane approached the mountains, it looked like the wind had "pushed the right wing up." He then heard the engine sound increase, like the pilot "throttled forward" as the airplane entered a vertical descent.

According to the Las Vegas terminal radar approach control facility, about 0954, the pilot requested and was granted visual flight rules flight following services. The last communication with the accident airplane was at 1027 when the pilot was issued an updated altimeter setting, which he acknowledged.

Pilot Information

Certificate:	Private	**Age:**	65,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:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	August 11, 2017
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	August 28, 2016
Flight Time:	(Estimated) 1240 hours (Total, all aircraft)		

The pilot, who was also the airplane builder, age 65, held a private pilot certificate with a rating for airplane single-engine land. His most recent Federal Aviation Administration (FAA) third-class medical certificate was issued on August 11, 2017; on the application for that certificate, he reported 1,240 total hours of flight experience and 15 hours in the previous six months. The pilot's flight logbook was not located.

Aircraft and Owner/Operator Information

Aircraft Make:	HASTINGS THOMAS G	**Registration:**	N52TH
Model/Series:	CIRRUS VK 30 NO SERIES	**Aircraft Category:**	Airplane
Year of Manufacture:	1999	**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	143
Landing Gear Type:	Retractable - Tricycle	**Seats:**	5
Date/Type of Last Inspection:	January 1, 2018 Condition	**Certified Max Gross Wt.:**	3600 lbs
Time Since Last Inspection:	5 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	1037.7 Hrs at time of accident	**Engine Manufacturer:**	Continental
ELT:	C91A installed, not activated	**Engine Model/Series:**	IO-550-GIB
Registered Owner:	On file	**Rated Power:**	280 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

The airplane (serial number 143), a low-wing, composite monoplane powered by a Continental IO-550-G engine (serial number 679050) rated at 280 horsepower, was built by the pilot/owner. An FAA special airworthiness certificate in the experimental category was issued on July 21, 1999.

The engine was mounted mid-fuselage facing rearward, and the propeller was located at the aft end of the fuselage (commonly referred to as a "pusher" configuration). A torque tube (driveshaft) and forward and aft elastomeric couplings (dampers) were used to transfer power from the propeller flange located on the front of the engine crankshaft to the rear-mounted, constant-speed propeller.

According to maintenance records, the most recent condition inspection was completed on January 1, 2018, at a recorded Hobbs time of 1,032.6 hours. (The Hobbs hour meter indicated 1,037.7 hours at the accident site.) The most recent condition inspection for the engine was started on December 16, 2017, at a recorded Hobbs time of 1,031.6 hours. The entry did not specify if the inspection was completed. The last time that an engine condition inspection was specified as completed in the logbooks was December 9, 2006.

The engine drive system was most recently balanced on April 28, 2009, at a Hobbs time of 701.1 hours, following the replacement of a coupling. Whether the forward or aft coupling was replaced was not specified. A review of the available records did not yield a description of how the system was balanced.

On January 9, 2010, at a Hobbs time of 736.5 hours, during an annual condition inspection, the entry indicated that the coupling was reworked for "concentricity to shaft." No further details of the work were provided.

On December 31, 2017, at a Hobbs time of 1,032.6 hours, during an annual condition inspection, the entry indicated that the flywheel and coupling bolts were retorqued. No further details of the work or torque values were provided.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KWHP,1003 ft msl	**Distance from Accident Site:**	13 Nautical Miles
Observation Time:	18:55 Local	**Direction from Accident Site:**	205°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:		**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.94 inches Hg	**Temperature/Dew Point:**	20°C / -4°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	LAS VEGAS, NV (HND)	**Type of Flight Plan Filed:**	Unknown
Destination:	VAN NUYS, CA (VNY)	**Type of Clearance:**	VFR flight following
Departure Time:	10:00 Local	**Type of Airspace:**	Class G

According to information from Leidos Flight Service, the pilot received a weather briefing about 1 hour before departing on the flight.

The 1055 recorded weather observation at Whiteman Airport (WHP), Los Angeles, California, located about 13 miles south-southeast of the accident site, included calm wind, 10 statute miles visibility, clear sky, temperature 20°C, dew point -4°C, and an altimeter setting of 29.94 inches of mercury.

A weather study conducted by a National Transportation Safety Board meteorological specialist

identified no significant weather around the accident site about the accident time. The complete weather study is in the public docket for this investigation.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	3 Fatal	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	4 Fatal	**Latitude, Longitude:**	34.463333,-118.303611(est)

The airplane impacted terrain between rolling hills and power transmission lines about 2.5 miles southeast of Agua Dulce, California.

Damage to the lowest of the three power lines was noted. The transmission lines were located about 106 ft above the main wreckage. The power company that owned the power transmission lines reported that there were no interruptions in service and no faults recorded about the time of the accident.

All major structural components of the airplane were located at the accident site. The main wreckage comprised the fuselage area from the aft seat rearward, both wings, and most of the empennage.

The majority of the wreckage was contained within an area about 100 ft in diameter, with the exception of the left horizontal stabilizer fairing, which was located about 2,500 ft west of the main wreckage.

The cabin area was fracture-separated from the front seats forward to the nose cone and was located near the main wreckage.

The right wing remained partially attached at the wing root. The wing area outboard of the aileron fracture-separated but remained with the main wreckage. The fuel cap was found in place. The aileron remained attached to the wing. The flap remained attached to the wing and appeared to be in the retracted position.

The left wing remained attached to the fuselage. Wire strike marks were noted on the top of the wing skin. The fuel cap was found in place. The aileron remained attached to the wing and exhibited some impact damage. The flap remained attached to the wing and appeared to be in the retracted position.

The empennage remained mostly attached to the fuselage and exhibited extensive damage. The right horizontal stabilizer remained partially attached but exhibited extensive damage. The right elevator remained attached to the horizontal stabilizer and the inboard 2 ft displayed extensive damage. The left horizontal stabilizer was separated from the empennage and was located about 80 ft from the main wreckage. The left elevator remained attached to the horizontal stabilizer. Red paint transfer marks were noted on the trailing edge of the left elevator about 25 inches inboard of the elevator tip. The vertical stabilizer remained attached to the empennage and displayed little damage. The rudder remained

attached to the vertical stabilizer and was mostly intact.

The engine remained attached to the fuselage and was mostly intact. The propeller remained attached to the aft driveshaft flange. Two of the three wooden propeller blades were broken. The propeller spinner remained attached and displayed little damage; no rotational damage was noted.

All four engine mounts were broken. The engine-driven fuel pump was removed and inspected. Fuel was present in the fuel hoses attached to the engine-driven fuel pump and fuel was released when the pump was removed from the engine; the undamaged drive coupling was manually rotated with no binding noted.

A sample of the fuel captured from the fuel hose tested negative for water contamination.

The top sparkplugs were removed and inspected. When compared to a Champion "Check-A-Plug" chart, the wear appeared to be "normal" with normal coloration, with the exception of the sparkplugs from cylinder Nos. 3 and 5, which were oil contaminated.

All piston crowns and intake/exhaust valves were intact and exhibited normal combustion deposits when examined with a borescope.

The engine was manually rotated with a wrench at the engine driveshaft coupler and thumb compression was achieved on all cylinders. The magneto impulse couplers were heard releasing as the engine was manually rotated. All cylinder rocker covers were removed. All rocker arms and pushrods were intact and moved normally when the engine was manually rotated.

The left and right magnetos were removed and examined. The right magneto produced ignition spark to all six ignition leads. The left magneto produced ignition spark at one ignition lead. The left magneto was disassembled for further examination, which revealed that about 22 teeth were broken off of the plastic timing gear. The damage noted was consistent with a propeller overspeed.

The engine-driven fuel pump was disassembled and examined. The pump impeller blades and the pump chamber appeared normal with no indication of damage.

The rudder and inspection panels were removed. The propeller was manually rotated; however, rotating the damaged propeller did not transfer movement to the driveshaft. Further examination of the driveshaft revealed that the driveshaft had fractured in two about 2 ft forward of the propeller. The driveshaft coupler hardware near the engine propeller flange was removed and the driveshaft was disconnected from the engine crankshaft.

Further examination of the driveshaft revealed that one of the eight bolts that connected the spacer to the forward coupling was backed off about 4 mm. Further examination revealed that one of the two bolts that connected the aft coupling to the tail housing was backed off about 2.11 mm. Rotational scoring on the driveshaft was noted from the separation forward about 20 inches. The aft section of the separation displayed about 2 inches of polished aluminum. The driveshaft assembly was shipped to the NTSB Materials Laboratory for further examination.

The fracture around most of the driveshaft circumference was in a transverse plane with secondary fractures extending longitudinally. On the forward side of the fracture, the shaft wall was bowed inward adjacent to the fracture and slightly outward within about 1/2 inch of the fracture. About 1/3 of the circumference of the shaft wall was folded over on itself and bent forward and outward. Fracture surfaces on the forward and aft sides of the primary fracture in the transverse plane were examined; however, the fracture surfaces on both sides of the fracture were obliterated by smearing and post-fracture contact damage (see Materials Laboratory Factual Report in the public docket for further information).

Medical and Pathological Information

The Los Angeles County Coroner Medical Examiner, Los Angeles, California, conducted an autopsy of the pilot and determined that the cause of death was "multiple traumatic injuries." In addition, moderate coronary artery disease was identified with up to 60% narrowing of the circumflex artery, 40% narrowing of the left anterior descending artery, and 20% narrowing of the right coronary artery; however, there was no evidence of previous ischemia and the remainder of the cardiac exam was unremarkable.

Toxicology testing performed by the FAA Forensic Sciences Laboratory identified 0.107 (µg/ml, µg/g) diphenhydramine in blood (cavity), diphenhydramine in liver, and unspecified amounts of atorvastatin in liver and blood (femoral).

Diphenhydramine is a sedating antihistamine used to treat allergy symptoms and as a sleep aid. It is available over the counter under the names Benadryl and Unisom. Diphenhydramine carries the following Food and Drug Administration (FDA) warning: "may impair mental and/or physical ability required for the performance of potentially hazardous tasks (e.g., driving, operating heavy machinery)." The therapeutic range for diphenhydramine is 0.0250 to 0.1120 µg/ml. Blood concentrations following a single dose of 50 mg diphenhydramine in 10 healthy adults produced an average peak plasma concentration of 66 ng/mL at 2.3 hours. Atorvastatin is a cholesterol-lowering drug that is not considered impairing.

Administrative Information

Investigator In Charge (IIC):	Vanover, Jackie
Additional Participating Persons:	Frank L Motter; FAA; Van Nuys, CA Jerry L Badillo; FAA; Van Nuys, CA Michael H Council; Continental Motors; Mobile, AL
Original Publish Date:	November 6, 2019
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=96726