Aviation Investigation Final Report

Location:	Yellowstone Nat, Wyoming	**Accident Number:**	DEN03FA138
Date & Time:	August 4, 2003, 18:35 Local	**Registration:**	N258Y
Aircraft:	Wright Hughes 1-B	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

Several witnesses at Yellowstone National Park's Midway Geyser basin area reported seeing the airplane approaching them at a "low altitude" from the southeast. The airplane was quiet, and was observed gliding with its wings tipping back and forth. Next, it was observed to corkscrew, or spiral to the ground. The airplane's propeller was a highly modified constant speed Hamilton Standard 12D40 hub. Neither of the two 7 pound counterweights were found at the accident site. Examination of the #2 counterweight bracket revealed a fatigue crack at the proximal end of the counterweight slot. The propeller's shim plates exhibited impact signatures of the two blades indicating an angular difference of 10 degrees. The propeller's cylinder was crushed on one side, locking the piston inside the cylinder; the location of the piston inside the cylinder correlated to a blade angle of 34.9 degrees. If a propeller counterweight had separated in flight, aerodynamic forces would have driven the blade towards fine pitch or low blade angle. The blade's rotation would be limited to the low blade angle, of 24 degrees, by the remaining portion of its counterweight bracket arm which would contact and be stopped by the propeller’s barrel. If one blade was at the low blade angle of 24 degrees, the measured angular difference of 10 degrees, would indicate that the other blade was at an angle of 34 degrees. The agreement between this derived blade angle of 34 degrees and the piston position of 34.9 degrees suggests that one blade was still slaved to its counterweight at the time of impact and one blade was not.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The in-flight loss of a propeller counterweight, followed by the pilot's loss of aircraft control during a forced landing attempt and subsequent inadvertent stall/spin to the ground.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: CRUISE - NORMAL

Findings
1. (C) PROPELLER SYSTEM/ACCESSORIES,COUNTERWEIGHT - SEPARATION

Occurrence #2: FORCED LANDING
Phase of Operation: DESCENT - EMERGENCY

Occurrence #3: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: DESCENT - UNCONTROLLED

Findings
2. (C) AIRCRAFT CONTROL - NOT MAINTAINED - PILOT IN COMMAND
3. (C) STALL/SPIN - INADVERTENT - PILOT IN COMMAND

Occurrence #4: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

Factual Information

HISTORY OF FLIGHT

On August 4, 2003, at approximately 1835 mountain daylight time, a Wright, Hughes 1-B amateur-built airplane, N258Y, was destroyed following an uncontrolled descent to the terrain in Yellowstone National Park, Wyoming. The private pilot, the sole occupant in the airplane, was fatally injured. The flight was being conducted under Title 14 CFR Part 91. Visual meteorological conditions prevailed for the cross-country flight that originated at approximately 1735 from Gillette, Wyoming. The pilot had not filed a flight plan; however, friends of the pilot said the destination was Cottage Grove, Oregon [260 degrees for 758 nautical miles].

The pilot was flying from Oshkosh, Wisconsin, (Experimental Aircraft Association fly-in) back to his home. Witnesses at Gillette, Wyoming, said that he landed there for fuel at approximately 1600. They said that he departed at approximately 1640, but returned and landed because his controllable propeller was stuck in the high RPM position [takeoff position]. Several witnesses said the pilot got on a ladder with some tools and lubricant, and he worked in the vicinity of the propeller for some time. They reported that he departed a second time at approximately 1735.

The pilot's lead mechanic said that the pilot called him following his quick return to Gillette, Wyoming. The pilot reported that he had had some difficultly with the propeller remaining in high RPM (takeoff position) after his first takeoff [this was a recurring problem]. The pilot said that he would lubricate it and adjust it, and if all worked well, would continue his flight.

Several witnesses at Yellowstone National Park's Midway Geyser basin area reported seeing the airplane approaching them at a "low altitude" from the southeast. One witness said she "stopped to watch the plane overhead because we heard the plane's engine sounding 'rough,' The engine seemed to cut out with a little bit of intermittent engine sound. Then it was quiet. The plane seemed to be going very slowly....like as slow as it could go. Then rocking....wings tipped back and forth. It looked like it was doing aerobatics. It started going down and we kept waiting for it to pull out. I remember it went straight down. My husband remembers a large corkscrew." Another witness said "I witnessed a plane at approximately 500 feet in a steep dive. It made about one-half revolution before impacting the ground."

Another witness said "my wife and I heard a loud sputtering noise which sounded like a noisy motor cycle. The noise ended with a few loud pops and then was quiet. About 20? seconds later, I saw a plane heading straight down, flipping around, out of control. As it headed toward the ground, I thought the pilot seemed to regain some control and started to pull out of the dive. Maybe? I heard engine sounds again." Another witness said he "heard the sound of an

aircraft engine stalling. We looked to the east and saw an older single engine plane gliding in a westward direction. The plane appeared to be gliding and losing altitude."

One witness said he heard the airplane overhead and then it "cut out"; he then "heard the engine go again." Another witness said "the plane was about 100 feet in [the] air when I saw it. It was in a vertical downward spiral. Right before it hit I heard the engine over-revving, like the person was trying to pull the plane through so he could save it." Yet another witness said "when I saw the plane first, it was spiraling downward. I watched it and at the very last second, it sounded as if the plane was revving up as if to try and pull out."

PERSONAL INFORMATION

The pilot's most recent Federal Aviation Administration (FAA) flight medical exam (third class) was on June 17, 2002, and at that time he reported on his application that he had 2,500 hours of flight experience. The pilot owned two other aircraft, a Beech Bonanza and a Glasair III. The pilot's flight logbook was never located.

AIRCRAFT INFORMATION

The airplane was a non-pressurized, single engine, propeller-driven, single seat amateur-built replica of Howard Hughes' 1-B racer. It was built in June 2002. Its estimated maximum gross weight was 7,250 pounds. The original Hughes 1-B racer was built in 1935, and is located in the Smithsonian Aviation Museum in Washington D.C. The airplane was powered by a Pratt and Whitney R-1535-11, fourteen cylinder (two banks of seven cylinders), round, reciprocating, air cooled, normally aspirated (carbureted), super-charged (RPM ratio was 8.7 to 1) engine which had a maximum takeoff rating of 750 horsepower at sea level. The last condition inspection was performed in June 2003. The lead mechanic estimated that the airplane had approximately 74 hours of flight at the time of the accident.

The lead mechanic said that the airplane was "very aerodynamically clean" and could glide a long ways. The airplane "would take a long time to slow down." He said that there was no twist in the wing, and the wing was tapered. The resultant design permitted the wing tip and its associated aileron to stall before the wing root. The stall speeds were 80-82 knots with full flaps, and 90-92 knots clean. The airplane would cruise at 280 to 300 knots at 30% power; fuel consumption was 32-35 gallons per hour (gph). Normal takeoff fuel consumption was approximately 75 gph; maximum power fuel consumption was approximately 96 gph.

The propeller was a modified constant speed Hamilton Standard 12D40 hub, which was controlled by a governor using oil pressure and opposing counter weights. The blades were from an Italian T-28, and were highly modified for high speed. The counter weight brackets had been changed from 15 degrees to 20 degrees to allow the propeller to generate more thrust at a lower RPM. The aerodynamic twisting forces of the blade could over power the centrifugal forces of the counter weight if the hub was not consistently lubricated. Consequently, particularly under high density altitude situations, the propeller pitch would

intermittently stick in the fine pitch position. The lead mechanic said that a little lubrication of the shaft, and a small adjustment to the counter weights would take care of the problem. He also reported that although the 20 degree counterweight brackets were installed, they were adjusted to limit the blade travel to 16 degrees.

The airplane was constructed with four rubber bladder-type fuel cells and two metal tanks for a total capacity of 304 gallons of fuel. There were four tanks in the wings; the two outboard fuel tanks (metal) held 14 gallons each and the two inboard fuel tanks held 67 gallons each. The aft main body tank held 102 gallons of fuel and the forward body tank held 40 gallons. The forward body tank was used for takeoff, landing, and emergency situations, because it had the highest head pressure with high angles of attack during takeoff and landing. Additionally, keeping fuel in the forward body tank kept the airplane within center of gravity limitations, i.e., if the forward body tank was used up before any wing tank fuel was used, the airplane's center of gravity would be aft of limits.

The pilot was wearing a parachute at the time of the accident. He had told his lead mechanic and several friends that if "something goes wrong, I'm bailing out." The airplane was equipped with a moving map Global Positioning System.

METEOROLOGICAL INFORMATION

At 1746, the weather conditions at West Yellowstone Airport (elevation 6,644 feet), West Yellowstone, Montana, 320 degrees, 18 nautical miles (nm) from the accident site, were as follows: wind 160 degrees at 8 knots; visibility 20 statute miles; cloud condition 4,000 feet broken; temperature 72 degrees Fahrenheit; dew point 48 degrees Fahrenheit; altimeter setting 30.26. The density altitude at the accident site was calculated to be 9,477 feet.

WRECKAGE AND IMPACT INFORMATION

The airplane was found in Yellowstone National Park's Midway Geyser Basin (N44 degrees, 31', 33.8"; W110 degrees, 49', 54.5"; elevation 7,255 feet). The initial impact was on friable, geyser mineral deposits, on the west side of the Firehole River; the initial impact location was approximately 35 feet above the river. The airplane's engine and right wing (inboard half) came to rest, in the river, near the east bank, approximately 125 feet northeast of the initial impact point. The main fuselage and separated empennage were located approximately 75 feet north of the engine, on the east bank of the river. The right elevator was found approximately 70 feet east of the empennage, on the highway which was paralleling the river. Numerous fragments of metal and wood were found at the impact point, in the river, along the bank of the river, and on the highway. All of the airplane's major components were accounted for at the accident site.

A photograph taken (by a nearby tourist) at the exact moment the airplane impacted the terrain indicated that the airplane was nearly vertical, with the longitudinal axis of the fuselage angled approximately 40 degrees towards the right wing. Three cylinders from the front row

(approximately from 8 o'clock to 5 o'clock, from the pilot's seat) were separated from the engine, and the three adjacent cylinders in the second row were also separated. The impeller blades from the engine's super charger exhibited uniform damage to their leading edges and its housing exhibited distinct impact marks with minimal smearing, which suggests low rotation rate at the time of impact. Both propeller blades had stripped their blade bushings, and one propeller blade was loose in the hub. The second blade was bent aft, and conformed to the engine. The propeller manufacturer's representative said that the "extent and type of damage to the propeller blades suggest a low RPM at the time of impact." Both blades exhibited minimal leading edge damage and minimal chord wise striations. Neither of the two approximate 7 pound propeller blade counterweights (with caps and hardware) were found at the accident site.

The landing gear was found in the up position. The fuel selector was found in the forward body tank position.

MEDICAL AND PATHOLOGICACLAL INFORMATION

An autopsy was performed on the pilot by Yellowstone Pathology Institute, Inc., Billings, Montana, for the Yellowstone National Park, Wyoming, on August 6, 2003. The pathologist reported that no anatomical or physiological conditions in the pilot, which might have contributed to the accident, were identified.

The FAA's Civil Aeromedical Institute (CAMI) in Oklahoma City, Oklahoma, performed toxicology tests on the pilot. According to CAMI's report (#200300242001), tests on the blood and urine did not detect any carbon monoxide, cyanide, nor ethanol. However, sertraline was found in the blood and urine, as well as its metabolite, desmethylsertraline. The NTSB medical officer said sertraline, trade name Zoloft, is a prescription antidepressant medication, which is also used for the treatment of obsessive-compulsive disorder, panic disorder, post-traumatic stress disorder, pre-menstrual dysphoric disorder, and social anxiety disorder.

TESTS AND RESEARCH

Examination of the propeller's hub found that the two counterweight brackets had separated from their counterweight shafts in different manners. The #2 counterweight shaft was in place with its respective washers and bearings. The #1 counterweight shaft was separated inside its hole, on an approximate 45 degree angle, and the hole itself was distorted in an oblong manner. Additionally, symmetrical impact marks were identified on the aft face of the cylinder which matched the separated ends of the counterweight brackets.

Examination of the #2 counterweight bracket revealed a fatigue crack at the proximal end of the counterweight slot which extended over approximately 70% of the inner arm. Approximately 60% of the fatigue crack exhibited oxidation, and was heavily damaged by fracture face recontact [hammering]. The NTSB Investigator-In-Charge asked Hamilton Sundstrand to look at these parts from the airplane's modified Hamilton Standard 12D40

propeller assembly. They examined the identified fatigue crack on the #2 counterweight bracket and the fractured #1 counterweight bracket. Their representative said that the fatigue crack and associated over load failures provided insufficient physical evidence to conclude whether the #2 counterweight bracket failed prior to or at impact. A metallurgist from the NTSB reviewed Hamilton Sundstrand's report and performed an examination of the propeller components. Based on the fractographic evidence, the NTSB metallurgist could not rule out the possibility that the #2 counterweight bracket failed due to the fatigue prior to impact.

The propeller's cylinder was found crushed on one side, locking the piston inside the cylinder. Measurements of the piston's position indicated that the cylinder was extended 1.25 inches. The zero extension position of the cylinder was high blade angle (44 degrees), or cruise position. The full extension position of the cylinder was 2.75 inches, which was the low blade angle (24 degrees), or takeoff position. This indicated that the cylinder was found at 54.5% of full travel, corresponding to a blade angle of 34.9 degrees.

The lead mechanic said that if a propeller counterweight were to separate in flight, aerodynamic forces would drive the blade towards fine pitch or low blade angle. The blade's rotation would be limited to the low blade angle, of 24 degrees, by the remaining portion of its counterweight bracket arm which would contact and be stopped by the propeller's barrel.

Additional impact signatures were identified on the propeller's shim plates. Hamilton Sundstrand examined the shim plates, and determined that there was an angular difference between the two blades, at the time of impact, of approximately 10 degrees. The lead mechanic said that one blade was at the low blade angle of 24 degrees, the measured angular difference of 10 degrees, would indicate that the other blade was at an angle of 34 degrees. The agreement between this derived blade angle of 34 degrees and the piston position of 34.9 degrees suggests that one blade was still slaved to it's counterweight at the time of impact and one blade was not.

The NTSB IIC interviewed a highly experienced agricultural pilot, who was familiar with this type of propeller assembly, and is certificated as an Airframe and Power Plant (A&P) mechanic and has FAA Inspection Authorization (IA), who said, "the loss of a counterweight in flight would cause significant imbalance and subsequent vibration to the aircraft. It is possible that the magnitude of the vibration would be sufficient to create collateral damage to the airplane's structure."

ADDITIONAL INFORMATION

The airplane, including all components and logbooks, was released to the pilot's family on September 8, 2003.

Pilot Information

Certificate:	Private	**Age:**	53,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Front
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	June 17, 2002
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	2500 hours (Total, all aircraft), 4 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Wright	**Registration:**	N258Y
Model/Series:	Hughes 1-B	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	2
Landing Gear Type:	Retractable - Tailwheel	**Seats:**	1
Date/Type of Last Inspection:	June 12, 2003 Condition	**Certified Max Gross Wt.:**	4806 lbs
Time Since Last Inspection:	61 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	74 Hrs at time of accident	**Engine Manufacturer:**	Pratt & Whitney
ELT:	Installed, not activated	**Engine Model/Series:**	R-1535-11
Registered Owner:	James L. Wright	**Rated Power:**	750 Horsepower
Operator:		**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	WYS,6644 ft msl	**Distance from Accident Site:**	18 Nautical Miles
Observation Time:	17:46 Local	**Direction from Accident Site:**	320°
Lowest Cloud Condition:	4000 ft AGL	**Visibility**	20 miles
Lowest Ceiling:	Broken / 4000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	8 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	160°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.26 inches Hg	**Temperature/Dew Point:**	22°C / 9°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Gillette, WY (GCC)	**Type of Flight Plan Filed:**	None
Destination:	Eugene, OR (EUG)	**Type of Clearance:**	Unknown
Departure Time:	17:30 Local	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	On-ground
Total Injuries:	1 Fatal	**Latitude, Longitude:**	44.525276,-110.834167

Administrative Information

Investigator In Charge (IIC):	Struhsaker, James
Additional Participating Persons:	Bruce Hanson; FAA FSFO; Casper, WY
Original Publish Date:	March 30, 2005
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=57648