Aviation Investigation Final Report

Location:	Iliamna, Alaska	**Accident Number:**	ANC15FA071
Date & Time:	September 15, 2015, 06:06 Local	**Registration:**	N928RK
Aircraft:	DEHAVILLAND DHC 3T	**Aircraft Damage:**	Substantial
Defining Event:	Loss of control in flight	**Injuries:**	3 Fatal, 5 Serious, 2 Minor
Flight Conducted Under:	Part 91: General aviation - Other work use		

Analysis

The airline transport pilot and nine passengers departed in a float-equipped airplane in dark night, visual meteorological conditions on a 14 *Code of Federal Regulations* Part 91 other work use flight from a fishing lodge to a remote fishing location. The pilot reported that, before the flight departed, the front and center fuel tanks were filled, and the aft fuel tank had "residual" fuel. He did not weigh the cargo nor did he document any weight and balance calculations. When asked how he calculated the airplane's weight and balance before departure, the pilot said he "guesstimated" it.

According to a witness, after liftoff, the airplane began to climb and then descended, and the floats subsequently struck the water's surface. The airplane then became airborne again and veered right, but he lost sight of it behind an area of rising terrain. The pilot reported that he heard a noise from the left side of the airplane shortly after liftoff, which was likely the floats impacting the water. According to the automatic dependent surveillance-broadcast data, the airplane then began a gradual right turn before reaching a maximum altitude of 175 ft above the water. The airplane then descended toward the water's surface, flew low over the water and terrain, and then climbed briefly again before it impacted terrain. The pilot stated that he did not know that the airplane touched the water's surface after the initial liftoff or that the airplane then turned right.

Impact signatures were consistent with a right-wing-low attitude at impact. The entire airplane was accounted for at the wreckage site. Disassembly and examination of the engine and propeller revealed that both were operating during impact. Examination of the airframe and flight control systems found no preimpact malfunctions or failures that would have precluded normal operation.

A postaccident weight and balance study using the passenger weights, weighed cargo, and fuel load showed that the airplane exceeded its maximum gross weight of 8,367 lbs by about 508.6 lbs and that the center of gravity (CG) was 4.08 inches aft of the aft CG limit. Data from the airplane's automatic dependent surveillance-broadcast (ADS-B) showed that the airplane was at or below the stall speeds

listed in the airplane flight manual during both the initial and second climbs. The ADS-B data show that, because the pilot failed to determine the airplane's actual preflight weight and CG and loaded and operated outside of the weight and CG limits, the airplane did not attain a proper airspeed to climb, and it experienced an aerodynamic stall.

The pilot departed during dark night conditions over water and was relying on external visual cues and not the airplane's instrumentation to control the airplane. There were insufficient external cues available to the pilot to reliably control the airplane, and he was likely experiencing spatial disorientation after takeoff and the subsequent maneuvering.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's decision to depart in dark night, visual meteorological conditions over water, which resulted in his subsequent spatial disorientation and loss of airplane control. Contributing to the accident was the pilot's failure to determine the airplane's actual preflight weight and balance and center of gravity (CG), which led to the airplane being loaded and operated outside of the weight and CG limits and to a subsequent aerodynamic stall.

Findings

Personnel issues	Decision making/judgment - Pilot
Personnel issues	Aircraft control - Pilot
Environmental issues	Dark - Decision related to condition
Personnel issues	Spatial disorientation - Pilot
Personnel issues	Weight/balance calculations - Pilot
Aircraft	CG/weight distribution - Not attained/maintained

Factual Information

History of Flight

Initial climb	Loss of control in flight (Defining event)

On September 15, 2015, about 0606 Alaska daylight time, a single-engine, turbine-powered, float-equipped de Havilland DHC-3T (Otter) airplane, N928RK, impacted tundra-covered terrain just after takeoff from East Wind Lake, about 1 mile east of the Iliamna Airport, Iliamna, Alaska. Of the 10 people on board, three passengers died at the scene, the airline transport pilot and four passengers sustained serious injuries, and two passengers sustained minor injuries. The airplane sustained substantial damage. The airplane was registered to and operated by Rainbow King Lodge, Inc., Lemoore, California, as a visual flight rules other work use flight under the provisions of 14 *Code of Federal Regulations* (CFR) Part 91. Dark night, visual meteorological conditions existed at the departure point at the time of the accident, and no flight plan was filed for the flight. At the time of the accident, the airplane was en route to a remote fishing site on the Swishak River, about 75 miles northwest of Kodiak, Alaska.

The manager of Rainbow King Lodge reported that the accident airplane was being used to transport sport-fishing clients and guides to a remote area for a day of salmon fishing. The manager noted that, on the morning of the accident, a lodge employee transported the guests to East Wind Lake in a lodge-owned van for the early morning departure.

The pilot reported that, on the morning of the accident, he woke at 0430 to check the weather and prepare for the flight. He stated that he had been sleeping normally and was feeling well except for pain in his right knee. He left the lodge at 0515 to conduct a preflight of the airplane. He stated that, for an easterly departure, the light on the building near the departure point is left on so the pilot can use it as a visual reference, but for a westerly departure, there are no lights to use as a reference. The pilot typically used a ridgeline about 7 miles west of Iliamna as a horizon, but the dark night conditions made it difficult to see the ridgeline. He stated that a very small percent of flights departed in the dark.

The lodge employee that drove the guests to the lake stated that they left the lodge at 0545. The airplane had been loaded the day before with fishing equipment. He said that, after all of the passengers boarded the airplane and the pilot had started the engine, he then untied the airplane's floats so the pilot could taxi away from the shoreline. The lodge employee reported it was dark but that he was still able to watch the airplane as it started its westerly takeoff run. He said that, after liftoff, the airplane began to climb and then descended, and the floats subsequently struck the water's surface. The airplane then became airborne again and veered right, but he lost sight of it behind an area of rising terrain.

The pilot stated that, during takeoff, he looks outside the airplane and does not focus on his instruments. The pilot stated that, after the airplane lifted off the water at what seemed like a normal pitch, he heard a noise from the left side of the airplane that distracted him. He looked outside for visual cues but was unable to see due to the dark night conditions. According to the automatic dependent surveillance-broadcast (ADS-B) data, the airplane then began a gradual right turn before reaching a maximum

altitude of 175 ft above the water. The airplane then descended toward the water's surface, flew low over the water and terrain, and then climbed briefly again before it impacted terrain. The pilot stated that he did not know that the airplane touched the water's surface after the initial liftoff or that it then turned right.

A search and rescue team was assembled consisting of Iliamna residents, lodge employees, and Alaska State Troopers. Dark night conditions delayed the search and the discovery of the wreckage by about 30 minutes.

Pilot Information

Certificate:	Airline transport; Commercial; Flight instructor	**Age:**	54,Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land; Multi-engine sea	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	May 12, 2015
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 11300 hours (Total, all aircraft), 450 hours (Total, this make and model), 11100 hours (Pilot In Command, all aircraft), 200 hours (Last 90 days, all aircraft), 70 hours (Last 30 days, all aircraft)		

The pilot, age 54, held an airline transport pilot certificate with an airplane multiengine land rating and commercial pilot privileges with an airplane single-engine land rating. He also held a type rating for Beech 1900 and Beech 300 airplanes and a flight instructor certificate with an airplane single-engine land rating.

According to the Federal Aviation Administration (FAA) medical certification file, the pilot was first medically certificated in 1981. His most recent FAA second-class medical certificate was issued May 12, 2015, with the limitation that he must have available glasses for near vision. At that time, he measured 71 inches tall and weighed 249 lbs. He reported no medications, and the examining physician did not identify any abnormal findings.

According to the pilot's logbooks, he had about 11,280 total flight hours, about 450 hours of which were in the accident airplane make and model. In the 90 and 30 days before the accident, the pilot logged 200 and 70 flight hours, respectively. His most recent flight review was on February 9, 2014, in a Schweizer S269C helicopter.

The pilot had flown for Rainbow King Lodge during the 2012 to 2015 fishing seasons. The first two seasons were before the Otter was converted to a turbine-powered airplane (see the next section for more information about the conversion). The pilot stated that he had not received any training in the airplane

since the turbine conversion.

Aircraft and Owner/Operator Information

Aircraft Make:	DEHAVILLAND	**Registration:**	N928RK
Model/Series:	DHC 3T	**Aircraft Category:**	Airplane
Year of Manufacture:	1954	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	61
Landing Gear Type:	Float	**Seats:**	11
Date/Type of Last Inspection:	July 25, 2015 100 hour	**Certified Max Gross Wt.:**	8367 lbs
Time Since Last Inspection:		**Engines:**	1 Turbo prop
Airframe Total Time:	15436 Hrs as of last inspection	**Engine Manufacturer:**	Honeywell
ELT:	C91A installed, not activated	**Engine Model/Series:**	TPE33112JR702
Registered Owner:		**Rated Power:**	1000 Horsepower
Operator:		**Operating Certificate(s) Held:**	None

The accident airplane was a high-wing, float-equipped, single-pilot, de Havilland DHC-3T, N928RK, serial number 61, manufactured in 1954. It was powered by a Honeywell TPE 331-12JR-702TT turboprop engine per a Texas Turbine Conversions, Inc., supplemental type certificate (STC). It was equipped with a Hartzell model HC-B4TN-5NL four-bladed propeller.

In April 2014, the airplane was sent to Recon Air Corporation in Geraldton, Ontario, Canada, for a major overhaul and the turbine conversion. The airplane's US registry was changed to N928RK. The airplane was also modified with a Baron STOL kit and an upgross kit per an STC to improve its performance. The upgross kit increased the maximum gross weight of the airplane from 8,000 lbs to 8,367 lbs. The airplane was configured to carry one pilot and 10 passengers and cargo.

On May 24, 2014, after the overhaul, a new weight and balance calculation was performed, which showed that the airplane's basic empty weight on wheels was 4,345 lbs.

On May 30, 2014, an 800-hour inspection of the airplane and special inspection items was completed. The records indicated that all applicable airworthiness directives were complied with at this time. According to maintenance records, the airplane's last inspection was a 100-hour inspection on July 25, 2015, at which time, the airframe had accumulated 15,436 total hours, and the engine had accumulated 384 total hours.

On June 11, 2014, another weight and balance calculation was performed, which indicated that the airplane's empty weight on floats was 4926.8 lbs with a useful load of 3,073.2 lbs and that its center of gravity (CG) was 131.79 inches. A maximum gross weight of 8,000 lbs was used for the computation, not the adjusted weight of 8,367 lbs. The installation of the upgross kit was noted in the equipment list, but the increase of the maximum gross weight was not reflected in the final weight and balance

paperwork.

On August 30, 2015, a 150-hour engine inspection was conducted with no defects or leaks noted. At the time of inspection, the engine had a total of 430.3 hours.

Weight and Balance Study

The accident airplane was configured to carry 62 gallons of fuel in the forward tank, 102 gallons of fuel in the center tank, and 51 gallons of fuel in the aft tank. The Texas Turbine Conversions, Inc., Airplane Flight Manual (AFM) supplement instructs the operator to burn fuel from the forward tank during takeoff and, after takeoff, from the aft tank forward to leave as much fuel in the forward tank as possible for landing. The minimum amount of fuel for takeoff is 20 gallons in each of the three tanks to prevent introduction of air into the fuel system. The pilot stated the center and forward tanks were full, and there was "residual" fuel in the aft tank.

Rainbow King Lodge had no procedures in place or equipment available for calculating preflight weight and balance. Pilots should calculate the airplane's actual weight and balance using the procedures contained in the original DHC-3 Otter AFM, published by de Havilland Canada, along with the information in the various flight manual supplements for the STCs installed on the airplane. The entire flight manual and all of its supplements were carried in the airplane during the accident flight. When asked how he calculated the weight and balance for the accident airplane before departure, the pilot said he "guesstimated" it.

As noted, the airplane was carrying the pilot and nine passengers. The seating location of each passenger was determined based on passenger statements. In accordance with passenger statements, 10 lbs was added to each person's weight to account for gear and clothing, including chest waders and boots.

All of the cargo, which included fishing gear, coolers, firewood, and passenger bags, was loaded in the baggage compartment located behind the last row of passenger seating. After the accident, these items were removed and weighed. See table 1 for a summary of the weight and balance calculations.

	Weight (lbs)	Arm (in)	Moment
Empty Weight and CG	4,926.80	131.79	649,302.97
Fuel - front tank	415.40	121.00	50,263.40
Fuel - center tank	683.40	154.00	105,243.60
Fuel - aft tank	134.00	184.00	24,656.00
Pilot	259.00	98.00	25,382.00
Front right seat passenger	211.00	98.00	20,678.00
First row right seat passenger	186.00	137.00	25,482.00
First row left seat passenger	200.00	137.00	27,400.00
Second row right seat passenger	238.00	165.00	39,270.00
Second row left seat passenger	225.00	165.00	37,125.00
Third row right seat passenger	180.00	195.00	35,100.00
Third row left seat passenger	0.00	195.00	0.00
Fourth row right seat passenger (and Start Pac)	257.00	218.00	56,026.00
Fifth row right seat	210.00	250.00	52,500.00
Fifth row left seat	290.00	250.00	72,500.00
Baggage	460.00	286.00	131,560.00
TOTALS	**8,875.60**	**152.38**	**1,352,488.97**

Table 1. Summary of weight and balance calculations.

Using this data, the airplane's weight before takeoff was calculated to be 8,875.6 lbs, which was 508.6 lbs over the maximum gross weight. The CG range for the airplane at 8,367 lbs was between 140.3 and 148.3 inches. The airplane's pretakeoff CG was calculated to be 152.38 inches, 4.08 inches aft of the aft CG limit.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	PAIL,192 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	13:53 Local	**Direction from Accident Site:**	180°
Lowest Cloud Condition:	Scattered / 700 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Overcast / 4400 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	240°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.6 inches Hg	**Temperature/Dew Point:**	9°C / 8°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Iliamna, AK	**Type of Flight Plan Filed:**	None
Destination:	Kodiak, AK	**Type of Clearance:**	None
Departure Time:		**Type of Airspace:**	Class G

The closest weather reporting weather station was Iliamna, about 1 mile south of the accident site. At 0553, a METAR reported, in part, wind 270° at 7 knots; visibility 10 statute miles; clouds and sky condition, scattered at 700 ft, overcast at 4,400 ft; temperature 48° F; dew point 47° F; and altimeter 29.61 inches of mercury.

According to the US Naval Observatory Astronomical Applications Department, civil twilight began at 0706, and sunrise was at 0748.

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:	3 Fatal, 4 Serious, 2 Minor	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 Fatal, 5 Serious, 2 Minor	**Latitude, Longitude:**	59.777778,-154.91777

The main wreckage was found about 510 ft from the shore of East Wind Lake at N59.777778 W154.917778, on a magnetic heading of 020°, about 0.5 miles from the departure point. The airplane impacted soft, tundra-covered terrain. There was no evidence of any impact with terrain between the lake and the main wreckage. There was a ground scar about 20 ft long and 10 inches deep aft and in line with the right wing. There was an additional ground scar aft of the right float that was about half the length of the right float.

The left wing remained attached, and the left flap and aileron were attached at their respective attachment points. The right wing was separated from the fuselage at the wing root, and the forward

attachment point bolt was broken at the wing and remained in the wing. The rear attachment, about 5 inches into the spar, was separated. The right flap was separated, and the right lift strut was separated at the fuselage structure. The last 10 ft of the right wing sustained extensive aft accordion-style crushing from the tip inboard. The right aileron had extensive impact damage and only remained attached outboard of the attachment point.

The tail was displaced about 30° to the left. The stabilator remained attached and was relatively undamaged. The outboard 2 ft of the right elevator was separated, and the inboard portion of the right elevator had accordion-style crushing where it had impacted the rudder. The left elevator remained attached and undamaged. The rudder remained attached and sustained damage where it was penetrated by the servo tab. The rudder and elevator cables were still attached to their relative attachment points.

The jack screw separated at the top fitting from the horizontal stabilator, and the forward bolts threads were stripped. There was no noted inner movement of the jack screw, which remained attached at the lower attachment point and measured about 3/4 inch.

The left float was attached to the fuselage at the forward and aft attachment points. The forward spreader bar remained attached to the float. The left float came to rest on top of the right float. Multiple outboard panels on the left float had slight inward crushing. The right float was heavily damaged and fragmented at the attachment points.

The elevator, trim indicator, and a manual control wheel were in a nose-up position. The rudder trim was in a slightly right position. The flaps were hydraulically actuated and were in the "takeoff" position.

The navigation, beacon, cockpit, and instrument lights were in the "on" position, and the dome, strobe, and landing lights were in the "off" position.

The propeller was still attached to the propeller flange. Three blades had extensive leading edge gouging and exhibited torsional twisting. One of the blades tip had separated, one of the blades was rotated 180° in the hub, and another blade was buried in the terrain.

The power lever was slightly above flight idle. The condition lever was midrange. The fuel shut-off was not in an off position, the fuel selector was on the center tank, and the ignition was set to continuous ignition. All three of the fuel caps were on and secure. The fuselage had accordion-style crushing, and at the rear spar there was a tear in the production joint. There was no damage to the engine mounts.

Additional Information

Weight and Balance Guidance

FAA-H-8083-1A, "Aircraft Weight and Balance Handbook," stated the following:

Improper loading cuts down the efficiency of an aircraft from the standpoint of altitude, maneuverability, rate of climb, and speed. It may even be the cause of failure to complete the flight, or for that matter, start the flight. Because of abnormal stresses placed upon the structure of an improperly loaded aircraft, or because of changed flying characteristics of the aircraft, loss of life and destruction of

valuable equipment may result.

The pilot in command of the aircraft has the responsibility on every flight to know the maximum allowable weight of the aircraft and its CG limits. This allows the pilot to determine on the preflight inspection that the aircraft is loaded in such a way that the CG is within the allowable limits.

Excessive weight reduces the efficiency of an aircraft and the safety margin available if an emergency condition should arise. Some of the problems caused by overloading an aircraft are:

- The aircraft will have a higher takeoff speed, which results in a longer takeoff run.
- Both the rate and angle of climb will be reduced.
- Maneuverability will be decreased.

An important part of careful preflight planning includes a check of these charts to determine the aircraft is loaded so the proposed flight can be safely made. If the CG is too far aft, it will be too near the center of lift and the airplane will be unstable, and difficult to recover from a stall.

Federal Aviation Regulations

Title 14 CFR Part 91.9, "Civil aircraft flight manual, marking, and placard requirements," stated the following:

(a) Except as provided in paragraph (d) of this section, no person may operate a civil aircraft without complying with the operating limitations specified in the approved Airplane or Rotorcraft Flight Manual, markings, and placards, or as otherwise prescribed by the certificating authority of the country of registry.

Part 91.103 Preflight action: Each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight. This information must include—

(2) For civil aircraft other than those specified in paragraph (b)(1) of this section, other reliable information appropriate to the aircraft, relating to aircraft performance under expected values of airport elevation and runway slope, aircraft gross weight, and wind and temperature.

Spatial Disorientation

The FAA's "Pilot's Handbook of Aeronautical Knowledge" (FAA-H-8083-25), stated, "Spatial disorientation specifically refers to the lack of orientation with regard to the position, attitude, or movement of the airplane in space." The handbook also contained the following guidance:

under normal flight conditions, when there is a visual reference to the horizon and ground, the sensory system in the inner ear helps to identify the pitch, roll, and yaw movements of the airplane. When visual contact with the horizon is lost, the vestibular system becomes unreliable. Without visual references

outside the airplane, there are many situations where combinations of normal motions and forces can create convincing illusions that are difficult to overcome.

FAA Publication "Spatial Disorientation Visual Illusions" (OK-11-1550), stated, in part, the following:

false visual reference illusions may cause you to orient your aircraft in relation to a false horizon; these illusions are caused by flying over a banked cloud, night flying over featureless terrain with ground lights that are indistinguishable from a dark sky with stars, or night flying over a featureless terrain with a clearly defined pattern of ground lights and a dark starless sky.

The FAA publication Medical Facts for Pilots (AM-400-03/1) described several vestibular illusions associated with the operation of aircraft in low-visibility conditions. Somatogravic illusions, which involve the utricle and saccule of the vestibular system, were generally placed into one of three categories, one of which was "the head-up illusion." According to the publication, the head-up illusion involves a forward linear acceleration, such as takeoff, where the pilot perceives that the aircraft's nose is pitching up. The pilot's response to this illusion would be to push the control yoke forward to pitch the aircraft's nose. It added, "A night takeoff from a well-lit airport into a totally dark sky (black hole)…can also lead to this illusion, and could result in a crash."

Medical and Pathological Information

Hospital treatment records revealed that the pilot had a 1-week history of right leg swelling before the accident. In addition to crash-induced injuries, the pilot was diagnosed with a right leg deep vein thrombosis and bilateral pulmonary emboli. Two days after admission, the pilot suffered a syncopal episode attributed to another pulmonary embolus.

Toxicology

The FAA Bioaeronautical Sciences Research Laboratory testing of the pilot's urine collected on admission to the hospital was negative for ethanol and drugs of abuse but detected ibuprofen, ketamine, and its metabolite norketamine. Ketamine is an injectable, rapidly acting general anesthetic agent that was administered during the pilot's postaccident transport to the hospital. Ibuprofen is a nonsedating medicine used to treat pain, swelling, and fever and is marketed with various names, including Motrin. (See the Medical Factual Report in the docket for this accident for more information.)

Pilot and Passenger Injuries

The NTSB Medical Officer reviewed hospital treatment records to determine the pilot's injuries. The IIC reviewed the Alaska State Medical examiner's autopsy reports for the three fatally injured passengers. See table 2 for a complete list of pilot and passenger injuries.

Role	Gender	Injury Severity	Seating location	Restraints Used/type
Pilot	Male	Serious	Left front	4-point
Passenger	Male	Fatal	Right front	4-point
Passenger	Male	Serious	Left first row	Lap belts
Passenger	Male	Fatal	Right first row	Lap belts
Passenger	Male	Serious	Left second row	Lap belts
Passenger	Male	Fatal	Right second row	Lap belts
Passenger	Male	Serious	Right third row	Lap belts
Passenger	Male	Serious	Right fourth row	Lap belts
Passenger	Male	Minor	Left fifth row	Lap belts
Passenger	Male	Minor	Right fifth row	Lap belts

Table 2 List of pilot and passenger injuries.

Tests and Research

On September 22, 2015, the wreckage was examined at a private hangar in Iliamna under the supervision of the NTSB IIC. Flight control system cable continuity was established from each control surface to the point of impact-related damage.

On November 2, an engine teardown and examination were conducted at Honeywell facilities in Phoenix, Arizona, under the supervision of the NTSB IIC. Disassembly and examination of the engine revealed the following significant characteristics consistent with rotation and operation at the time of impact: rotational scoring of the propeller shaft and rotational scoring throughout the compressor and turbine sections indicate rotation at the time of impact. Metal spray was present throughout the turbine components in the air stream path indicating operation at the time of impact. There were multiple, nonadjacent, vanes in the first-stage compressor impeller bent opposite the direction of rotation. There was dirt and debris in the first- and second-stage compressor housings.

The propeller coupling was fractured. Examination of the coupling and the mating coupling revealed the

two axial cracks in the coupling were the result of overload. There was no debris found in the fuel filter or in the fuel collected from the fuel control unit and fuel pump.

The examination of the airframe and engine revealed no evidence of mechanical malfunctions or failures that would have precluded normal operation.

The engine fuel control unit was examined at Woodward Governor Company, Rockford, Illinois, under the supervision of an FAA inspector. The control was functionally tested, and no evidence of a preaccident malfunction was found.

Airplane Performance Study

The accident airplane was equipped with ADS-B technology. In typical applications, the ADS-B-capable aircraft uses an ordinary GPS receiver to derive its precise position from the global navigation satellite system constellation and then combines that position with any number of aircraft parameters, such as speed, heading, altitude, and aircraft registration number. This information is then simultaneously broadcast to other ADS-B-capable aircraft and to ADS-B ground or satellite communications transceivers, which then relay the aircraft's position and additional information to air traffic control centers in real time.

Data from the accident airplane's ADS-B, as shown in figure 1, show the airplane's flightpath. Airspeeds were calculated using the ADS-B position data and the reported wind information. Airplane orientation was calculated from these data and a basic aerodynamic model of the airplane. Calculations made from ADS-B and weather data are subject to uncertainty; therefore, airspeeds and attitude values should not be considered exact.

During the initial climb, the airplane remained below the recommended airspeed per the Texas Turbine Conversions, Inc., AFM. The data show the airplane initially gaining altitude at 0605:54 and reaching 56 mph, as recommended in the AFM. After the initial climb with a 10° bank angle, the airplane made a descending right turn at 57 mph and lost 175 ft of altitude, which placed the airplane at or near the water's surface. Subsequently, the airplane began regaining altitude with a 30° bank angle, and then it made another right turn at less than 57 mph. The airplane's stall speed is 57 mph at a 0° bank angle, 59 mph at a 20° bank angle, and 65 mph at a 40° bank angle.

Figure 1. Airplane's flightpath from ADS-B data.

Preventing Similar Accidents

Reduced Visual References Require Vigilance

About two-thirds of general aviation accidents that occur in reduced visibility weather conditions are fatal. The accidents can involve pilot spatial disorientation or controlled flight into terrain. Even in visual weather conditions, flights at night over areas with limited ground lighting (which provides few visual ground references) can be challenging.

Preflight weather briefings are critical to safe flight. In-flight, weather information can also help pilots make decisions, as can in-cockpit weather equipment that can supplement official information. In-cockpit equipment requires an understanding of the features and limitations.

We often see pilots who decide to turn back after they have already encountered weather; that is too late. Pilot's shouldn't allow a situation to become dangerous before deciding to act. Additionally, air traffic controllers are there to help; be honest with them about your situation and ask for help.

Even when flying at night, visual weather conditions can also be challenging. Remote areas with limited ground lighting provide limited visual reference cues for pilots, which can be disorienting or render rising terrain visually imperceptible. Topographic references can help pilots become more familiar with the terrain. The use of instruments, if pilots are proficient, can also help pilots navigate these challenging areas.

See http://www.ntsb.gov/safety/safety-alerts/documents/SA_020.pdf for additional resources.

The NTSB presents this information to prevent recurrence of similar accidents. Note that this should not be considered guidance from the regulator, nor does this supersede existing FAA Regulations (FARs).

Administrative Information

Investigator In Charge (IIC):	Hill, Millicent
Additional Participating Persons:	Hugh Youngers; FAA; Anchorage, AK
Original Publish Date:	August 9, 2017
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=91981