National Transportation Safety Board
Aviation Accident Final Report

Location:	Doyle, California	**Accident Number:**	WPR10FA055
Date & Time:	November 14, 2009, 02:01 Local	**Registration:**	N5793P
Aircraft:	Aerospatiale AS350BA	**Aircraft Damage:**	Substantial
Defining Event:	Loss of control in flight	**Injuries:**	3 Fatal
Flight Conducted Under:	Part 91: General aviation - Positioning		

Analysis

Ten minutes after dropping off a patient at the local hospital and while returning to home base in dark night conditions, the flight crew made a routine position report. About 8 minutes later, the flight crew transmitted that the helicopter was going down.

Radar data indicated that after departure from the hospital, the helicopter initiated a climb from about 4,500 feet mean sea level (msl) and established a northwesterly course. In the vicinity of the accident site, the target indicated a climbing turn to the northeast followed by a turn to the southwest, and then a climbing turn back to the northeast. The last two targets indicated a turn to the right. The last recorded altitude was at 10,200 feet msl.

On-site documentation of the wreckage suggested that the helicopter was in a nose-low attitude and about a 90-degree bank angle when it contacted the ground.

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

A study of the weather conditions in the vicinity of the accident site indicated clouds were present with tops reaching about 13,000 feet msl. Light clear icing was present with the potential for moderate clear icing in or near clouds. Visibility was at or greater than 10 statute miles.

Given the helicopter's flight path shortly before the accident, it is likely that the pilot was maneuvering to avoid clouds and became disorientated in the dark night conditions, which resulted in a loss of helicopter control.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot became spatially disoriented while maneuvering on a dark night, which resulted in a loss of helicopter control.

Findings

Personnel issues	Spatial disorientation - Pilot
Personnel issues	Aircraft control - Pilot
Environmental issues	Clouds - Awareness of condition
Environmental issues	Low light - Effect on personnel

Factual Information

HISTORY OF FLIGHT

On November 14, 2009, about 0201 Pacific standard time, an Aerospatiale AS350BA, N5793P, collided with terrain near Doyle, California. Mountain Lifeflight was operating the helicopter under the provisions of 14 Code of Federal Regulations (CFR) Part 91. The commercial pilot and two passengers sustained fatal injuries; the helicopter was substantially damaged by impact forces and post-crash fire. The cross-country positioning flight departed Reno, Nevada, about 0143 with a planned destination of Susanville, California. Visual meteorological conditions prevailed, and a company flight plan had been filed.

The helicopter departed its home base at Susanville Airport at 0016, and picked up a patient at Banner Hospital in Susanville. It departed Susanville at 0038, and arrived at Renown Hospital in Reno at 0111. It departed Renown Hospital at 0143, and the medical crew made position reports every 10 minutes to its dispatch center in Susanville. At 0153, they reported Hallelujah Junction; Susanville was 43 miles at 311 degrees, and the accident site was 5 miles at 341 degrees. At 0201, dispatch received a transmission that the helicopter was going down.

Law enforcement personnel interviewed a witness who was in a car on nearby Highway 395. The witness observed the helicopter flying straight and level; it then descended vertically at a rapid rate. The witness lost sight of it behind terrain, and then observed a fireball. The witness drove on a dirt road, and found the wreckage, which was approximately 1/4 mile west of Highway 395.

The company reported that the pilot departed at 1955 on the same round trip (base to Banner Hospital to Reno and return), but with a different medical crew on board. Both crewmen stated that the pilots typically flew about 8,500 feet msl, which was above the mountain tops along their route of flight. The pilots typically followed Highway 395 in order to maintain the best visual contact with the ground.

The National Transportation Safety Board (NTSB) investigator-in-charge (IIC) reviewed recorded radar data. The helicopter was using a discreet code of 0465. A plot of the radar track is part of the public docket. The first target appeared at 0144:16, at a Mode C reported altitude of 4,700 feet mean sea level (msl); it was at the approximate coordinates for Renown Hospital, which was at an estimated elevation of 4,500 feet. It climbed on a northwesterly course for about 5 miles, and then turned about 15° left for 4 miles until the target was lost at 0150:08. At this point, it was about halfway between Highway 395 and Reno Stead Airport, and indicating a Mode C altitude of 7,100 feet.

The target was reacquired at 0200:19, at a Mode C altitude of 9,200 feet in the vicinity of the accident site. The target tracked to the northeast for about 0.6 mile, and climbed to 9,700 feet by 0200:43. The next target, which occurred 10 seconds later, was back to the southwest at an altitude of 9,800 feet. At 0201:06, the target was west of the previous location at a Mode C altitude of 10,100 feet; a target 5 seconds later was essentially in the same location at 10,200 feet. The next target was less than 5 seconds later and northeast of the previous two targets.

About 10 seconds later, the next target continued to the northeast. The last two targets occurred 4.5 seconds apart; they were at 10,200 feet, and collocated about 90° east of the previous target. This location was within the immediate vicinity of the accident site.

PERSONNEL INFORMATION

The operator reported that the 39-year-old pilot held a commercial pilot certificate with ratings for rotorcraft-helicopter and instrument helicopter. The pilot held a certified flight instructor (CFI) certificate with a rating for rotorcraft-helicopter.

The pilot held a second-class medical certificate issued on May 20, 2009. It had no limitations or waivers.

The operator reported that the pilot had a total flight time of 6,055 hours. He logged 49 hours in the last 90 days, and 10 in the last 30 days. He had 4,815 hours in this make and model. He completed a flight review on August 3, 2009. The pilot accumulated 53 hours with this company and 46 hours of this mission type. He had a total of 248 hours of flight experience in night conditions with 15 hours of night time logged in the 8 months prior to the accident.

The pilot indicated on his resume that he worked as a tour pilot in Hawaii the previous 6 years. He had flown as a tour, charter, external load, and EMS pilot in Alaska the 6 months prior to Hawaii. The pilot information/experience form that the pilot filled out for Mountain Lifeflight indicated that as of July 24, 2009, he had a total time of 6,003 hours with 233 hours at night. His resume indicated that he had 53 hours of instrument time. His date of assignment as a pilot with Mountain Lifeflight was August 3, 2009. He lived in Hawaii, and would live at the base when on shift. He arrived at the base a couple of days before the accident flight to begin a week of night shifts from 1900-0700. The accident occurred on the second night of his shift.

The pilot reported for duty at 1900, and flew the same mission as the accident fight with two different crew members. That flight began at 1955. Both crew members reported that the pilot was in good spirits, and appeared to be rested.

AIRCRAFT INFORMATION

The helicopter was originally manufactured by Aerospatiale in 1982 as an AS350D, serial number 1476. The helicopter's logbooks revealed that it was converted to AS350BA. On July 18, 2008, the operator replaced the type-certificated Turbomeca Arriel 1B engine with a Honeywell LTS-101-600A-3A engine under a Soloy LLC Supplemental Type Certificate (STC) # SR00805SE. The helicopter had accrued a total airframe time of 5,827 hours at the last 250-hour inspection on October 8, 2009. The logbooks contained an entry for an annual inspection dated January 29, 2009, at an airframe total time of 5,432 hours.

The engine was a Honeywell LTS101-600A-3A, serial number LE-46096CE. Total time recorded on the engine was 7,020 hours, and time since major overhaul was 751 hours.

Operator personnel stated that the helicopter stands by with a 60% fuel load, and that was how it was configured for the accident flight.

Two crew members flew on a flight earlier in the evening with the accident pilot. Both stated that the flight was uneventful from startup to shut down with no strange sounds or vibrations noted during the flight. The entire crew had commented on how good the helicopter was operating.

METEOROLOGICAL INFORMATION

An NTSB meteorologist provided a weather brief.

The closest official weather observation station was Reno (KRNO), which was 25 nautical miles (nm) at 150° from the accident site at an elevation of 4,415 feet mean sea level (msl). An aviation routine weather report (METAR) was issued at 0155 PST. It stated: wind from 340° at 6 knots; visibility 10 miles; skies 5,500 feet broken; temperature 4/39° Celsius(C)/Fahrenheit(F); dew point -3/25°C/F; altimeter 29.96 inches of mercury.

Doppler weather radar gave no indication of precipitation in the area. No PIREPs were available near the time of accident.

METARs from KRNO and Truckee, California (KTRK), (33 NM south at an elevation of 5,900 feet) indicated the presence of clouds in the area. KRNO and KTRK reported cloud bases as broken at 5,500 feet above ground level (agl or approximately 9,900 feet msl) and 3,200 feet agl (approximately 9,100 feet msl), respectively. Visibility was at or greater than 10 statute miles.

GOES11 and MODIS infrared imagery confirmed clouds in the area at the time of the accident. Brightness temperatures in the MODIS infrared imagery for clouds in the area were -12°C, which corresponded to cloud tops reaching about 13,000 feet msl.

A rawinsonde launch from KRNO at 1200 universal coordinated time, as well as meteorological model data, indicated light clear icing at the upset altitude, with potential for moderate clear icing in/near clouds.

For the California forecasting region, there was no active AIRMET SIERRA, TANGO or ZULU for the accident location/time. However, there was an active AIRMET ZULU for ice between 4,000 feet and 12,000 feet msl near the accident site.

For the Nevada forecasting region, there was an active AIRMET TANGO for moderate turbulence at flight levels 180-390. This forecast extended into California, but there were no other active AIRMETS for the accident time and location.

Two crew members flew on a flight earlier in the evening with the accident pilot. One stated that he didn't observe clouds on their flight; if there were any, he said that they were above them and very few. He was able to distinguish the mountains along the route. The other noted that there was very little moon, and it was a very dark night.

WRECKAGE AND IMPACT INFORMATION

Investigators examined the wreckage at the accident scene. Detailed on site notes are in the public docket. The first identified point of contact (FIPC) consisted of three parallel ground scars. The center scar contained the recognition light fixture. All references in the following paragraphs reflect left and right of the debris path centerline and distance from the FIPC.

The debris path was 305 feet along a magnetic heading of 230 degrees; the first half of the path was on a 20-degree downslope of uneven terrain.

The vertical stabilizers separated as a unit, and were at 29 feet. Landing gear pieces were about 15 feet to the right of them.

The tailboom with tail rotor attached separated aft of the cabin, and came to rest on its right side at 58 feet. The left side of the tailboom was crushed in and aft with wrinkles; it sustained more damage than the right side. Scrape marks from the front to the rear on the left side were parallel to the longitudinal axis, and were visible within the folds of the wrinkles. The right horizontal stabilizer sustained less damage than the left horizontal stabilizer, which was crushed aft and up.

The ground and brush to the right of the tailboom was scorched, and the scorching continued downhill to the main rotor blades.

The cockpit area and instrument panel were at 140 feet; they were highly fragmented and burned. They came to rest against an earth berm several feet high; after the berm, the terrain flattened. Major segments of the cyclic, antitorque pedals, and instrument panel were identified. A Geneva center pedestal was identified in the debris field; it exhibited crush damage, and most switches were in the forward position.

Investigators found flight control pieces along the flight path. These included segments of the mixing unit and collective torque tube; the fracture surfaces were bent and angular.

About 30 feet right of the cockpit were pieces of the landing gear. The steel extensions at the back of the landing gear were bent up (their normal position is 5 degrees down).

After the berm was the main rotor gearbox with the main rotor blades attached. The main rotor head was manually rotated with resulting rotation of planetary gears. The transmission drive shaft separated just aft of the input flange, and remained connected to the liaison tube and engine. The fracture surface was bent and twisted. The transmission input flex coupling remained intact and attached to the transmission input flange.

The flight control tubes fragmented and the fracture surfaces were bent and angular. The Starflex main rotor head remained attached to the transmission. The blade order in the direction of rotation was yellow, blue, and red. The red sleeve sustained the most damage; it had retreated and was broomstrawed. The red star arm separated, and was found near the tail cone. The yellow sleeve was advanced; the yellow star arm fractured and separated. The blue sleeve was still intact; the blue star arm was fractured, but still in position.

All three main rotor blades exhibited chord wise bending and trailing edge splitting. The yellow blade exhibited the least amount of damage of the three blades. The outboard section of blue blade exhibited impact and fire damage. The red blade was the most extensively damaged, and exhibited the most fire damage of the three blades. The spars on the blades did not appear to be extensively damaged.

The tail rotor remained attached to the tail rotor gearbox. The tail rotor paddles were cracked at the cuffs, and exhibited minimal rotational scoring.

A substance that smelled like aviation jet fuel was evident at the site. The fuel cutoff valve was found along the wreckage path in the closed position; however, debris was found inside the valve when it was opened. The valve was cable operated in tension to off position.

The engine, which split open, was at 220 feet.

The most distant item of major wreckage located, at 292 feet, was the sun gear from the main rotor gearbox.

An additional examination of the accident site occurred on May 18, 2010. Investigators used metal detectors to locate additional components. These included ball bearings from the governor.

MEDICAL AND PATHOLOGICAL INFORMATION

The Washoe County Medical Examiner/Coroner completed an autopsy, and determined that the cause of death was multiple blunt force injuries. The FAA Forensic Toxicology Research Team, Oklahoma City, Oklahoma, performed toxicological testing of specimens of the pilot.

Analysis of the specimens for the pilot contained no findings for volatiles or tested drugs. They did not perform tests for carbon monoxide or cyanide.

TESTS AND RESEARCH

The FAA, American Eurocopter, and Honeywell investigators examined the wreckage at Plain Parts, Sacramento, California, on November 18, 2009. Highlights of the examination follow; detailed notes of the examination are part of the public docket.

Airframe

Investigators disassembled the hydraulic pump, and the manufacturer reported that it appeared to be properly greased inside with the spline coupling in good condition.

The tail rotor could be rotated by hand with resulting rotation of the tail rotor gearbox input flange and remaining shaft. The tail rotor drive train was reconstructed; short and long tail rotor drive shafts were buckled, and exhibited angular and jagged fracture surfaces. The tail rotor drive train flex couplings did not exhibit significant rotational damage. The tail rotor pitch change rod fracture surfaces were bent and angular. Manual movement of the tail rotor

pitch change bellcrank resulted in appropriate pitch change of tail rotor.

A locking pin (woodruff key) in the tail rotor drive sheared and fractured into two pieces, and investigators observed some smearing in the direction of rotation. The fracture surface was consistent with overload conditions.

Engine exam

The engine was examined at Honeywell facilities in Phoenix, Arizona, on December 1st and 2nd, 2009. Pertinent parts of the examination follow; detailed examination notes are part of the public docket.

Rotational Signatures

There were numerous witness marks on different components throughout the engine.

The matched idler gear assembly rotationally scored an adjacent interior surface of the front cover.

There were rotational witness marks on the forward face of the aft gear of the matched idler gear set.

Approximately 18 marks (increasing in depth in the direction of rotation) were noted on the aft gear.

Contact marks were on the aft outer diameter (OD) corners of approximately 18 teeth of the power output gear (increasing in magnitude in the direction of rotation).

All leading edges of the axial compressor rotor blades exhibited tearing and battering damage and were bent opposite the direction of rotation.

Rotational scoring was on the aft face of the axial compressor rotor disk hub.

Rotational scoring was observed on all of the axial compressor rotor blade tips.

Rotational scoring damage was on the forward face of the compressor vane assembly inner support.

Rotational scoring was evident to an approximately 120-degree section of the compressor vane assembly blade tip shroud (8 – 12 o'clock position, aft looking forward).

There was rotational scoring to the shroud line edges of all of the compressor impeller vanes.

Rotational scoring was observed to the forward facing power turbine rotor blade tips and firtrees.

There was rotational scoring to the PT turbine rotor blade tips.

Metal Spray

Metal spray was evident throughout the engine. Metal spray deposits were adhering to both the pressure and suction sides of the Gas Producer (GP) turbine nozzle vanes. Deposits were adhering to the leading edge and suction side of the GP turbine rotor blades. Investigators observed deposits adhering to the TBC coating of the outer transition liner curl assembly. There were also metal spray deposits adhering to the suction side of the PT nozzle vanes.

Servo Exam

An NTSB investigator oversaw examination of all three servos at the facilities of Hawker Pacific Aerospace, Sun Valley, California, on December 21, 2009. No anomalies were detected, and a full report is part of the public docket.

Sprag Clutch Assembly

An FAA inspector oversaw examination of the sprag clutch assembly at the Honeywell facilities in Phoenix, on May 5, 2010. No anomalies were noted, and a full report is part of the public docket.

Line Replaceable Units (LRUs) Exams

An FAA inspector oversaw examination of the recovered pieces of three spool bearings at the Honeywell facilities in South Bend, Indiana, on July 21, 2010. No anomalies were noted, and a full report is part of the public docket.

An FAA inspector oversaw examination of the recovered pieces of several LRUs (PT governor, fuel control unit, overspeed limiter, and the flow fence actuator) at the Honeywell facilities in South Bend, on April 13, 2010. No anomalies were noted, and a full report is part of the public docket.

NTSB Materials Laboratory Exams

Specialists with the NTSB Materials laboratory examined the fractured adaptor shaft (SOLOY conversion) and the fire damaged annunciator panel. The complete reports are part of the public docket.

SOLOY Adaptor Shaft

The fracture of the adaptor shaft was consistent with a bending overstress separation while under longitudinal tension loading.

Annunciator Panel

The annunciator panel sustained heavy fire damage. There were no filaments or fragments for the engine chip detector, doors, hydraulic, or battery T. The bulbs for the generator and battery

had damage to the glass and the condition of their filament could not be determined. None of the filaments or fragments that remained exhibited evidence of hot stretching of the filament coils.

History of Flight

Maneuvering	Loss of control in flight (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

Pilot Information

Certificate:	Commercial	**Age:**	39,Male
Airplane Rating(s):	None	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Helicopter	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 None	**Last FAA Medical Exam:**	May 20, 2009
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	August 30, 2009
Flight Time:	6055 hours (Total, all aircraft), 4815 hours (Total, this make and model), 6017 hours (Pilot In Command, all aircraft), 49 hours (Last 90 days, all aircraft), 10 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Aerospatiale	**Registration:**	N5793P
Model/Series:	AS350BA	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	1476
Landing Gear Type:	Skid	**Seats:**	5
Date/Type of Last Inspection:	November 13, 2009 Continuous airworthiness	**Certified Max Gross Wt.:**	4630 lbs
Time Since Last Inspection:	18 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	5895 Hrs as of last inspection	**Engine Manufacturer:**	Honeywell
ELT:	Installed, not activated	**Engine Model/Series:**	LTS101-600A-3
Registered Owner:		**Rated Power:**	641 Horsepower
Operator:		**Operating Certificate(s) Held:**	On-demand air taxi (135)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night/dark
Observation Facility, Elevation:	KRNO,4415 ft msl	**Distance from Accident Site:**	25 Nautical Miles
Observation Time:	01:55 Local	**Direction from Accident Site:**	150°
Lowest Cloud Condition:		**Visibility**	10 miles
Lowest Ceiling:	Broken / 5500 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	320°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.95 inches Hg	**Temperature/Dew Point:**	4°C / -4°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Reno, NV	**Type of Flight Plan Filed:**	Company VFR
Destination:	Susanville, CA (SVE)	**Type of Clearance:**	None
Departure Time:	01:44 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	2 Fatal	**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 Fatal	**Latitude, Longitude:**	39.851387,-120.349998

Administrative Information

Investigator In Charge (IIC):	Plagens, Howard
Additional Participating Persons:	Don Newport; Federal Aviation Administration; Reno, NV David Studtmann; Honeywell; Phoenix, AZ Rafe Russell; Mountain LifeFlight; Susanville, CA Lindsay Cunningham; American Eurocopter; Arlington, TX
Original Publish Date:	August 29, 2013
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=75051

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The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available here.