National Transportation Safety Board
Aviation Accident Final Report

Location:	El Paso, Texas	**Accident Number:**	CEN10FA113
Date & Time:	February 5, 2010, 19:20 Local	**Registration:**	N157BC
Aircraft:	Aerospatiale AS350	**Aircraft Damage:**	Substantial
Defining Event:	Loss of control in flight	**Injuries:**	3 Fatal
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled - Air Medical (Discretionary)		

Analysis

The commercial pilot and two paramedics were dispatched to a remote desert area for a simulated patient pick up. This was the pilot's second company flight and first uninstructed night vision goggle (NVG) flight since his recent company training. While maneuvering for the landing zone, ground personnel observed the helicopter orbit one or two times and the pilot was using the non-NVG spotlight to illuminate the ground. Ground personnel then observed the helicopter make a wide orbit before it banked about 45 degrees, entered a steep nose-down attitude, and impacted the ground. None of the witnesses reported an attempt by the helicopter to avoid an impact with the ground. A postcrash fire ensued. An examination of the airframe and engine did not reveal any preimpact anomalies that would have precluded the safe operation of the helicopter.

On the night of the accident there was zero percent moon illumination and very little cultural lighting in the remote area where the accident occurred, resulting in low visual contrast when using NVG's. The pilot's recent NVG training had all been conducted on nights with high moon illumination and in populated areas with high amounts of cultural lighting and did not prepare the pilot for flight in the conditions encountered on the night of the accident. The low visual contrast conditions, combined with the narrow field of view of the NVG's, reduced the pilot's ability to maintain situational awareness. The lack of attempted recovery prior to ground impact suggests that the pilot did not recognize the helicopter's descent rate and bank angle.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's loss of situational awareness resulting in controlled flight into terrain. Contributing to the accident was the pilot's unfamiliarity with the hazards of a low-contrast area while using

night vision goggles.

Findings

Personnel issues	Situational awareness - Pilot
Personnel issues	(general) - Pilot
Environmental issues	Dark - Ability to respond/compensate

Factual Information

HISTORY OF FLIGHT

On February 5, 2010, approximately 1920 mountain standard time, an Aerospatiale AS350/B2 helicopter, N157BC, was substantially damaged upon impact with terrain while maneuvering in the McGregor Military Range, 23 miles northeast of El Paso, Texas. A postaccident fire ensued. The commercial pilot and two paramedics received fatal injuries. The helicopter was owned and operated by Enchantment Aviation Inc., D.B.A. Southwest Med Evac under the provisions of 14 Code of Federal Regulations Part 135 as a practice emergency medical services (EMS) flight. Night visual meteorological conditions prevailed for the flight, which operated without a flight plan. The flight departed the El Paso International Airport (KELP), El Paso, Texas, approximately 1825.

The flight was conducted under a contract with the United States Army and was attempting to pick up a soldier to simulate transporting injured Army personnel. The flight was to use night vision goggles (NVGs) and standard company practice was for the pilot and the paramedic seated in the left aft seat to be on NVGs.

Several Army personnel utilizing various night vision devices were in the vicinity of the accident. The Army personnel stated that the helicopter arrived to the south of the accident site and made two right turn orbits. The helicopter was seen turning on and panning the white spot light during these orbits. Personnel on the ground attempted to make radio contact with the helicopter but were not successful, so they began waving chemical light sticks in an attempt to signal the helicopter. The helicopter was then observed to make a third orbit which was wider than the first two. During the third orbit, the helicopter banked approximately 45 degrees and entered a steep nose down attitude before impacting the ground. None of the witnesses reported an attempt by the helicopter to avoid an impact with the ground.

PERSONNEL INFORMATION

The pilot, age 63, held a commercial pilot certificates for airplane single-engine land, helicopter, and instrument helicopter. In addition, the pilot held an airline transport pilot certificate for airplane, multi-engine land with Boeing 707, 720, 737, 757, 767, and Lockheed L-1011 type ratings. A review of his logbook revealed that he had logged over 17,610 hours total flight time with over 5,142 hours of rotorcraft time and over 3,351 hours of night time.

On July 10, 2009, he was issued a first class medical certificate with restrictions for "holder shall wear lenses that correct for distant vision and possess glasses that correct for near vision." In addition, the pilot had authorizations for special issuance of a medical certification for a history of vitreous exchange, retinal detachment, sclera buckle, cataract surgery, hyperopia, and glaucoma.

Review of the pilot's FAA medical records identified a history of cataract surgery with intraocular lens implants in both eyes (left eye 1998, right eye 2005); a bilateral vitreous exchange in 2004 for vitreal detachment with vitreous debris; a right retinal detachment in

2005 treated with a scleral buckle and cryotherapy; glaucoma, treated with eye drops; a "minor arcuate field loss right eye"; and an episode of cystoid macular edema with decreased visual acuity and "distortion" in his right eye in 2005 after his cataract surgery, persisting for several weeks. On September 18, 2008, the pilot was granted a 6-year Authorization for Special Issuance of a Medical Certification for his history of glaucoma, noting, in part, "... you must promptly report any adverse changes in your medical condition ... Because of your history of glaucoma, operation of aircraft is prohibited at any time new symptoms or adverse changes occur or if you experience side effects from, or require a change in medication ...." The pilot's most recent application for (first class) airman medical certificate, dated July 10, 2009, noted the pilot's corrected visual acuity to be 20/15 (distance), 20/20 (near) and 20/25 (intermediate) for each eye separately and for both eyes together. Visual field testing to 30 degrees performed on July 14, 2008 and June 26, 2009 demonstrated a small fixed peripheral right upper quadrant visual field deficit about 25 to 30 degrees out from the center. On November 13, 2009, the FAA indicated that the pilot was "eligible for continued Authorization for Special Issuance of a first class airman medical certificate" and noted that "operation of aircraft is prohibited at any time new symptoms or adverse changes occur or if you experience side effects or require a change in medication."

Review of records from the office of the pilot's optometrist and ophthalmologist identified two additional episodes of cystoid macular edema, not noted in the FAA records, involving distortion of vision in the right eye beginning in May of 2008 and in August of 2009, with complete resolution of symptoms after topical treatment for each event. Those records also documented laser surgery on November 6, 2009, to the left eye to help control the pilot's glaucoma, with a follow up evaluation on December 31, 2009, indicating that the pilot's "vision has been stable" with corrected distant visual acuity documented as 20/20 in the right eye and 20/20-2 in the left eye. No subsequent visits were noted.

The pilot completed an Airman Competency/Proficiency Check Part 135.293 (initial and recurrent pilot testing requirements), and 135.299 (pilot in command line check) checks on December 22, 2009. The pilot was graded satisfactory for all graded maneuvers. In addition, on January 29, 2010, the pilot completed an Airman Competency/Proficiency Check for night vision training in accordance with FAR 61.31

The commercial pilot had recently been hired by Enchantment Aviation Inc. having previously flown helicopters for the United States Army and was an auxiliary pilot for the Maricopa County Sheriff's Office. Attempts to locate the pilot's flight records through the auxiliary branch of the Sheriff's Air Support Unit were not successful.

The pilot began training with Enchantment Aviation near the end of November 2009, and on December 22, 2009, the pilot completed the company's initial pilot-in-command training. On January 29, 2010, the pilot had completed the company's NVG training program. At the time of the accident, the pilot had accumulated 22.3 hours in AS350 B3s, 1.4 hours in AS350 B2s, and 7.5 hours utilizing NVGs. The accident flight was the pilot's second non-training flight and was his first non-training NVG flight. The pilot had not operated in the McGregor Military Range prior to the accident.

According to the pilot's spouse, the pilot felt comfortable flying helicopters, did not make any

negative comments about the training he received, and felt prepared to be a pilot for the operator. Nor, did he express any concerns about flying with NVGs.

AIRCRAFT INFORMATION

The single-engine helicopter, N157BC, serial number 2418, was manufactured in 1991. It was powered by a 732-shaft horsepower Turbomeca Arriel 1D1 engine, serial number 9098. Review of the maintenance documents revealed that the last inspection was a continuous airworthiness inspection that occurred on October 29, 2009 at a total airframe time of 8,583.9 hours and an engine total time of 8,512.5 hours. According to company maintenance records, on the morning of the accident, the helicopter had accrued 8,594.7 airframe hours and 8,523.3 engine hours.

On January 5, 2009, the helicopter was modified via Supplemental Type Certificate for the installation of night vision goggle compatible interior lighting.

METEOROLOGICAL INFORMATION

At 1951, an automated weather reporting station at KELP, located 23 nautical miles southwest of the accident site reported wind calm, visibility 10 miles, skies clear, temperature 46 degrees Fahrenheit (F), dew point 28 F, and a barometric pressure of 30.13 inches of Mercury.

A review of astronomic data revealed zero moon illumination at the time of the accident. The moon did not rise until 0111 on February 6, 2010. Dark, rolling terrain prevailed in the accident area with ambient star light, distant city lights, chemical lights sticks, and infrared strobes being the only lighting available for the goggles to amplify.

COMMUNICATIONS

Enchantment Aviation had been acquired by Omniflight Helicopter Inc., Dallas, Texas. Omniflight's Mesa Communication Center in Mesa, Arizona, monitored the western region of flight operations for Omniflight. The communication center was staffed with full-time air medical service communication specialists, provided communication support, and monitored flight operations. During the accident flight, the aircrew was in GPS phone communications with the Communication Center.

On the night of the accident, around 1805, the McGregor Range contacted the Mesa Communication Center (Mesa) to dispatch a helicopter for the training exercise. The pilot was notified by Mesa of the training flight and the coordinates of the landing zone. At 1833, the pilot called Mesa and reported they were airborne. At 1847, an Army officer called Mesa and reported the helicopter was about 500 meters away but they did not have direct communications with the helicopter. Mesa and the Army officer discussed the possibility of communicating on the FM band since the ground personnel could not transmit on the VHF band. At 1854, the helicopter crew informed Mesa they were over the coordinates, but could not locate the landing zone. At 1900, the Army officer phoned Mesa and said the soldiers on the ground could not see or hear the helicopter and gave new coordinates for the landing zone. Mesa contacted the aircrew to relay the new coordinates. Shortly thereafter, McGregor Range

contacted Mesa and asked to redirect the helicopter towards the west since the helicopter was flying in the opposite direction. Mesa contacted the aircrew and informed the crew that they were flying in the opposite direction. The aircrew reported that they had just entered the new coordinates and were turning around. At 1923, the aircrew phoned Mesa and reported the landing zone was in sight, that they were commencing reconnaissance of the area, and would report landing. At 1927, McGregor Range personnel called Mesa to report a helicopter crash. Mesa placed another company helicopter on standby, attempted to contact the accident helicopter, and then launched the standby helicopter to the accident helicopter's last position.

WRECKAGE AND IMPACT INFORMATION

The helicopter collided with relatively level terrain which contained low-lying desert vegetation. The surrounding area was free of towers, transmission wires, and man-made obstacles. The primary accident site was located at an elevation of 4,830 feet mean sea level. The helicopter was found broken into several pieces, the largest of which were found in or near the 18-inch deep impact crater. All major components were accounted for at the accident site. The direction of impact was consistent with a magnetic heading of 300 degrees.

The postimpact fire consumed a majority of the cockpit instrumentation. The helicopter's gearbox transmission showed evidence of shearing at the drive shaft. Two of the three main rotor blades (the yellow and red labeled blades) remained attached to the hub. Both blades displayed signatures consistent with ground impact under power. Both respective blade sleeves exhibited broomstrawing, and both star arms were fractured at 45 degree angles consistent with overload. The blue (labeled) blade sleeve had separated in overload with the blade separating from the hub, and was located approximately 100 yards from the main wreckage. Its corresponding frequency adapter was located approximately 290 yards from the main wreckage. Portions of the Starflex coupling remained safetied to the blue blade.

The tail boom section was separated from the fuselage. The tail rotor drive shaft was found to be continuous with "splaying" damage at the engine to tail rotor driveshaft coupling. Tail rotor gearbox continuity was confirmed. Upon disassembly of the tail rotor gear box, the shaft key displayed signatures consistent with power of the time of impact and with a main rotor sudden stoppage. Both tail rotor blades remained attached to the tail rotor hub. One blade displayed signatures of a broom straw fracture while the other blade was bent and deformed; both blades displayed signs of thermal damage. The forward portion of the right skid toe was found fractured and embedded in hard soil with signatures consistent with an impact angle of 42 degrees nose low and 35 degrees of right bank. Both skids were found fractured from the fuselage in overload.

The engine, hydraulic pump, control servo actuators, and tail rotor actuator were examined under the supervision of the National Transportation Safety Board (NTSB). The examination of the hydraulic pump revealed all components present in an undamaged condition with evidence of adequate lubrication; no anomalies were detected. Although the control servo and tail rotor actuators were heavily damaged; no anomalies were detected during their examination.

An examination of the engine revealed no pre-impact anomalies. Of note, the index marks on the input drive gear and lock nut of the reduction gearbox were misaligned 2 to 3 millimeters;

consistent with power being applied from the engine side, at the time of a sudden blade stoppage. In addition, the free wheel shaft assembly was bent approximately 11 centimeters from the shaft end, also consistent with power being applied from the engine at the time of a sudden blade stoppage. A small quantity of soil and rocks was recovered from the diffuser section, while approximately one cup of "burnt" soil was recovered from the engine's combustion chamber; both findings are consistent with the engine continuing to operate and ingest particles after ground impact.

MEDICAL AND PATHOLOGICAL INFORMATION

An autopsy was performed on the pilot on February 5, 2010, by the Office of the Armed Forces Medical Examiner, as authorized by the Office of the Armed Forces Medical Examiner in accordance with 10 United States Code 1471. The manner of death was as an accident.

Forensic toxicology was performed on specimens from the pilot by the Armed Forces Institute of Pathology, Washington, District of Columbia. The condition of specimens were "marked putrefaction." A screening for carbon monoxide, cyanide, volatiles (with ethanol detected over 20 mg/dl), and drugs was negative. Additional forensic toxicology performed by the FAA Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, noted the following:

18 (mg/dL, mg/hg) ETHANOL detected in Muscle
NO ETHANOL detected in Liver
1 (mg/dL, mg/hg) N-PROPANOL detected in Muscle

Notes: The ethanol found in this case is from sources other than ingestion.

Ethanol found in the specimens were consistent with postmortem production.

ADDITIONAL INFORMATION

ITT Night Vision & Imaging Aviator Night Vision Imaging System (ANVIS)-9 F4949

The operator utilized a Generation III ANVIS 9 system for their aircrews. According to company personnel, the pilot and one additional crew member were to utilize the ANVIS 9 during NVG operations. According to a student handout provided to company pilots, the F4949 intensified light 2,000 to 3,500 times. Marketing documents stated that the ANVIS 9 has a 40 degree nominal field of view (FOV).

Both sets of goggles were found at the accident site. However, damage sustained to the devices precluded an examination of the systems. Both goggles exhibited signatures consistent with the goggles being worn by the aircrew and in the down position at the time of impact.

Night Vision Goggle (NVG) Training

The pilot entered the company's NVG training program on January 25, 2010, with the completion of a Night Vision Ground School Written test. The pilot flew NVG training flights on the nights of January 26, 27, and 29, 2010. Flight records indicated that the flights occurred

near Las Cruces International Airport (KLRU), Las Cruces, New Mexico. Meteorological information for this area revealed a waxing to full moon with illumination 83 percent, 91 percent, 100 percent respectively. On the night of January 29, 2010, the pilot flew two flights with the same instructor/check airmen. The pilot flew 2.0 hours followed by an Airman Competency/Proficiency Check for night vision goggle operations flight which lasted 0.5 hours with 0.1 hours of simulated instrument time.

Below is a table of the training flights' takeoff time, landing time, time of civil twilight and time of astronomical twilight.

Date	Takeoff time	Landing time	Civil Twilight	Astronomical twilight
26 Jan 2010	1832	2057	1801	1900
27 Jan 2010	1757	2057	1802	1901
29 Jan 2010	1819	2057	1804	1902

United States Army Field Manual (FM) 3-04.203, Fundamentals of Flight, May 2007

The Army has incorporated NVGs into their flying programs for decades, making their knowledge base larger than most organizations. While not required reading for civilian pilots, FM 3-04.203 is constructed to educate pilots of the principles surrounding aviation for them to be better prepared to react to unexpected conditions. In chapter four, titled "Rotary-Wing Night Flight," several passages describe the hazards and risks of night flight with night vision systems. Key observations are that the NVGs have a tendency to distort depth perception and distance estimation with the quality of depth perception being dependent on ambient light, terrain surface conditions, the ability of the NVG device, and the pilot's experience flying in those conditions. In addition, the reduced FOV of the NVG reduces peripheral vision dependent on the NVG's FOV. Scanning terrain becomes the pilot's primary method of maintaining situational awareness. Any flight maneuver involving a large bank angle tends to induce spatial disorientation. When landing at night, pilots are warned that altitude, ground speed, and rates of closure are difficult to estimate.

SkyConnect data

The helicopter was equipped with a Sky Connect system which utilizes 66 Iridium low-orbit satellites and an on-board TRACKER-Automatic Flight Following (AFF) configured to provide position reports about every minute. The data retrieved displayed the accident helicopter's flight path as it departed KELP for the McGregor Range. The helicopter track depicted a course following US Highway 54 for several miles before heading east. The heading continued for about 25 miles before maneuvering near a point. This maneuvering corresponded with the aircrew's call back to their control center that they were over the destination and could not locate the landing zone; the aircrew then received new coordinates for the landing zone. The data showed the helicopter moving in the opposite direction of the coordinates for approximately 15 miles before Mesa radioed that their course was in the wrong direction. The track turned towards the coordinates and at least one orbit is depicted before the track ends near the accident site. The final plot was at 1919:45 with the helicopter at 6,155 feet mean sea level (approximately 1,200 feet above ground level) traveling at 92 knots.

History of Flight

Approach	Loss of control in flight (Defining event)

Pilot Information

Certificate:	Airline transport; Commercial	**Age:**	63,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Front
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	July 10, 2009
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	December 22, 2009
Flight Time:	17610 hours (Total, all aircraft), 1 hours (Total, this make and model), 24 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Aerospatiale	**Registration:**	N157BC
Model/Series:	AS350 B2	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	2418
Landing Gear Type:	High skid	**Seats:**	
Date/Type of Last Inspection:	October 29, 2009 Continuous airworthiness	**Certified Max Gross Wt.:**	4961 lbs
Time Since Last Inspection:	14 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	8596 Hrs at time of accident	**Engine Manufacturer:**	TURBOMECA
ELT:	C91A installed, not activated	**Engine Model/Series:**	ARRIEL1D1
Registered Owner:		**Rated Power:**	732 Horsepower
Operator:		**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:	SOUTHWEST MED EVAC	**Operator Designator Code:**	NE6A

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night/dark
Observation Facility, Elevation:	KELP,3959 ft msl	**Distance from Accident Site:**	28 Nautical Miles
Observation Time:	19:51 Local	**Direction from Accident Site:**	245°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:		**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.12 inches Hg	**Temperature/Dew Point:**	8°C / -2°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	EL PASO, TX (KELP)	**Type of Flight Plan Filed:**	Company VFR
Destination:	MCGREGOR RANGE, NM	**Type of Clearance:**	VFR
Departure Time:	18:27 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	3 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 Fatal	**Latitude, Longitude:**	32.10889,-105.955001(est)

Administrative Information

Investigator In Charge (IIC):	Aguilera, Jason
Additional Participating Persons:	Robert O'Haver; Federal Aviation Administration; Albuquerque, NM Matt Rigsby; Federal Aviation Administration; Fort Worth, TX Archie Whitten; Turbomeca USA; Grand Prairie, TX Lindsay Cunningham; American Eurocopter; Grand Prairie, TX Thomas Smith; Omniflight Helicopters, Inc; Phoenix, AZ Ronald Price; National Transportation Safety Board; Washington, DC
Original Publish Date:	November 29, 2011
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=75342

The National Transportation Safety Board (NTSB), established in 1967, is an independent federal agency mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

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.