Aviation Investigation Final Report

Location:	Newfield, Arizona	**Accident Number:**	WPR13TA051
Date & Time:	November 23, 2012, 14:10 Local	**Registration:**	N3984A
Aircraft:	Eurocopter AS350B3 2B1	**Aircraft Damage:**	Substantial
Defining Event:	Ground resonance	**Injuries:**	1 Minor
Flight Conducted Under:	Public aircraft		

Analysis

About 2 hours into his mission, the pilot decided to take a lunch break. After landing the helicopter in a suitable area, although with potholes and cattle hoof prints in the dried mud, the pilot performed a stability check with the cyclic and then lowered the collective to the full-down position. With the engine at 100-percent power, the pilot added cyclic and collective friction to prevent the controls from inadvertently moving while he reached to retrieve his lunch from a bag located just aft and right of his seat; he did not engage the collective lock. The pilot let go of the cyclic with his left hand and, while guarding it with his legs, used both hands to seal the lunch bag and replace it behind the seat, which resulted in the pilot experiencing a momentary loss of situational awareness due to distraction. At that moment, the pilot felt the nose of the helicopter begin to get light on the skids with a slight upward pitch change. The pilot then placed both hands back on the controls and added forward cyclic to correct for the increase in pitch and to ensure positive skid contact with the ground; the cyclic and collective friction remained applied. The helicopter then began to exhibit vertical dynamic oscillations, which continued to resonate and worsen, consistent with the onset of ground resonance. It is likely that at least one, if not both, ground resonance straps were in a pothole depression and not in contact with the ground. When the condition worsened, the pilot made a positive collective application to lift the helicopter off the ground in an attempt to regain stability. As the helicopter began to ascend, it lurched forward and downward in an unusually nose-low attitude, which resulted in the lower wire strike blade contacting the ground and establishing a pivot point. The pilot then made an aggressive aft cyclic movement with a positive collective input to arrest the nose-down attitude. The tail skid subsequently impacted the ground, pushed the vertical fin and tail rotor gearbox upward, and severed the tail rotor drive shaft forward of the tail rotor gearbox. The tail of the helicopter then bounced upward from the impact followed by an uncommanded left yaw around its nose. The helicopter continued to spin left until the pilot reduced the collective to arrest the spin. The helicopter then touched down in a nose-up attitude and settled upright on its skids. A postaccident examination of the helicopter revealed that the pilot's inability to regain control was due to the loss of the tail rotor drive, which occurred as a result of the pilot's aggressive overapplication of the flight controls. The pilot's actions resulted in the tail skid impacting terrain, which damaged the tail rotor gear box and severed the tail rotor drive shaft.

Probable Cause and Findings

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

The pilot's distraction while retrieving an item behind him while the helicopter was on the ground with the engine running, which led to his aggressive overapplication of the flight controls after experiencing a ground resonance condition and subsequent loss of helicopter control.

Findings

Personnel issues	Task monitoring/vigilance - Pilot
Personnel issues	Incorrect action sequence - Pilot
Personnel issues	Aircraft control - Pilot

Factual Information

History of Flight

Standing-engine(s) operating	Ground resonance (Defining event)
Takeoff	Collision with terr/obj (non-CFIT)
Maneuvering-hover	Controlled flight into terr/obj (CFIT)
Maneuvering-hover	Loss of control in flight
Landing-flare/touchdown	Abnormal runway contact

HISTORY OF FLIGHT

On November 23, 2012, about 1410 mountain standard time, an American Eurocopter Corporation AS350 B3 helicopter, N3984A, was substantially damaged following a loss of control while maneuvering near Newfield, Arizona. The helicopter was registered to the Customs and Border Protection (CBP), Washington, D.C. The certified commercial pilot, the sole occupant, was not injured. Visual meteorological conditions prevailed for the routine air patrol mission, which was conducted as a Public Use flight, and a CBP flight plan was filed. The flight departed Davis Monthan Air Force Base (DMA), Tucson, Arizona, about 1210.

According to a statement submitted to the National Transportation Safety Board (NTSB) investigator-in-charge (IIC) by CBP management personnel, it was reported that about 1 hour into the mission the pilot was diverted to assist other Border Patrol Agents (BPA). About 45 minutes later the pilot departed the area, and shortly thereafter he decided to take a lunch break; he landed in a confined area about 2 miles north of the U.S./Mexico border along his search track. During the investigation, CBP investigators revealed that while the landing zone selected by the pilot was suitable, the pilot could not recall the exact point of landing in relation to numerous potholes and cattle hoof prints in the dried mud. As there were no discernable skid markings or ground scarring due to the hard surface, the investigation team could not definitively identify the original skid marks, particularly the ground resonance straps.

After landing, the pilot performed a stability check with the cyclic and then lowered the collective to the full down position. With the Nr at 100%, the pilot added cyclic and collective friction (without engaging the collective lock) to prevent the controls from moving inadvertently. He then took his lunch from a bag located just aft and to the right of his seat against the cabin door. After he retrieved his lunch, the pilot took a small container from the bag and placed it on the vacant passenger seat beside him. In the process of replacing the lunch bag, the pilot felt the nose of the helicopter begin to get light on the skids, with a slight pitch up. The pilot placed his hands back on the controls and added full forward cyclic to correct for the increase in nose up pitch, and insure positive skid contact with the ground. Within seconds, the aircraft began to exhibit vertical dynamic oscillations that continued to resonate and worsen. The pilot then made a positive collective application to lift the aircraft off the ground and regain aircraft stability. During the investigation CBP investigators reported that "…it is conceivable that at

least one, if not both, ground resonance straps were in a pothole depression and not in contact with the ground at the time the aircraft's nose pitched up and initial cyclic movement took place."

Subsequent to the helicopter lifting off of the ground, it lurched forward and downward in an unusually nose-low attitude. This resulted in the lower wire strike blade contacting the ground, and establishing a pivot point. The pilot then made an aggressive aft cyclic movement with positive collective input, which resulted in the tail skid contacting the ground and pushing the vertical fin and tail rotor gearbox upward. The main rotor then severed the tail rotor drive shaft forward of the tail rotor gear box. The helicopter's tail section then bounced upward, followed immediately by an uncommanded left yaw around the nose of the helicopter. The aircraft continued to spin to the left until the pilot made a reduction in collective to arrest the spin. The helicopter touched down in a nose up attitude with a slight aft drift, and settled on its skids. After exiting the helicopter, the PIC observed that the aft section of the tail boom was severed and the tail rotor was missing.

PERSONNEL INFORMATION

The pilot, age 32, possessed a commercial pilot certificate with rotorcraft-helicopter, and an instrument helicopter rating. He held a second-class Federal Aviation Administration (FAA) airman medical certificate, which was issued on March 22, 2012.

According to data provided by the CBP, at the time of the accident the pilot had accumulated a total flight time of 2,240 hours, with 1,900 hours as pilot in command, and 655 hours in the make and model of the accident helicopter. The pilot's flight times over the last 30, 60, and 90 days respectively were 58.5, 72.9, and 95.4. The pilot's flight time in the AS-350 helicopter over the last 30, 60, and 90 days respectively were 40.2, 50.3, and 70.8 hours. Additionally, the pilot successfully completed his annual proficiency evaluation on May 27, 2012.

AIRCRAFT INFORMATION

The accident helicopter was an American Eurocopter Corporation AS350B3 2B1, serial number 7105, which was acquired by the CBP in 2011. The helicopter's most recent Continuous Airworthiness inspection was performed on November 16, 2012, at an aircraft total time of 1000 hours. At the time of the accident the helicopter had accumulated 56 hours of flight time, for a total airframe time at the time of the accident of 1,056 hours. The helicopter was equipped with a single turbo-shaft Turbomeca model 2B1 engine, which produced 543 shaft horsepower.

METERORLOGICAL INFORMATION

CBP personnel reported that about the time of the accident the sky was clear, gusty winds prevailed from the southeast, and that the temperature was about 84° Fahrenheit (29° Celsius).

At 1354, about 16 minutes prior to the reported time of the accident, the weather reporting facility at the Nogales International Airport (OLS), Nogales, Arizona, located about 44 nm east-southeast of the accident site, reported wind 080° at 12 knots, visibility 10 miles, sky clear, temperature 27° C, dew point -02° C, and an altimeter setting of 30.18 inches of mercury.

WRECKAGE AND IMPACT INFORMATION

On December 5, 2012, a damage assessment team from American Eurocopter reported that the helicopter had sustained damage to the tail cone, vertical fins, tail rotor drive train, tail rotor blades and pitch change spider assembly, right hand landing gear spring was bent upwards, the lower wire strike component had been bent. It was also revealed that the engine produced a "grinding noise" when it was rotated.

MEDICAL AND PATHOLOGICAL INFORMATION

The CBP reported that the pilot had received a minor injury as a result of the accident. Additionally, it was reported that the pilot was sufficiently rested prior to this mishap, and that there was no evidence that he was fatigued, or suffering from any human factor issues that would have adversely affected his ability to perform crewmember duties. There was no evidence of any adverse medical histories or chronic or acute ailments discovered during the course of this investigation.

TESTS AND RESEARCH

The aircraft's Appareo Vision 1000 cockpit camera was transported to the NTSB Laboratory, Vehicle Recorder Division, which is located at its headquarters in Washington, D.C. The objective was to recover the two non-volatile memory modules, the internal memory component, and the removable standard digital card. The download and tests of the components were negative for data associated with this accident.

ADDITIONAL INFORMATION

Appareo Vision 1000 Camera System

During the course of the investigation it was discovered that an Appareo Vision 1000 camera, a small self-contained image, audio, and data recorder, which was mounted inside the aircraft at the time of the accident, had been unplugged. It was revealed that the last recording came at/near September 22, 2012, which was about two months prior to the date of the accident. As a result, the existing recordings on the internal media card yielded no information associated with the accident flight. CBP personnel stated that had the camera been in operation, the recovered data would have been critical to the investigation of this accident and would have answered many questions that were left to answer through other investigative methods.

Situational Awareness

The Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25) defined situational awareness as the "accurate perception of the operational and environmental factors that affect the airplane, pilot, and passengers during a specific period of time." The handbook stated that a situationally aware pilot "has an overview of the total operation and is not fixated on one perceived significant factor."

Ground Resonance

According to the FAA Rotorcraft Flying Handbook, FAA-H-8083-21, "Ground resonance is an aerodynamic phenomenon associated with full-articulated rotor systems. It develops when the rotor blades move out of phase with each other and cause the rotor disc to become unbalanced. This condition

can cause a helicopter to self-destruct in a matter of seconds. However, for this condition to occur, the helicopter must be in contact with the ground.

Pilot Information

Certificate:	Commercial	**Age:**	31
Airplane Rating(s):	None	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	Unknown
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	March 22, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	July 30, 2012
Flight Time:	2240 hours (Total, all aircraft), 687 hours (Total, this make and model), 1900 hours (Pilot In Command, all aircraft), 95 hours (Last 90 days, all aircraft), 59 hours (Last 30 days, all aircraft), 5 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Eurocopter	**Registration:**	N3984A
Model/Series:	AS350B3 2B1	**Aircraft Category:**	Helicopter
Year of Manufacture:	2011	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	7105
Landing Gear Type:	Skid	**Seats:**	6
Date/Type of Last Inspection:	November 16, 2012 Continuous airworthiness	**Certified Max Gross Wt.:**	5225 lbs
Time Since Last Inspection:	56 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	1056 Hrs at time of accident	**Engine Manufacturer:**	Turbomeca
ELT:	C126 installed, not activated	**Engine Model/Series:**	2B1
Registered Owner:	Department of Homeland Security	**Rated Power:**	543 Horsepower
Operator:	Department of Homeland Security	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	OLS,3955 ft msl	**Distance from Accident Site:**	44 Nautical Miles
Observation Time:	13:58 Local	**Direction from Accident Site:**	100°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	12 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	80°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.18 inches Hg	**Temperature/Dew Point:**	27°C / -2°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Tucson, AZ (DMA)	**Type of Flight Plan Filed:**	None
Destination:	Tucson, AZ (DMA)	**Type of Clearance:**	None
Departure Time:	12:08 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Minor	**Latitude, Longitude:**	31.543056,-111.692497

Administrative Information

Investigator In Charge (IIC):	Little, Thomas
Additional Participating Persons:	James Mills; US Customs and Border Protection; Washington, DC Philippe Roblin; Bureau e'Enquetes et d'Analyses; Le Bourget
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Investigation Class:	Class
Note:	
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