



# National Transportation Safety Board Aviation Accident Final Report

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<b>Location:</b>	Cherokee, Alabama	<b>Accident Number:</b>	NYC08FA071
<b>Date &amp; Time:</b>	December 30, 2007, 03:06 Local	<b>Registration:</b>	N109AE
<b>Aircraft:</b>	Bell 206L-3	<b>Aircraft Damage:</b>	Substantial
<b>Defining Event:</b>		<b>Injuries:</b>	3 Fatal
<b>Flight Conducted Under:</b>	Part 91: General aviation - Positioning		

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## Analysis

The helicopter was maintaining a searchlight on a lost hunter as ground personnel attempted to execute a rescue. During the maneuver, the pilot was flying in an out-of-ground-effect hover, or very slow flight below effective translational lift, about 100 to 150 feet above the trees. The maneuver was contrary to the operations manual, which required a minimum altitude of 500 feet above ground level for night searches. It was also contrary to the operations manual as the maneuver fell inside the height-velocity diagram curve, published in the make and model rotorcraft flight manual (RFM). In addition, a company flight data analyst in the communications center was attempting to persuade the pilot to terminate the search due to safety concerns as the helicopter was flying low and slow. The helicopter began to spin right and descend into trees, consistent with loss of tail rotor effectiveness (LTE). During the spin, witnesses reported an engine noise increase and "fireball" coming from the exhaust, most likely as a result of an over-speed/over-temperature condition as the pilot increased engine power attempting to recover from the spin. Review of the RFM did not reveal any information on LTE; however, the operator maintained an LTE training program, which the pilot had completed. Additionally, the Federal Aviation Administration had previously published Advisory Circular (AC) 90-95, which stated that LTE is not related to a maintenance malfunction and may occur in varying degrees in all single main rotor helicopters at airspeeds less than 30 knots. The AC further stated that flight operations at low altitude and low airspeed are particularly susceptible to LTE, with greater susceptibility in right turns. Examination of the wreckage did not reveal any pre-impact mechanical malfunctions.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's failure to maintain control of the helicopter during an out-of-ground-effect hover. Contributing to the accident was a loss of tail rotor effectiveness.

## Findings

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## Factual Information

### HISTORY OF FLIGHT

On December 30, 2007, at 0306 Central Standard Time, a Bell 206L-3, N109AE, owned and operated by Air Evac EMS Inc., was substantially damaged during collision with terrain while maneuvering near Cherokee, Alabama. The certificated airline transport pilot, paramedic, and flight nurse were killed. Night visual meteorological conditions prevailed, and a company flight plan was filed for the local aerial search flight conducted under the provisions of 14 Code of Federal Regulations (CFR) Part 91.

According to the Safety Program Manager at Air Evac, the flight was initiated after they were notified of a missing hunter, who may have been injured or suffering from exposure. The flight was a voluntary mission, as the operator would not receive payment for the flight unless the hunter required air transport to a hospital. The Safety Program Manager further stated that the three occupants were all employees of Air Evac, and as such, the flight was conducted under CFR Part 91. Although no flight plan was filed with the Federal Aviation Administration (FAA), Air Evac had a dispatch department, and maintained its own computerized flight-tracking program via "SkyTrac" software.

According to the operator's tracking data and recorded communications, the flight departed the operator's base, located about 5 miles south-southwest of Northwestern Alabama Regional Airport (MSL), Muscle Shoals, Alabama, at 0151, and arrived over the search area at 0159.

At 0250, the flight data analyst (FDA), working with the flight followers (sometimes referred to as flight communicators) in the operator's communication center, wanted to terminate the mission due to safety concerns. Specifically, the FDA was concerned about the helicopter flying low and slow to search for the hunter; however, the FDA did not have operational control of the flight as a dispatcher would have under 14 CFR Part 121. Rather, the FDA suggested, "...are you about ready to wrap up that search." The reply transmission from the helicopter was "broken up."

At 0257, the accident helicopter reported to the FDA that they were getting ready to terminate the search, when a gunshot was heard on the ground, so they were going back to the area where the sound was heard.

No further communications were received from the accident helicopter. Review of the flight tracking data revealed that data points were captured once per minute. Review of the 5 minutes preceding the accident revealed that the helicopter's groundspeed varied between 29 to 62 knots, and its altitude above mean sea level (msl) varied between 1,147 and 1,597 feet.

Several emergency personnel were on the ground, also searching for the hunter, and witnessed the accident. They reported that the helicopter crewmembers were about to terminate the search, when ground personnel heard a gunshot, which they perceived as a signal from the lost hunter. The ground personnel followed the gunshot noise, and located the hunter's vehicle. At the time, the helicopter had been flying away from the scene, but returned after the gunshot

noise was heard. The helicopter subsequently illuminated a searchlight in the vicinity of the vehicle, and then located the hunter. The helicopter crewmembers intended to maintain the light on the hunter until ground personnel could also locate him. At that time, the helicopter was about 100 to 150 feet above the trees, and in a hover or very slow flight, when the witnesses heard a decrease in engine noise, followed by an increase in engine noise. They then observed the helicopter spinning right, with a "fireball" near the engine exhaust, as it descended vertically into wooded terrain. The helicopter subsequently came to rest inverted, and a post crash fire ensued.

The hunter was subsequently interviewed by a captain from the Colbert County Sheriff Department. The hunter reported that while lost in darkness, he heard a helicopter. He then heard familiar voices of his brother and brother's friend. The hunter yelled a reply to the voices, and fired two rounds into the air from his "30-30 Winchester, model 94" rifle, to assist the rescuers. The rescuers reached the hunter, and then the helicopter "went down" into the trees. The hunter further stated that 10 minutes elapsed from the time he fired his rifle, until the helicopter flew overhead and crashed.

#### PERSONNEL INFORMATION

The pilot, age 41, held an airline transport pilot certificate, with a rating for rotorcraft helicopter. He also held a commercial pilot certificate, with ratings for airplane single-engine land, airplane multiengine land, glider, and instrument airplane. In addition, the pilot held a flight instructor certificate, with ratings for airplane single-engine, airplane multiengine, rotorcraft, instrument airplane, and glider.

The pilot's most recent FAA first-class medical certificate was issued on February 9, 2007.

The pilot's logbook was not recovered. According to the operator's estimate, at the time of the accident, the pilot had accumulated approximately 3,500 hours of flight experience; of which, 2,900 hours were in helicopters, with 400 hours in the same make and model as the accident helicopter. The operator also estimated 600 total hours of night experience for the accident pilot.

The pilot began employment with the operator during March 2007. On his employment application, the pilot reported 2,673 hours of total flight experience in helicopters, of which, 158 hours were in the same make and model as the accident helicopter. The pilot previously flew helicopters in the United States Coast Guard.

#### AIRCRAFT INFORMATION

According to company records, the helicopter was manufactured in 1989, and maintained under an FAA-Approved Airworthiness Inspection Program. The helicopter's most recent inspection was an "Event 1 Check," which was completed 4 days prior to the accident. The helicopter had flown 4.9 hours since that inspection, and had accumulated 5,091.9 total hours of operation at the time of the accident.

The helicopter was equipped with a Rolls Royce (Allison) model 250-C30P, 550-shaft

horsepower turbine engine. Review of the maintenance records revealed that the engine was installed on the helicopter in 2006, at 4,200.2 total engine hours.

#### METEOROLOGICAL INFORMATION

The reported weather at MSL, which was located about 15 nautical miles east of the accident site, at 0253, was: wind calm; visibility 5 miles in mist; broken ceiling at 7,500 feet; overcast ceiling at 8,500 feet, temperature 5 degrees Celsius, dew point 4 degrees Celsius; altimeter 30.02 inches of mercury.

#### WRECKAGE AND IMPACT INFORMATION

The wreckage was examined at the site on December 30 and 31, 2007. The accident site was located in the Freedom Hills Wildlife Management Area, a large hunting preserve with trees ranging in height about 60 to 80 feet. Numerous tree strikes were noted in the immediate vicinity above the main wreckage, and the terrain near the wreckage sloped 20 to 30 degrees. The main wreckage was consumed by post crash fire, and consisted of the cockpit, fuselage, and a majority of the tail boom. The wreckage was oriented about a 345-degree magnetic heading, at an elevation approximately 725 feet above mean sea level (msl). The tail boom exhibited crush damage, and had separated about 1 foot aft of the tail boom attach point. The aft section of tail boom separated about 2 feet aft of the horizontal stabilizer. The aft tail boom separation point exhibited evidence of main rotor blade strike from left to right. The forward end of the tail cone also exhibited evidence of a main rotor blade strike from left to right. Both main rotor blades were found in the wreckage, and had separated about 3 feet outboard of the rotor hub. They were partially burned and exhibited leading edge damage and red paint transfer, consistent with one or more tail boom strikes. The outboard sections of the main rotor blades exhibited s-bending.

Continuity of the main rotor drive train was confirmed from the engine, through the K-Flex shaft, to the transmission, and through the main rotor mast. The mast was embedded in the ground and extended through the main rotor hub. The trunion remained attached to the top of the mast by the mast retention nut. The inboard section of the main rotor blades remained attached to the hub at ground level. The main rotor pitch change links were separated about mid-span. Continuity of the tail rotor drive train, and the tail rotor pitch change linkage was established from the engine, to the tail rotor, except for the damaged locations where the tail boom separated.

The engine sustained post crash fire damage and was retained for further examination. The engine was subsequently disassembled at the manufacturer's facility, under the supervision of an FAA inspector, on February 13, 2008. The FAA inspector noted that the gearbox had been consumed by fire, and the compressor exhibited impact and fire damage. Turbine disassembly revealed minor rotational scoring on the second stage and fourth stage nozzles. The scoring was located at the 6 o'clock position and was consistent with in both gas producer and power turbine rotor tracking. The examination did not reveal any pre-impact mechanical malfunctions.

#### MEDICAL AND PATHOLOGICAL INFORMATION

An autopsy was performed on the pilot by the Alabama Department of Forensic Sciences, Huntsville, Alabama. The cause of death was reported as "blunt force crash injuries."

Toxicological testing on the pilot was performed by the FAA's Civil Aerospace Medical Institute, Oklahoma City, Oklahoma. All test results were negative for drugs and alcohol.

## TESTS AND RESEARCH

Although the accident flight was conducted under 14 CFR Part 91, the operator held an on-demand air taxi certificate under the provisions of 14 CFR Part 135. As such, the operator maintained an FAA-approved operations manual. Review of the operations manual revealed:

### "5.54 Search Procedures

Search operations are authorized as long as the minimum altitudes of 300 feet day and 500 feet night are complied with in addition to the other requirements of Para 5.17 of this manual. Avoidance of any operations within the height velocity curve (Bell 206L Flight Manual, Section 5) will be strictly adhered to."

Paragraph 5.17 also addressed visual flight rules (VFR) cloud clearances.

According to the Safety Program Manager at Air Evac, a flight conducted under 14 CFR Part 91 would not technically be required to adhere to the operations manual. The Safety Program Manager further stated that the searchlight was relatively ineffective above 300 feet above ground level (agl).

Review of a "Height-Velocity Diagram" (height-velocity curve) in a Bell 206L-3 Rotorcraft Flight Manual (RFM) revealed that at 100 feet agl, the helicopter would have to maintain a forward airspeed of at least 52 knots to remain outside the curve. At 200 feet agl, the helicopter would have to maintain a forward airspeed of at least 47 knots to remain outside the curve. At 300 feet agl, the helicopter would have to maintain a forward airspeed of at least 36 knots to remain outside the curve. At 400 feet agl, the helicopter would have to maintain a forward airspeed of at least 22 knots to remain outside the curve.

Review of the RFM did not reveal any information on loss of tail rotor effectiveness (LTE); however, the operator maintained an LTE training program, which the pilot had completed.

Review of FAA Advisory Circular 90-95 revealed, "LTE is a critical, low-speed aerodynamic flight characteristic which can result in an uncommanded rapid yaw rate which does not subside of its own accord and, if not corrected, can result in the loss of aircraft control. LTE is not related to a maintenance malfunction and may occur in varying degrees in all single main rotor helicopters at airspeeds less than 30 knots. LTE is not necessarily the result of a control margin deficiency...Flight operations at low altitude and low airspeed in which the pilot is distracted from the dynamic conditions that affecting control of the helicopter are particularly susceptible to this phenomena...There is greater susceptibility to LTE in right turns. This is especially true during flight at low airspeed since the pilot may not be able to stop rotation. The

helicopter will attempt to yaw to the right. Correct and timely pilot response to an uncommanded right yaw is critical. The yaw is usually correctable if additional left pedal is applied immediately. If the response is incorrect or slow, the yaw rate may rapidly increase to a point where recovery is not possible..."

#### ADDITIONAL INFORMATION

The NTSB issued a safety recommendation to the FAA on September 26, 1994. Number A-94-140 recommended that the FAA: Strongly encourage the manufacturers of single main rotor/anti-torque rotor helicopters to include in the operator's handbook, and flight manual, discussions of the characteristics of, and recovery techniques from the phenomenon known as LTE. On April 4, 1995, the FAA sent a letter to all U.S. helicopter manufacturers and European aviation authorities asking them to include in the operator's handbook, and flight manual, a discussion of the characteristics of LTE, and appropriate recovery techniques.

According to the Safety Board database (of completed accident investigations), during a 13-year period since the FAA sent letters on April 4, 1995, there have been about 78 accidents involving LTE. Of the 78 accidents, 37 involved a Bell 206 model helicopter, and 12 of those accidents involved serious injuries and/or fatalities.

#### OTHER INFORMATION

The weather conditions that existed at the accident site during the time of the accident were observed to be dark night conditions. The helicopter was equipped with a terrain awareness warning system (TAWS). The pilot was not utilizing a night vision imaging system (NVIS) during the flight. A radar altimeter was installed on the helicopter, but its setting was unknown. The accident flight was being tracked by a flight following program, and it received flight dispatch services prior to the initiation of the flight. Additionally, a formal flight risk assessment was performed prior to the flight.

On February 7, 2006, the NTSB issued four safety recommendations to the FAA addressing EMS operations. They are as follows:

NTSB Recommendation No. A-06-12 - Require all EMS operators to comply with 14 CFR Part 135 operations specifications during the conduct of all flights with medical personnel onboard.

NTSB Recommendation No. A-06-13 - Require all EMS operators to develop and implement flight risk evaluation programs that include training all employees involved in the operation, procedures that support the systematic evaluation of flight risks, and consultation with others trained in EMS flight operations if the risks reach a predefined level.

NTSB Recommendation No. A-06-14 - Require EMS operators to use formalized dispatch and flight-following procedures that include up-to-date weather information and assistance in flight risk assessment decisions.

NTSB Recommendation No. A-06-15 - Require EMS operators to install terrain awareness and warning systems on their aircraft and to provide adequate training to ensure that flight crews

are capable of using the systems to safely conduct EMS operations.

These four recommendations were also placed on the NTSB's "Most Wanted List of Safety Improvements" in October 2008.

Additionally, the NTSB stated in its January 2006 Special Investigation Report on EMS Operations that they were pleased that the FAA encouraged the use of night vision imaging systems in EMS operations, and that the NTSB would continue to monitor the applicability and usage of these devices in the EMS industry.

Also, on December 21, 2007, the NTSB issued two safety recommendations to the FAA regarding the use of radar altimeters in EMS night operations. They are as follows:

NTSB Recommendation No. A-07-111 - Require helicopter EMS operators to install radar altimeters in all helicopters used in HEMS night operations.

NTSB Recommendation No. A-07-112 - Ensure that the minimum equipment lists for helicopters used in helicopter EMS operations require that radar altimeters be operable during flights conducted at night.

## History of Flight

### Pilot Information

<b>Certificate:</b>	Airline transport; Commercial; Flight instructor	<b>Age:</b>	41, Male
<b>Airplane Rating(s):</b>	Single-engine land; Multi-engine land	<b>Seat Occupied:</b>	Right
<b>Other Aircraft Rating(s):</b>	Glider; Helicopter	<b>Restraint Used:</b>	
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	No
<b>Instructor Rating(s):</b>	Airplane multi-engine; Airplane single-engine; Glider; Helicopter; Instrument airplane	<b>Toxicology Performed:</b>	Yes
<b>Medical Certification:</b>	Class 1 Without waivers/limitations	<b>Last FAA Medical Exam:</b>	February 1, 2007
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	March 1, 2007
<b>Flight Time:</b>	3500 hours (Total, all aircraft), 400 hours (Total, this make and model), 2500 hours (Pilot In Command, all aircraft), 79 hours (Last 90 days, all aircraft), 17 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

## Aircraft and Owner/Operator Information

<b>Aircraft Make:</b>	Bell	<b>Registration:</b>	N109AE
<b>Model/Series:</b>	206L-3	<b>Aircraft Category:</b>	Helicopter
<b>Year of Manufacture:</b>		<b>Amateur Built:</b>	
<b>Airworthiness Certificate:</b>	Normal	<b>Serial Number:</b>	51317
<b>Landing Gear Type:</b>	Skid	<b>Seats:</b>	4
<b>Date/Type of Last Inspection:</b>	December 1, 2007 AAIP	<b>Certified Max Gross Wt.:</b>	4150 lbs
<b>Time Since Last Inspection:</b>	5 Hrs	<b>Engines:</b>	1 Turbo shaft
<b>Airframe Total Time:</b>	5092 Hrs at time of accident	<b>Engine Manufacturer:</b>	Rolls-Royce
<b>ELT:</b>	Installed, not activated	<b>Engine Model/Series:</b>	250-C30P
<b>Registered Owner:</b>		<b>Rated Power:</b>	550 Horsepower
<b>Operator:</b>		<b>Operating Certificate(s) Held:</b>	On-demand air taxi (135)
<b>Operator Does Business As:</b>		<b>Operator Designator Code:</b>	EVCA

## Meteorological Information and Flight Plan

<b>Conditions at Accident Site:</b>	Visual (VMC)	<b>Condition of Light:</b>	Night
<b>Observation Facility, Elevation:</b>	MSL, 550 ft msl	<b>Distance from Accident Site:</b>	15 Nautical Miles
<b>Observation Time:</b>	02:53 Local	<b>Direction from Accident Site:</b>	90°
<b>Lowest Cloud Condition:</b>		<b>Visibility</b>	5 miles
<b>Lowest Ceiling:</b>	Broken / 7500 ft AGL	<b>Visibility (RVR):</b>	
<b>Wind Speed/Gusts:</b>	/	<b>Turbulence Type Forecast/Actual:</b>	/
<b>Wind Direction:</b>		<b>Turbulence Severity Forecast/Actual:</b>	/
<b>Altimeter Setting:</b>	30.02 inches Hg	<b>Temperature/Dew Point:</b>	5°C / 4°C
<b>Precipitation and Obscuration:</b>	N/A - None - Mist		
<b>Departure Point:</b>	Muscle Shoals, AL (NONE)	<b>Type of Flight Plan Filed:</b>	Company VFR
<b>Destination:</b>		<b>Type of Clearance:</b>	None
<b>Departure Time:</b>	01:51 Local	<b>Type of Airspace:</b>	

## Wreckage and Impact Information

<b>Crew Injuries:</b>	3 Fatal	<b>Aircraft Damage:</b>	Substantial
<b>Passenger Injuries:</b>	N/A	<b>Aircraft Fire:</b>	On-ground
<b>Ground Injuries:</b>	N/A	<b>Aircraft Explosion:</b>	None
<b>Total Injuries:</b>	3 Fatal	<b>Latitude, Longitude:</b>	34.68861,-87.919998

## Administrative Information

<b>Investigator In Charge (IIC):</b>	Gretz, Robert
<b>Additional Participating Persons:</b>	George Castleberry; FAA/FSDO; Birmingham, AL David C Dosker; Bell Helicopter; Fort Worth, TX Micahel A Weber; Rolls Royce; Indianapolis, IN Dave Hardin; Air Evac EMS Inc; West Plains, MO
<b>Original Publish Date:</b>	January 15, 2009
<b>Note:</b>	The NTSB traveled to the scene of this accident.
<b>Investigation Docket:</b>	<a href="https://data.ntsb.gov/Docket?ProjectID=67312">https://data.ntsb.gov/Docket?ProjectID=67312</a>

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](#).