
		NTSB ID: CHI06GA241		Aircraft Registration Number: N554CP	
		Occurrence Date: 08/19/2006		Most Critical Injury: None	
		Occurrence Type: Accident		Investigated By: NTSB	
Location/Time					
Nearest City/Place Columbus	State OH	Zip Code 43224	Local Time 1639	Time Zone EDT	
Airport Proximity: Off Airport/Airstrip		Distance From Landing Facility:			
Aircraft Information Summary					
Aircraft Manufacturer McDonnell Douglas Helicopters		Model/Series 369E		Type of Aircraft Helicopter	
Revenue Sightseeing Flight: No			Air Medical Transport Flight: No		
Narrative					
<p>Brief narrative statement of facts, conditions and circumstances pertinent to the accident/incident:</p> <p>*** Note: : NTSB investigators either traveled in support of this investigation or conducted a significant amount of investigative work without any travel, and used data obtained from various sources to prepare this public aircraft accident report. ***</p> <p>HISTORY OF FLIGHT</p> <p>On August 19, 2006, at 1639 eastern daylight time, a McDonnell Douglas Helicopters model 369E, N554CP, operated by the City of Columbus Police Department and piloted by a commercial pilot, was substantially damaged during an uncontained engine failure while in cruise flight over Columbus, Ohio. The pilot performed an autorotation and landed without further damage to the helicopter. Visual meteorological conditions prevailed at the time of the accident. The public-use flight was operating under the provisions of 14 Code of Federal Regulations (CFR) Part 91. The pilot and the observer officer were not injured. The local area flight departed at 1600 from the Columbus Heliport (OH52), Columbus, Ohio.</p> <p>The flight crew was conducting a routine patrol flight over the Columbus area when they were dispatched to a crime scene to provide aerial support for responding ground units. The pilot increased engine power and accelerated to a cruise speed of about 110 knots indicated air speed (KIAS). While en route to the crime scene, between 1,300 and 1,400 feet mean sea level (msl), the pilot heard a loud explosion. At that point, the N1 (gas producer) gauge displayed zero percent rpm, the engine power output (EPO) warning horn sounded, and the annunciator panel displayed several warnings.</p> <p>The pilot stated that the airframe was shaking significantly as he entered an emergency autorotation. He performed a run-on landing to an open parking lot area, and the helicopter slid 150-180 feet before coming to rest upright. The pilot performed an emergency shutdown of the helicopter; rotated the throttle to the off position, pulled the emergency fuel shut-off, and turned-off the battery, generator, and ignition. The observer officer released his safety restraints and exited the helicopter without difficulty. He proceeded to the rear of the helicopter and notified the pilot of an engine fire. The pilot immediately released his safety restraints and exited the helicopter without difficulty. He then extinguished the engine fire using a hand-held Halon fire extinguisher.</p> <p>PERSONNEL INFORMATION</p> <p>According to Federal Aviation Administration (FAA) records, the pilot of N554CP, age 45, held a commercial pilot certificate with rotorcraft-helicopter and airplane single-engine land ratings. His airplane rating was limited to private pilot privileges. He was not instrument rated. The pilot's last aviation medical examination was completed on September 29, 2005, when he was issued a second-class medical certificate with the limitation that he wear corrective lenses.</p> <p>The pilot reported having 973.3 hours total flight time. He had flown 874.0 hours in rotorcraft and 99.3 hours in single-engine airplanes.</p>					
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## Narrative (Continued)

He had accumulated 842.0 hours as pilot-in-command (PIC) in rotorcraft. He had flown 826.4 hours in a McDonnell Douglas Helicopters model 369E. His last flight review was completed on July 10, 2005, in a McDonnell Douglas Helicopters model 369E.

During the previous 90-days, 30-days, and 24-hours, the pilot had flown 110.4 hours, 35.7 hours, and 0.7 hours total flight time, respectively. The flight time accumulated during those periods was completed in a McDonnell Douglas Helicopters model 369E.

## AIRCRAFT INFORMATION

The City of Columbus Police Department used the 1999 McDonnell Douglas Helicopters model 369E, serial number 0542E, as a public-use helicopter. The helicopter had a five-bladed main rotor system, a four-bladed tail rotor system, and was powered by a single 420 shaft-horsepower Rolls-Royce model 250-C20B, serial number CAE 836964, turbo shaft engine. The helicopter's maximum gross weight was 3,000 pounds and was configured to accommodate a pilot and three passengers. At the time of the accident, the airframe and engine had accumulated 6,639.7 hours in service. The helicopter had accumulated 41.4 hours since the last maintenance inspection, which was completed on August 8, 2006.

At the time of departure, the helicopter had 64-gallons of Jet-A fuel onboard and weighed 2,534 lbs, with a center-of-gravity location of 100.9 inches aft of datum.

A review of the maintenance logbook records found no history of unresolved airworthiness issues.

## METEOROLOGICAL INFORMATION

The closest weather reporting facility was at the Ohio State University Airport (OSU), about 5.2 miles west-northwest of the accident site. The airport was equipped with an automated surface observing system (ASOS).

At 1653, the OSU ASOS reported the following weather conditions: Wind 310 degrees true at 11 knots; visibility 10 miles; scattered clouds at 3,600 feet above ground level (agl), broken ceilings at 4,700 and 6,000 feet agl; temperature 28 degrees Celsius; dew point 21 degrees Celsius; altimeter setting 29.91 inches of mercury.

The next closest weather reporting facility was at the Port Columbus International Airport (CMH), about 6.3 miles southeast of the accident site. The airport was equipped with an ASOS.

At 1651, the CMH ASOS reported the following weather conditions: Wind 290 degrees true at 15 knots, gusting to 21 knots; visibility 10 miles; scattered towering cumulus clouds at 4,500 feet agl, broken ceiling at 20,000 feet agl; temperature 30 degrees Celsius; dew point 19 degrees Celsius; altimeter setting 29.89 inches of mercury.

## FLIGHT RECORDERS

The accident helicopter was not equipped, nor was it required to be equipped, with a cockpit voice recorder or flight data recorder.

## WRECKAGE AND IMPACT INFORMATION

Initial inspection of the engine revealed that portions of the 1st-stage gas producer wheel had departed the engine. Parts of the 1st-stage gas producer wheel were found on the engine deck. The power turbine rotor turned freely by hand and remained attached to the power turbine output.

There were several punctures with outward deformation noted on the engine compartment, engine cowling, and engine access doors. Additionally, the tailboom primary structure and skin contained punctures with outward deformation.

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## Narrative (Continued)

All of the observed punctures were consistent with projectile damage originating from an uncontained engine failure.

The engine was removed and shipped to the manufacturer for disassembly and examination.

## TEST AND RESEARCH

The engine was disassembled at the Rolls-Royce Corporation facility in Indianapolis, Indiana, on September 6, 2006, under the supervision of the National Transportation Safety Board (NTSB) investigator-in-charge.

The compressor section rotated freely after the remaining turbine components were removed. Visual inspection of the compressor components did not reveal any damage. The accessory gearbox rotated freely by hand and no anomalies were noted with either gearbox drive trains. Continuity was established to the power turbine and accessory drive outputs.

The gas producer support and corresponding aft bolt flange was fractured and missing about 240-degrees of its circumference. The energy absorption ring was fractured and deformed outward into an oval shape. The ring had circumferential scoring along its inner surface.

The 1st-stage gas producer turbine nozzle outer portion was fractured. The 1st-stage gas producer wheel was fractured into several segments and a portion of the wheel was not recovered. Visual inspection of the 2nd-stage gas producer nozzle revealed that the 1st-stage blade path was fractured around the entire circumference. Only small fragments of the 1st-stage blade path were recovered. Several 2nd-stage gas producer nozzle airfoils were fractured and missing at the 120-degree position, as viewed from the pressure side. The 2nd-stage gas producer wheel had impact damage to the airfoil leading edges. Rub damage was noted along the 2nd-stage wheel airfoil tips, which corresponded with rub damage noted on the 2nd-stage gas producer nozzle blade path. The 3rd-stage turbine nozzle exhibited slight impact damage along the leading edges and suction side of the airfoils. The power turbine assembly was not disassembled. Visual inspection of the power turbine assembly did not reveal any damage to the wheels or nozzle.


Removal of the oil system supply lines and the oil scavenge sump revealed that there was residual oil throughout the engine. About 2 teaspoons of fuel were recovered from the fuel nozzle supply hose.

The turbine-to-compressor coupling was intact and exhibited light coking on the outer surface of the turbine end. The power turbine-to-pinion gear coupling was intact with both Teflon washers in place. The spur adapter gearshaft remained intact.

The gas producer turbine tie bolt (part number 23068265, serial number NM81907) was fractured immediately adjacent to the torque nut. The aft portion of the tie bolt remained engaged with the torque nut. Further examination of the tie bolt revealed fracture features consistent with fatigue, initiating at the thread root radius. The tie bolt fracture progressed across the tie bolt diameter about 0.130-inch (40-percent) in fatigue before separating in overload. The microstructure, chemistry, and hardness of the turbine tie bolt met engineering drawing specifications. No material anomalies were detected at the fracture surface. Damage to the fracture surface precluded the determination if the failure was associated with low or high cycle fatigue.

A review of the component history showed that the turbine tie bolt had completed 3,427 cycles, about 38 percent, of its published life limit of 9,000 cycles. The tie bolt had accumulated 4,993.8 hours since being manufactured. The failure was the first documented since the tie bolt was redesigned during the late 1990s. The redesign was to decrease the propensity of the gas producer rotor assembly to respond to resonant frequency that could result in high cycle fatigue failure. The redesigned tie bolt incorporated a thicker and stiffer cross-section that had a higher resonant frequency.

The tie bolt installation required that the bolt length be measured in order to determine the exact stretch of the bolt after the nut was torqued to specification.

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## Narrative (Continued)


The original stretch requirement was used with the redesigned tie bolt to eliminate confusion during assembly. A subsequent Rolls-Royce service bulletin (no. CEB A-1371) and FAA airworthiness directive (no. 2006-13-06) mandated that the older design be removed from service, but the installation stretch requirement was not modified.

As part of the investigation, Rolls-Royce engineering reviewed the testing and analysis that was performed when the tie bolt was redesigned. Their review confirmed that the current life limit of 9,000 cycles was within design guidelines. Additionally, the stress modeling and analysis performed during the component redesign was reviewed and no discrepancies were noted.

The Rolls-Royce reliability group provided field data on the reengineered tie bolt service history and several tie bolts with between 5,000 and 9,000 cycles were taken out of service for examination. Component examinations and database reviews failed to show any similar failures within the fleet.

To mitigate future tie bolt fractures, Rolls-Royce reduced the stretch requirement on the tie bolt during the assembly process. As a result, the mean stress on the tie bolt was reduced. The reduced stretch is also expected to increase both high and low cycle fatigue margins in the part. The assembly instructions were updated with the new stretch callout during the first quarter of 2008.  
Updated on Nov 25 2008 4:29PM

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<b>Landing Facility/Approach Information</b>					
Airport Name	Airport ID:	Airport Elevation Ft. MSL	Runway Used N/A	Runway Length	Runway Width
Runway Surface Type:					
Runway Surface Condition:					
Approach/Arrival Flown: NONE					
VFR Approach/Landing: Forced Landing					
<b>Aircraft Information</b>					
Aircraft Manufacturer McDonnell Douglas Helicopters		Model/Series 369E		Serial Number 0542E	
Airworthiness Certificate(s): Normal					
Landing Gear Type: High Skid					
Amateur Built Acft? No	Number of Seats: 4	Certified Max Gross Wt. 3000 LBS	Number of Engines: 1		
Engine Type: Turbo Shaft	Engine Manufacturer: Rolls-Royce	Model/Series: 250-C20B	Rated Power: 420 HP		
- Aircraft Inspection Information					
Type of Last Inspection 100 Hour	Date of Last Inspection 08/2006	Time Since Last Inspection 41.4 Hours	Airframe Total Time 6639.7 Hours		
- Emergency Locator Transmitter (ELT) Information					
ELT Installed?/Type No	ELT Operated?	ELT Aided in Locating Accident Site?			
<b>Owner/Operator Information</b>					
Registered Aircraft Owner City of Columbus Police Department		Street Address 120 Marconi Boulevard			
		City Columbus	State OH	Zip Code 43215	
Operator of Aircraft City of Columbus Police Department		Street Address 120 Marconi Boulevard			
		City Columbus	State OH	Zip Code 43215	
Operator Does Business As:			Operator Designator Code:		
- Type of U.S. Certificate(s) Held: None					
Air Carrier Operating Certificate(s):					
Operating Certificate:			Operator Certificate:		
Regulation Flight Conducted Under: Part 91: General Aviation					
Type of Flight Operation Conducted: Public Aircraft - Local					
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**First Pilot Information**

Name On File	City On File	State On File	Date of Birth On File	Age 45
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Sex: M	Seat Occupied: Left	Occupational Pilot? Yes	Certificate Number: On File
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Certificate(s): Commercial

Airplane Rating(s): Single-engine Land

Rotorcraft/Glider/LTA: Helicopter

Instrument Rating(s): None

Instructor Rating(s): None

Current Biennial Flight Review? 07/2005

Medical Cert.: Class 2	Medical Cert. Status: With Waivers/Limitations	Date of Last Medical Exam: 09/2005
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- Flight Time Matrix	All A/C	This Make and Model	Airplane Single Engine	Airplane Multi-Engine	Night	Instrument		Rotorcraft	Glider	Lighter Than Air
						Actual	Simulated			
Total Time	973	826	99		79			874		
Pilot In Command(PIC)	906	826	64		75			842		
Instructor										
Instruction Received										
Last 90 Days	110	110						110		
Last 30 Days	36	36						36		
Last 24 Hours	1	1						1		

Seatbelt Used? Yes	Shoulder Harness Used? Yes	Toxicology Performed? No	Second Pilot? No
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**Flight Plan/Itinerary**

Type of Flight Plan Filed: Company VFR

Departure Point Same as Accident/Incident Location	State	Airport Identifier OH52	Departure Time 1600	Time Zone EDT
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Destination Local Flight	State OH	Airport Identifier OH52	
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Type of Clearance: None

Type of Airspace:

**Weather Information**


Source of Wx Information:  
Flight Service Station

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<b>Weather Information</b>					
WOF ID	Observation Time	Time Zone	WOF Elevation	WOF Distance From Accident Site	Direction From Accident Site
OSU	1653	EDT	905 Ft. MSL	5 NM	292 Deg. Mag.
Sky/Lowest Cloud Condition: Scattered			3600 Ft. AGL	Condition of Light: Day	
Lowest Ceiling: Broken		4700 Ft. AGL	Visibility: 10	SM	Altimeter: 29.91 "Hg
Temperature: 28 °C	Dew Point: 21 °C	Weather Conditions at Accident Site: Visual Conditions			
Wind Direction: 310	Wind Speed: 11	Wind Gusts:			
Visibility (RVR): Ft.	Visibility (RVV): SM				
Precip and/or Obscuration: No Obscuration; No Precipitation					

<b>Accident Information</b>		
Aircraft Damage: Substantial	Aircraft Fire: Ground and In-flight	Aircraft Explosion: None

- Injury Summary Matrix	Fatal	Serious	Minor	None	TOTAL
First Pilot				1	1
Second Pilot					
Student Pilot					
Flight Instructor					
Check Pilot					
Flight Engineer					
Cabin Attendants					
Other Crew					
Passengers				1	1
- TOTAL ABOARD -				2	2
Other Ground					
- GRAND TOTAL -				2	2

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Administrative Information

Investigator-In-Charge (IIC)

Andrew T. Fox

Additional Persons Participating in This Accident/Incident Investigation:

Gordon Smith  
Federal Aviation Administration - Columbus FSDO  
Columbus, OH

Lt. Michael Elkins  
City of Columbus Police Department  
Columbus, OH

Michael A Weber  
Rolls-Royce  
Indianapolis, IN

Jon A Michael  
Rolls-Royce  
Indianapolis, IN