



National Transportation Safety Board Aviation Accident Final Report

Location:	Telluride, CO	Accident Number:	CEN14FA232
Date & Time:	05/03/2014, 1130 CDT	Registration:	N407MH
Aircraft:	BELL 407	Aircraft Damage:	Substantial
Defining Event:	Loss of engine power (partial)	Injuries:	3 None
Flight Conducted Under:	Part 135: Air Taxi & Commuter - Non-scheduled - Air Medical (Discretionary)		

Analysis

The commercial pilot and two flight crewmembers were conducting a search and rescue mission for a local sheriff's department in the helicopter. The pilot reported that, after flying five or six lines of the search grid and while in a right turn to begin flying another line of the grid, the engine noise changed. Immediately thereafter and while the helicopter was 200 ft above ground level, the engine chip detector light illuminated, followed by a full authority digital electronic control degrade light. The pilot started to descend toward an open snow-covered meadow for landing, but the engine rpm degraded, so he initiated an autorotation. The helicopter touched down with little forward airspeed and bounced, and the left skid then became caught on an object under the snow. The helicopter rolled onto its left side and then came to rest.

A postaccident examination of the engine showed that the engine gas producer and power turbine drive train had continuity, but there was resistance to the gas producer and scraping of the power turbine when rotated. Further examination of the engine revealed that the gearbox cover had been modified by a repair, which included an insert being threaded into the oil delivery tube port. The insert was blocking the oil flow to the power turbine thrust (No. 5) bearing, which resulted in the bearing overheating and failing due to the lack of lubrication and the subsequent engine failure. No records were found regarding any repair to the gearbox cover oil delivery tube port.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The failure of the power turbine thrust (No. 5) bearing due to overheating as a result of oil starvation, which led to the engine failure. Also causal to the accident was an undocumented repair to the gearbox cover oil delivery tube port during which an insert was threaded into the oil delivery tube port that subsequently restricted the oil flow to the power turbine thrust bearing.

Findings

Aircraft	Turbine section - Failure (Cause) Oil system - Damaged/degraded (Cause) Oil system - Incorrect service/maintenance (Cause) Oil - Not specified
Environmental issues	Hidden/submerged object - Contributed to outcome

Factual Information

HISTORY OF FLIGHT

On May 3, 2014 about 1130 mountain daylight time, a Bell 407 helicopter, N407MH, experienced an engine chip light followed by a loss of engine power. The pilot executed a forced landing to snow-covered mountainous terrain (above 10,000 ft MSL) near Telluride, Colorado. The commercial pilot and two crew members were not injured. The helicopter sustained substantial damage during the landing. The helicopter was registered to and operated by Classic Helicopters, Incorporated, of Odgen, Utah, on a company visual flight rules flight plan under the provisions of 14 Code of Federal Regulations Part 135 as a search and rescue flight. Visual meteorological conditions prevailed in the vicinity of the accident. The flight originated from Moab, Utah.

The pilot stated that they were conducting a search and rescue mission for the San Miguel Sheriff's Department, searching for a person who had been missing overnight. After flying 5 or 6 lines of the search grid, the pilot made a right turn to begin another line when there was change in engine noise. Almost immediately the engine chip detector light illuminated followed by a full authority digital engine control (FADEC) degrade light. The helicopter was about 200 ft AGL. The pilot started to descend toward an open snow-covered meadow for a landing, but the engine RPM degraded so he initiated an autorotation. The helicopter touched down with little forward airspeed, bounced, and the left skid became hung up on an object under the snow. The helicopter rolled onto its left side and came to rest. All three occupants exited without injuries.

AIRCRAFT INFORMATION

The helicopter was a Bell Helicopter Textron, Incorporated model 407, serial number 53100. It was configured for emergency medical use. The helicopter was powered by one Rolls Royce Incorporated M250-C47B turboshaft engine, serial number 847016, rated at 650 shaft horse power. The helicopter had undergone a 150 hour engine inspection on April 30, 2014. The airframe time at the inspection was 10,724.6 hours. The total airframe time recorded at the accident was 10,730.1 hours.

PILOT INFORMATION

The pilot, age 32, held a commercial pilot certificate with helicopter and instrument helicopter ratings. Additionally, the pilot held a flight instructor certificate with helicopter and instrument helicopter ratings. The pilot reported having 4,300 total flying hours with 740 hours in the make and model of the accident helicopter. He also reported having flown 42 hours in the 30 days preceding the accident. The pilot completed a flight review with his company on March 31, 2014.

The pilot reported having a second-class medical certificate dated April 22, 2014 with no restrictions or limitation.

WRECKAGE AND IMPACT INFORMATION

The left side of the helicopter passenger compartment showed inward buckling and skin wrinkles. Inward crushing damage was also observed to the upper rear engine cowling and engine exhaust. The lower left forward and lower right forward Plexiglas windows were broken out. The helicopter's tailboom was severed just aft of the main fuselage body. The tail rotor

gear box was torn out at the end of the boom. The main rotor system remained attached at the mast and transmission. Three of the four main rotor blades were bent and broken. Part of the trailing edge of one blade was torn out. An examination of the helicopter's flight control system revealed no preimpact anomalies. A post-accident examination of the helicopter's engine showed the engine gas producer and power turbine drive train had continuity, but there was resistance to the gas producer and scraping of the power turbine when rotated. Additionally, ferrous debris was found in the engine scavenge oil filter. The helicopter's engine was removed and shipped to the engine manufacturer for further examination.

TESTS AND RESEARCH

The helicopter's engine was examined at Rolls Royce Corporation, Indianapolis, Indiana, on June 3-4, 2014. The examination showed that the power turbine thrust (No. 5) bearing was dry, gray/black in color, and heavily worn. The races and separator were in place, but no recognizable ball elements were present. The bearing and outer races were smeared with melted metal deposits. The ball separator was heavily scored with worn/enlarged ball pockets. The remaining power turbine components exhibited rotational contact damage consistent with a loss of radial and axial positioning, which is normally provided by the No. 5 bearing.

No. 4/5 Bearing Oil Jet

A small amount of oil was present underneath the No. 4/5 bearing oil jet at the gearbox port. The jet appeared to be in good condition. Unmetered alcohol was flowed through the jet at low pressure and exited the nozzle jets with no evidence of obstruction.

GEARBOX COVER OIL TRANSFER PASSAGE

Visual Inspection

Light directed into the gearbox cover oil delivery tube port was not observable at the passage exit. Unmetered alcohol squirted into the passage did not pass through in either direction. The expected opening to the cast passage in the sidewall of the bore could not be observed under magnification or detected using a soft wire inserted into the port.

Radiographic Inspection

The gearbox cover was submitted for radiographic inspection. X-ray images revealed that the cover had been modified by a repair that included an insert being threaded into the oil delivery tube port. The insert was restricting the opening into the cast oil passage.

Oil Flow Test

A calibrated flow test of the gearbox passage using typical operating pressure and temperature settings was performed using a Rolls Royce production test bench. The initial test was performed with the 4/5 bearing oil jet installed. No measurable flow through the passage was produced. The piece was removed from the test bench and the No. 4/5 bearing oil jet was removed. The passage was ultrasonically cleaned. The cleaning produced some small particles consistent with coked oil and scarf. A second flow test performed using the same settings but without the 4/5 bearing oil jet installed produced a small amount of flow. The flow measured less than 2 percent of the No. 5 bearing 4/5 oil jet design flow specification.

Metallographic Examination

Measurements taken of the circumferential gap between the bottom of the threaded insert and

the gearbox cover ranged from between 0.0005 and 0.005 inch. Deposits consistent with coked oil were observed in the cast oil passage adjacent to the circumferential gap.

ENGINE HISTORY RELEVANT TO THE GEARBOX COVER INSERT/OBSTRUCTION

The engine was manufactured in 1966. The gearbox cover, P/N23065470, serial number 44193, was original to the engine. The gearbox cover was marked with a material review board (MRB) symbol. The MRB record for the gearbox cover showed that a threaded insert was used as part of an oil transfer passage during original manufacture.

Gearbox Cover In-Service Exposure

The gearbox was disassembled seven times during its service life. No entry for additional gearbox cover oil delivery tube port repairs were found in the available service records. For additional information, see the Powerplant Group Chairman's Factual Report provided in the docket for this report.

History of Flight

Maneuvering-low-alt flying	Loss of engine power (partial) (Defining event)
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Pilot Information

Certificate:	Commercial	Age:	32, 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; Instrument Helicopter	Toxicology Performed:	No
Medical Certification:	Class 2 None	Last Medical Exam:	04/22/2014
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	03/31/2014
Flight Time:	(Estimated) 4300 hours (Total, all aircraft), 740 hours (Total, this make and model), 42 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	BELL	Registration:	N407MH
Model/Series:	407 NO SERIES	Aircraft Category:	Helicopter
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Normal	Serial Number:	53100
Landing Gear Type:	Skid;	Seats:	4
Date/Type of Last Inspection:	04/30/2014, Continuous Airworthiness	Certified Max Gross Wt.:	5501 lbs
Time Since Last Inspection:	6 Hours	Engines:	1 Turbo Shaft
Airframe Total Time:	10730.1 Hours	Engine Manufacturer:	ALLISON
ELT:	Not installed	Engine Model/Series:	250-C47
Registered Owner:	CLASSIC MEDICAL INC	Rated Power:	650 hp
Operator:	CLASSIC MEDICAL INC	Air Carrier Operating Certificate:	On-demand Air Taxi (135)
Operator Does Business As:		Operator Designator Code:	JAPA

Meteorological Information and Flight Plan

Observation Facility, Elevation:		Observation Time:	
Distance from Accident Site:		Condition of Light:	Day
Direction from Accident Site:		Conditions at Accident Site:	Visual Conditions
Lowest Cloud Condition:	Clear	Temperature/Dew Point:	4°C / -1°C
Lowest Ceiling:	None	Visibility	20 Miles
Wind Speed/Gusts, Direction:	Calm	Visibility (RVR):	
Altimeter Setting:	29.91 inches Hg	Visibility (RVV):	
Precipitation and Obscuration:			
Departure Point:	Moab, UT (MOB)	Type of Flight Plan Filed:	Company VFR
Destination:	Telluride, CO	Type of Clearance:	None
Departure Time:		Type of Airspace:	Class G

Wreckage and Impact Information

Crew Injuries:	3 None	Aircraft Damage:	Substantial
Passenger Injuries:	N/A	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	3 None		

Administrative Information

Investigator In Charge (IIC):	David C Bowling	Adopted Date:	08/10/2016
Additional Participating Persons:	Dave Cawthra; Federal Aviation Administration; Salt lake City, UT Joan Gregoire; Bell helicopter Textron Incorporated; Irving, TX Jon-Adam Michael; Rolls Royce Corporation; Indianapolis, IN		
Publish Date:	08/10/2016		
Investigation Docket:	http://dms.nts.gov/pubdms/search/dockList.cfm?mKey=89183		

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