Aviation Investigation Final Report

Location:	Talking Rock, Georgia	**Accident Number:**	ERA19FA118
Date & Time:	March 5, 2019, 11:10 Local	**Registration:**	N89ZC
Aircraft:	Hughes 369	**Aircraft Damage:**	Substantial
Defining Event:	Sys/Comp malf/fail (non-power)	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 133: Rotorcraft ext. load		

Analysis

The helicopter pilot was using an aerial saw to trim trees along power lines. A witness reported that the pilot performed one pass, then returned for the second pass when the helicopter began to spin counterclockwise around its main rotor mast. During the second rotation, the helicopter impacted trees and terrain before coming to rest on its right side. Postaccident examination revealed a fracture of the overrunning clutch outer race and cracks on three of the engine mounts. While two of the three engine mounts cracks were likely a result of impact forces, the cracks on a third engine mount were likely present prior to the accident. The failure of the overrunning clutch subassembly outer race resulted in a loss of power to the main rotor system. Given the helicopter's low altitude and airspeed at the time of the loss of power, the pilot was likely unable to successfully initiate and perform an autorotative landing.

Before its installation onto the helicopter, the overrunning clutch subassembly had been repaired, which included the installation of a new outer race. The accident helicopter operated with the overrunning clutch subassembly for about 33 flight hours until the accident occurred. Examination of the fracture surfaces revealed signatures consistent with fatigue and subsequent overload. The orientation of the crack in the circumferential plane was consistent with an anomalous bending load, such as an angular misalignment of the drivetrain, that drove fatigue crack initiation.

Directionality of the deformation and fracture of the center engine mount was primarily in the vertical direction and the fracture surfaces exhibited evidence of oxidation, indicating that the cracks were present before the accident. Therefore, it is likely that the damaged center engine mount was the source of the anomalous bending loads that led to fatigue crack initiation and subsequent failure of the overrunning clutch outer race.

The 100-hour/annual inspection of the engine mounts could be performed with the engine installed on the airframe, and the operator had done so; however, the presence of the engine could present difficulties for a mechanic in performing a visual inspection, particularly of the forward side of the center engine mount, where the cracks were located. Maintenance records indicated that, in the 9 months preceding the

accident, the engine mounts were inspected six times with no anomalies observed. However, when the engine mount cracks may have developed and whether they would have been visible during any of the previous inspections could not be determined based on the available information..

Probable Cause and Findings

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

A fatigue failure of the overrunning clutch subassembly due to abnormal bending loads due to cracks on the center engine mount, which resulted in an inflight loss of power. Contributing to the accident was the helicopter's low altitude and airspeed when the loss of power occurred, which precluded the pilot from successfully performing an autorotation.

Findings

Aircraft	Engine/transmission coupling - Failure
Aircraft	Engine/transmission coupling - Fatigue/wear/corrosion
Aircraft	Main frame (on nacelles/pylon) - Fatigue/wear/corrosion
Aircraft	Main frame (on nacelles/pylon) - Damaged/degraded
Aircraft	Altitude - Attain/maintain not possible

Factual Information

History of Flight

Maneuvering-low-alt flying	Sys/Comp malf/fail (non-power) (Defining event)
Maneuvering-low-alt flying	Collision with terr/obj (non-CFIT)

HISTORY OF FLIGHT

On March 5, 2019, about 1110 eastern standard time, an MD Helicopters 369D, N89ZC, was substantially damaged when it was involved in an accident near Talking Rock, Georgia. The commercial pilot was fatally injured. The helicopter was operated as a Title 14 *Code of Federal Regulations* Part 133 external load flight.

The pilot was using a 10-bladed aerial saw to trim trees along power lines, and was to complete three passes (upper, middle, and lower) to trim the full height of the trees. A witness reported that the pilot performed the upper pass, then returned for the middle pass when the helicopter began to rotate counterclockwise around the main motor mast. It completed one full rotation, and during the second rotation, the helicopter impacted trees and then the ground. The helicopter came to rest on its right side and sustained substantial damage to the fuselage and tailboom.

AIRCRAFT INFORMATION

The helicopter's main rotor was equipped with five blades that turned counterclockwise when viewed from above. The most recent 100-hr and 300-hr airframe inspections were performed on February 18, 2019, at an aircraft total time of 13,637.0 hours (2,349.0 hours Hobbs time). The Hobbs meter indicated 2,382.3 hours at the accident site.

A review of maintenance records revealed that, before its installation on the accident helicopter, the overrunning clutch subassembly had been repaired, which included the installation of a new outer race. The overrunning clutch subassembly was installed onto the accident helicopter at the most recent inspection.

According to the maintenance logbooks, the engine mounts were inspected during every 100-hr inspection per manufacturer guidance. The entries for six previous 100-hr inspections (July 2018 through February 2019) contained no entries related to any defects or discrepancies with the engine mounts. When the engine mounts were installed on the helicopter could not be determined.

Chapter 5 of MD Helicopters Maintenance Manual No. CSP-HMI-2 contained instructions for periodic, special, and conditional inspections. The engine was not required to be removed to facilitate the periodic inspection. Conditional inspections of the engine mounts were performed based on certain events, such as a hard landing or a main rotor sudden stoppage. The special inspections do not contain criteria specifically for inspecting the engine mounts.

Instructions for the 100-hr or annual inspection included, in part, an inspection of the “engine mounts for cracks and play in mounting hardware at engine and airframe (retorque any loose mounting bolts).”

Section 71-20-00, "Engine Mounts," of the maintenance manual provided instructions for inspecting the engine mounts and fittings. These inspections included a visual inspection for straightness and for cracks or evidence of corrosion on the tubes and welded joints. The instructions stated to magnetic particle inspect suspect engine mount assemblies.

WRECKAGE AND IMPACT INFORMATION

The helicopter impacted terrain at an elevation of 1,250 ft mean sea level and came to rest on its right side on a heading of 037°. Multiple tree strikes were observed, and the helicopter struck the ground about 25 ft from the initial tree strike. All major components of the helicopter remained attached to the airframe.

Flight control continuity was confirmed from the flight controls to the main and tail rotors. The collective control remained attached through wires to the control tube and was found in the maximum (full up) collective input position. Continuity was confirmed from the throttle to the engine through all control linkages and push-pull tubes. The electric N2 trim operated when power was applied. The lateral and longitudinal cyclic trim operated when power was applied. The fuel quantity sending unit was removed and fuel was noted in the fuel tank.

The main rotor transmission fluid level was verified as full using the sight glass. The engine-to-transmission driveshaft was rotated by hand and corresponding movement of the main rotor was observed. The flex frames on the engine-to-transmission driveshaft couplings were intact. Continuity of the main and tail rotor driveshafts was verified. The tail rotor driveshaft flex couplings remained attached at all attach points and the torque stripes on the bolts were unbroken.

All main rotor blades remained intact and exhibited signatures consistent with unpowered impact damage. The tail rotor transmission assembly remained attached to the tailboom. Chordwise scratching was noted on both tail rotor blades. The leading edge of one blade was impact damaged. The tail rotor driveshaft remained attached to the main transmission and was bent. The tail rotor control push-pull tube also remained attached and was bent. The tailboom was fractured about 4 ft aft of the fuselage. The tail rotor driveshaft displayed a small amount of rotational scoring. The tail rotor pitch control links remained attached. Oil was noted in the tail rotor gear box.

An inspection panel was removed in the cabin area of the fuselage to access the forward section of the engine. The compressor impeller assembly did not rotate. The N1 turbine did not rotate. The drive gear connected to the overrunning clutch could be rotated by hand. The starter generator was removed and would rotate by hand. The combustion can was removed. The first stage nozzle exhibited no sign of thermal distress, cracks, missing material, or airfoil deterioration on the nozzle guide vanes.

The upper and lower chip detectors exhibited no debris. The compressor module could be rotated by hand. The governor drive shaft rotated freely and exhibited no excessive play. The fuel control was removed and the fuel control drive rotated freely. The power turbine to pinion gear (N2) rotated freely

when turned by hand. Continuity of the gas producer turbine-to-compressor (N1) drive train was confirmed when rotated through the N1 tachometer generator drive pad. There were no anomalies with the engine that would have precluded normal operation.

The overrunning clutch housing was fractured at its attachment flange; the flange remained attached to the engine gearbox. Residual oil was found when the clutch was removed from the housing. Rotational scoring was noted on the upper bearing support of the clutch. The upper bearing exhibited grease. The overrunning clutch operated as designed when the clutch was rotated in reverse. The overrunning clutch outer race exhibited a torsional fracture on the shaft adjacent to the splines. The C-clip exhibited tension when removed.

Examination of the overrunning clutch revealed that the attachment flange at the aft end of the housing was fractured, and the outer race at the aft end of the clutch subassembly was also fractured. The outer race fracture comprised a circumferential portion, a spiral portion that extended more than 360° around the circumference, and a longitudinal portion that linked between the spiral faces with features consistent with fatigue cracking. The cracks were perpendicular to the axis of rotation. The subassembly fracture surfaces revealed evidence of torsional overload.

The lower arm of the left upper engine mount was fractured under tensile overload and the upper arm of the right upper engine mount was bent to the right and cracked with a compression overload failure. Neither crack in the upper left or right engine mount exhibited corrosion. Cracks were also observed on the forward surface of the center (lower) engine mount that were partially obscured by paint. The paint was removed and orange oxidation was noted on most of the crack surface. The extent of the cracking was about 25% of the center engine mount’s circumference and oriented in the vertical direction. The surface was cleaned and examination revealed that the center engine mount fracture was consistent with overload, including the areas of weld heat affected zones. There was no evidence of crack propagation on the center engine mount fracture.

The engine-to-transmission driveshaft was examined at the manufacturer's facility and displayed no anomalies.

MEDICAL AND PATHOLOGICAL INFORMATION

The Georgia Bureau of Investigation, Atlanta, Georgia, performed the autopsy on the pilot. The autopsy report indicated the cause of death was multiple blunt force injuries.

Toxicology testing of the pilot was performed at the Federal Aviation Administration Forensic Sciences Laboratory. Diphenhytramine (54 mg/dl, mg/hg) was detected in the blood; it was also detected in liver. Atropine was detected in the blood and liver; atorvastatin was detected in liver but not blood; pioglitazone was detected in liver, but not blood; and midazolam was detected in liver, and blood; no ethanol was detected in blood.

The medications detected were consistent with treatment of cholesterol and allergies and with postaccident emergency care.

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	51,Male
Airplane Rating(s):	None	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	4-point
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Helicopter; Instrument helicopter	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	April 16, 2018
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	January 7, 2019
Flight Time:	6372 hours (Total, all aircraft), 2560 hours (Total, this make and model), 6312 hours (Pilot In Command, all aircraft), 128 hours (Last 90 days, all aircraft), 51 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Hughes	**Registration:**	N89ZC
Model/Series:	369 D	**Aircraft Category:**	Helicopter
Year of Manufacture:	1981	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	1098D
Landing Gear Type:	High skid	**Seats:**	4
Date/Type of Last Inspection:	February 18, 2019 100 hour	**Certified Max Gross Wt.:**	3000 lbs
Time Since Last Inspection:	33 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	13667 Hrs at time of accident	**Engine Manufacturer:**	Rolls-Royce
ELT:	Not installed	**Engine Model/Series:**	250-C20B
Registered Owner:	Dah Aircraft Llc	**Rated Power:**	425 Horsepower
Operator:	Rotor Blade LLC	**Operating Certificate(s) Held:**	Rotorcraft external load (133)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	JZP,1535 ft msl	**Distance from Accident Site:**	5 Nautical Miles
Observation Time:	11:15 Local	**Direction from Accident Site:**	146°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	9 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	10°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.18 inches Hg	**Temperature/Dew Point:**	-1°C / -10°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Talking Rock, GA	**Type of Flight Plan Filed:**	None
Destination:	Talking Rock, GA	**Type of Clearance:**	None
Departure Time:	09:35 Local	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	34.533332,-84.522499

Administrative Information

Investigator In Charge (IIC):	Kemner, Heidi
Additional Participating Persons:	David Detscher; FAA/FSDO; Atlanta, GA Joel D'Atillo; Rotor-Blade LLC; Georgetown, SC Joan Gregoire; MD Helicopters; Mesa, AZ Jack Johnson; Rolls-Royce Corporation; Indianapolis, IN
Original Publish Date:	November 19, 2020
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=99057