



National Transportation Safety Board Aviation Accident Final Report

Location:	Mountain City, TN	Accident Number:	ERA16LA202
Date & Time:	06/03/2016, 1345 EDT	Registration:	N4999
Aircraft:	BELL 407	Aircraft Damage:	Substantial
Defining Event:	Loss of engine power (partial)	Injuries:	1 Minor, 3 None
Flight Conducted Under:	Part 135: Air Taxi & Commuter - Non-scheduled - Air Medical (Medical Emergency)		

Analysis

During the initial climb, about 125 ft above ground level, the commercial pilot of the helicopter heard a loud noise that was accompanied by a left yaw, rapidly increasing measured gas temperature, and decreasing power turbine rpm. During the subsequent forced landing, the helicopter landed hard, which spread the skids and resulted in substantial damage.

Examination of the engine revealed a partial separation of the compressor diffuser, which allowed intake air to leak before combustion. Metallurgical examination of the compressor diffuser revealed that a portion of the aft plate had separated near a braze joint; however, manufacturer specifications indicated that the aft plate should have been a single component, not two components joined together by a brazing process.

The compressor diffuser had been overhauled by a repair facility and installed on the accident helicopter about 98 hours of operation before the accident. Information from the repair facility revealed that a machinist had joined a second ring to the compressor diffuser aft plate using a brazing process. There was no approval for that process and it is likely that the machinist performed the procedure to correct a mistake made during a dimensional shim repair, which was an approved procedure.

Probable Cause and Findings

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

An incorrect and unapproved repair of the engine compressor diffuser performed by a machinist at a repair facility, which resulted in failure of the compressor diffuser aft plate and a partial loss of engine power.

Findings

Aircraft	Maintenance/inspections - Incorrect service/maintenance (Cause)
Personnel issues	Repair - Maintenance personnel (Cause)

Factual Information

On June 3, 2016, about 1345 eastern daylight time, a Bell 407, N4999, operated by PHI Air Medical, was substantially damaged during a forced landing to a parking lot, following a partial loss of engine power during initial climb near Mountain City, Tennessee. The commercial pilot incurred minor injuries. The two crewmembers and one patient were not injured. The on-demand air medical flight was conducted under the provisions of 14 Code of Federal Regulations Part 135. Visual meteorological conditions prevailed and a company flight plan was filed for the flight that originated from the parking lot; destined to Johnson City Medical Center Heliport (TN91), Johnson City, Tennessee.

The pilot stated that during initial climb, about 125 feet above ground level, he heard a loud "bang" that was accompanied by a left yaw and rapidly increasing measured gas temperature (MGT). The pilot advised the crewmembers that he was rejecting the climb and landing immediately. The pilot further stated that he had to maneuver the helicopter right to avoid ground personnel, level the helicopter with cyclic control, and used all available collective to cushion the landing.

The helicopter was equipped with a Rolls Royce (Allison) 250-C47B, 650 horsepower turboshaft engine. Examination of the helicopter by a Federal Aviation Administration (FAA) inspector revealed that it landed hard, which spread the skids and resulted in substantial damage to the fuselage.

Review of data downloaded from an engine monitor revealed that during the accident takeoff, the MGT increased beyond maximum for takeoff while the power turbine rpm decreased. Examination of the engine at the operator's facility revealed a partial separation of the compressor diffuser, which allowed intake air to leak prior to combustion. The compressor diffuser was forwarded to the engine manufacturer's facility for teardown examination under the supervision of an FAA inspector.

Examination of the compressor diffuser revealed that a portion of the aft plate had separated near a braze joint. Review of engine manufacturer specifications revealed that the aft plate should have been a single component and not two components joined together by a brazing process. Maintenance records revealed that the compressor diffuser had been overhauled by a repair facility and installed on the accident helicopter about 98 hours of operation prior to the accident.

According to the FAA principle maintenance inspector (PMI) of the repair facility, a machinist had joined a second ring to the compressor diffuser aft plate using a brazing process. There was no approval (neither through the engine manufacturer nor the FAA) for that process and it is possible that the machinist performed the procedure to correct a mistake he had made during a dimensional shim repair, which was approved through the FAA designated engineering representative (DER) program. The machinist no longer worked for the repair facility and had left the company prior to the accident.

Further review of the repair facility by the FAA PMI revealed that they had authorization through the FAA DER program for approximately 4 years to repair compressor diffusers. During those 4 years, the repair facility had performed repairs on 52 other compressor diffusers. Most of those were common repairs to vanes, with 17 being dimensional shims to the aft plates. Review of the other 17 similar repairs revealed that the machinist in question had not worked on any of those.

According to the Quality and Engineering Manager at the repair facility, ultrasonic testing also failed to identify the unapproved repair. An immediate corrective action for the repair facility was to suspend dimensional shim repairs indefinitely. The repair facility also ensured that their three-tier approval process (engineering, quality and management) was required for any fixture, tooling, drawing, or process before it was performed and that all necessary personnel were trained in that method.

History of Flight

Initial climb	Loss of engine power (partial) (Defining event)
Emergency descent	Off-field or emergency landing
Landing	Hard landing

Pilot Information

Certificate:	Commercial	Age:	53, Male
Airplane Rating(s):	Single-engine Land	Seat Occupied:	Right
Other Aircraft Rating(s):	Helicopter	Restraint Used:	4-point
Instrument Rating(s):	Airplane; Helicopter	Second Pilot Present:	No
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 1 With Waivers/Limitations	Last FAA Medical Exam:	07/13/2015
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	08/16/2015
Flight Time:	8550 hours (Total, all aircraft), 680 hours (Total, this make and model), 6900 hours (Pilot In Command, all aircraft), 52 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

Aircraft Make:	BELL	Registration:	N4999
Model/Series:	407 NO SERIES	Aircraft Category:	Helicopter
Year of Manufacture:	1998	Amateur Built:	No
Airworthiness Certificate:	Normal	Serial Number:	53323
Landing Gear Type:	High Skid;	Seats:	4
Date/Type of Last Inspection:	06/01/2016, AAIP	Certified Max Gross Wt.:	5250 lbs
Time Since Last Inspection:	99 Hours	Engines:	1 Turbo Shaft
Airframe Total Time:	8449 Hours as of last inspection	Engine Manufacturer:	ALLISON
ELT:	C126 installed, activated, did not aid in locating accident	Engine Model/Series:	250-C47B
Registered Owner:	PHI INC	Rated Power:	650 hp
Operator:	PHI AIR MEDICAL	Operating Certificate(s) Held:	On-demand Air Taxi (135)
Operator Does Business As:		Operator Designator Code:	VE7A

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	TNB	Distance from Accident Site:	15 Nautical Miles
Observation Time:	1355 EDT	Direction from Accident Site:	180°
Lowest Cloud Condition:	Scattered / 3600 ft agl	Visibility	10 Miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	11 knots /	Turbulence Type Forecast/Actual:	/ None
Wind Direction:	310°	Turbulence Severity Forecast/Actual:	/ N/A
Altimeter Setting:	30.17 inches Hg	Temperature/Dew Point:	25° C / 14° C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Mountain City, TN	Type of Flight Plan Filed:	Company VFR
Destination:	Johnson City, TN (TN91)	Type of Clearance:	None
Departure Time:	1345 EDT	Type of Airspace:	

Wreckage and Impact Information

Crew Injuries:	1 Minor, 2 None	Aircraft Damage:	Substantial
Passenger Injuries:	1 None	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 Minor, 3 None	Latitude, Longitude:	36.474722, -81.804722 (est)

Administrative Information

Investigator In Charge (IIC):	Robert J Gretz	Report Date:	09/11/2018
Additional Participating Persons:	Matthew Porter; FAA/FSDO; Nashville, TN Terry Myers; PHI Air Medical; Phoenix, AZ Jon Michael; Rolls Royce; Indianapolis, IN Allan Slattery; Aero Propulsion Support; Harrison, OH		
Publish Date:	09/11/2018		
Note:	The NTSB did not travel to the scene of this accident.		
Investigation Docket:	http://dms.nts.gov/pubdms/search/dockList.cfm?mKey=93300		

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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](#).