Aviation Investigation Final Report

Location:	Mullan, Idaho	**Accident Number:**	SEA01LA121
Date & Time:	June 26, 2001, 08:45 Local	**Registration:**	N556D
Aircraft:	Kaman HH-43B	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	1 Minor
Flight Conducted Under:	Part 133: Rotorcraft ext. load		

Analysis

The pilot was preparing to lift a load of logs from a 150-foot hover in the Kaman HH-43B helicopter when a total loss of power occurred. He transitioned into an autorotation colliding with the steeply sloped, tree covered terrain. A partial disassembly of the ex-military Lycoming T53-L-13B turboshaft engine revealed that the 1st stage gas producer turbine rotor sealing disc was fractured and had broken into three approximately equal sized segments. Metallurgical examination of the disc fragments revealed fatigue cracks through three of the six cooling holes, and examination of the fracture faces for all three cooling holes by scanning electron microscope revealed multiple fatigue striations at each fracture face.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The development of multiple fatigue cracks which ultimately resulted in the fracture of the 1st stage gas producer turbine rotor sealing disc. Factors contributing to the accident were mountainous/hilly and unsuitable terrain conditions.

Findings

Occurrence #1: LOSS OF ENGINE POWER(TOTAL) - MECH FAILURE/MALF
Phase of Operation: HOVER - OUT OF GROUND EFFECT

Findings
1. (C) TURBINE ASSEMBLY,SHROUD - FATIGUE

2. TURBINE ASSEMBLY,SHROUD - FRACTURED

Occurrence #2: FORCED LANDING
Phase of Operation: EMERGENCY DESCENT/LANDING

Occurrence #3: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: EMERGENCY DESCENT/LANDING

Findings
3. (F) TERRAIN CONDITION - MOUNTAINOUS/HILLY
4. (F) TERRAIN CONDITION - NONE SUITABLE
5. ALTITUDE - LOW
6. OBJECT - TREE(S)

Factual Information

HISTORY OF FLIGHT

On June 26, 2001, approximately 0845 Pacific daylight time, a Kaman HH-43B helicopter, registered to an individual, operated by Precision Helicopters, and being flown by a commercial pilot, was substantially damaged during an in-flight collision with terrain following a complete loss of engine power while in a hover approximately one-half mile east of Snowstorm Peak, Mullan, Idaho (CHART I). The pilot sustained minor injuries. Visual meteorological conditions prevailed and no flight plan had been filed. The flight, which was engaged in logging operations, was operated under 14 CFR 133, and originated from a location near the accident site.

The pilot reported that he had begun pulling a load of logs together from an altitude of about 150 feet above ground but had not yet lifted the log load when he heard a loud "bang" from the rotorcraft's engine area. Witnesses confirmed the rotorcraft approximately 150 feet above ground at the beginning of a log lift cycle when they heard a "bang" and a "whining sound" and observed smoke coming from the helicopter. The pilot reported that the engine RPM began to decrease immediately and he executed an autorotation to steep, tree covered terrain (refer to photograph 1 and CHART I). The aircraft remained upright upon impact and there was no sound of engine spool down following the impact. Visual post crash examination of the engine revealed multiple turbine blade damage at the aft most turbine disk (refer to photograph 2).

AIRCRAFT INFORMATION

N556D, a Kaman HH-43B "Huskie," with a "restricted" category certificate was equipped with a single Lycoming T53-L-13B engine, serial number LE23176. The date of manufacture of the engine was not known and the engine was acquired from the military. The last engine inspection (annual) was conducted June 22, 2001, at which time the engine was reported to have 4964.6 total operating hours (2,129.1 hours time since overhaul). The aircraft was operated for approximately 12 additional hours between that time and the accident.

A copy of records maintained by Whispering Turbines, who acquired the engine from the military source, showed LE23176 as having a total time 1,175 hours in 1992. A service tag for LE23176 dated August 21,1994 showed a time since new of 2,845 hours.

The engine logbook was reviewed and the first page was preceded by documentation on an Allied Signal T53 Test Log sheet completed for Whispering Turbines, Inc. (customer) on May 20, 1999, relating to T53-L-13B, serial number LE23176. The test was conducted by Eagle

Copters Maintenance Ltd., Calgary, Alberta, Canada.

The log was opened with a single entry in the first tab section (Engine History Record). This entry, which was dated July 21, 1999, showed Horizon Helicopters as the owner. The Engine Inspection Record opened on the same date with a reported time since new (TSN) of 2,845.00 hours and a time since overhaul (TSO) of 0.00 hours. The log showed repeated 100 hour inspections conducted over the 24-month period beginning July 21, 1999 with the last entry dated June 22, 2001. The first and last (and most of the intermediate) inspections were signed off by the same FAA authorized inspector (IA) from Whispering Turbines. The TSO at the time of the June 22, 2001, was logged as 2129.1 hours. Additionally, two hot section inspections were noted, the first being dated February 8, 2000, at a TSO of 616.5 hours and the second dated September 8, 2000, at a TSO of 1,327.9 hours. The designated time between overhauls (TBO) for the engine was 2,400 hours and the time between hot section inspections was 1,200 hours.

The President/owner of Whispering Turbines noted in a letter to the Investigator-in-charge, that it was company policy to require their Repetitive Heavy Lift (logging) operators conduct hot section inspections at intervals of 600 hours rather than the 1,200 hours standard. If this interval had been applied to LE23176 at the last hot section (1,327.9 hours) the next hot section would have been due at 1,927.9 hours rather than the standard 2,527.9 hours, or approximately 127.9 hours after the scheduled TSO of 2,400.

TESTS AND RESEARCH

The engine was shipped to Honeywell (parent company of Lycoming) for further examination and a partial teardown. The teardown and examination revealed that the 1st stage gas producer turbine rotor sealing disc was fractured and broken into three specific sections which remained within the engine. Additionally, the six retaining bolts which secure the 1st stage gas producer turbine rotor sealing disc to the 1st stage gas producer turbine rotor were observed to be sheared at the disc/rotor interface. General damage consisting of battered or broken blades decreasing in severity towards the aft end of the engine was noted (refer to attached Honeywell report).

The fractured pieces of the 1st stage gas producer turbine rotor sealing disc, the 1st stage gas producer turbine rotor and other associated hardware were shipped to the Safety Board's Materials Laboratory in Washington, DC, where further metallurgical examination was conducted.

The 1st stage gas producer turbine rotor sealing disc was manufactured by Lycoming and its part number (P/N) was 1-100-135-03. The disc, a ring shaped piece of metal attached at the forward end of the 1st stage gas producer turbine rotor, was approximately nine inches in diameter and had holes numbered 1 through 12 circumferentially around the bore (inside of the ring). Those holes numbered 1, 3, 5, 7, 9, and 11 were referred to as "cooling holes." The

remaining six holes were associated with the six attach bolts (refer to DIAGRAM I).

A visual examination of the rotor sealing disc at the Safety Board's lab revealed that it had fractured into three separate and approximately equal segments, and that the three fracture surfaces passed through cooling holes (numbers 1, 5 and 9 respectively). Examination of the fracture faces for all three cooling holes by scanning electron microscope (SEM) revealed multiple fatigue striations at each fracture face. There was no observed evidence of corrosion pitting or mechanical damage on the inside (fracture face) of the number 1 cooling hole.

ADDITIONAL INFORMATION

There were no FAA Airworthiness Directives related to the 1st stage gas producer turbine rotor sealing disc on the engine. There was, however, a Service Bulletin (SB) number 020 which established a maximum cycles and/or total part time limitation at which time the 1st stage gas producer turbine rotor sealing disc should be replaced. The SB also provides a methodology for assessing total cycles on a rotating part for military and non-military operations based on the total time of the part (refer to ATTACHMENT H-SB). The service bulletin is not required for restricted category aircraft. There were no military records available which tracked the history of this rotor sealing disc (P/N 1-100-135-03). Additionally, there was no reference to this rotor sealing disc in the engine log, and its true total time, cycles or age could not be determined.

The engine and the associated parts examined by the Board were formally returned to the insurance representative for PAC Northwest on July 8, 2002, (refer to attached NTSB Form 6120.15).

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	58,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	Helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--w/ waivers/lim	**Last FAA Medical Exam:**	December 27, 2000
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	July 6, 2000
Flight Time:	13300 hours (Total, all aircraft), 4200 hours (Total, this make and model), 13000 hours (Pilot In Command, all aircraft), 230 hours (Last 90 days, all aircraft), 90 hours (Last 30 days, all aircraft), 12 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Kaman	**Registration:**	N556D
Model/Series:	HH-43B	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Restricted (Special)	**Serial Number:**	59-1556
Landing Gear Type:	Ski/wheel	**Seats:**	2
Date/Type of Last Inspection:	June 22, 2001 Annual	**Certified Max Gross Wt.:**	9150 lbs
Time Since Last Inspection:	12 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	11811 Hrs as of last inspection	**Engine Manufacturer:**	Lycoming
ELT:	Installed, not activated	**Engine Model/Series:**	T53-L-13B
Registered Owner:	Jorgenson, Gary N.	**Rated Power:**	1400
Operator:	Precision Helicopters LLC.	**Operating Certificate(s) Held:**	
Operator Does Business As:		**Operator Designator Code:**	PZ7L

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	COE,2318 ft msl	**Distance from Accident Site:**	48 Nautical Miles
Observation Time:	08:55 Local	**Direction from Accident Site:**	270°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	11 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	350°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.95 inches Hg	**Temperature/Dew Point:**	14°C / 9°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Mullan, ID	**Type of Flight Plan Filed:**	None
Destination:		**Type of Clearance:**	None
Departure Time:	08:15 Local	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Minor	**Latitude, Longitude:**	47.459178,-115.740226(est)

Administrative Information

Investigator In Charge (IIC):	McCreary, Steven
Additional Participating Persons:	Philip L Vittetoe; FAA FSDO, Spokane; Spokane, WA John Eller; FAA FSDO, Scottsdale; Scottsdale, AZ Harald Reichel; Honeywell; Phoenix, AZ
Original Publish Date:	February 25, 2003
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=52565