



Aviation Investigation Final Report

Location:	Chapelle, New Mexico	Accident Number:	CEN22FA317
Date & Time:	July 16, 2022, 19:20 Local	Registration:	N911SZ
Aircraft:	Bell UH-1H	Aircraft Damage:	Destroyed
Defining Event:	Powerplant sys/comp malf/fail	Injuries:	4 Fatal
Flight Conducted Under:	Public aircraft		

Analysis

The pilot of the helicopter, two tactical flight observers, and a rescue specialist were returning to their home airport after conducting firefighting operations. While in a west-bound cruise flight about 500 to 600 ft about ground level (agl), the helicopter entered a descent that rapidly increased to over 5,000 ft per minute, and impacted terrain in a tail-low attitude. The helicopter was destroyed during the impact with terrain.

Examination of the engine revealed that the starter-generator input (zerol) gear failed due to fatigue. This failure led to the starter-generator driveshaft shearing, N1 accessory gearbox seizure, and a total loss of engine power. An examination of the remaining helicopter systems revealed no mechanical anomalies that would have precluded normal operations.

About 17 flight hours before the accident, an engine chip event occurred, and a small piece of ferrous metal was found on the magnetic chip plug. Following the chip event the oil system was drained and flushed and the filter elements were removed, cleaned, and reinstalled. No further engine chip lights were reported after the engine chip event.

The chip and oil sample were shipped to a lab for analysis. The results of the lab analysis were not used by the operator to troubleshoot the reason for the chip event. Had the operator conducted an analysis, they could have potentially identified the deteriorating component and impending failure.

The helicopter's low altitude (500 to 600 ft agl) during the return leg made the transition from powered flight to autorotation after an unexpected loss of engine power more time critical. The high density altitude conditions, combined with flight directly into the setting sun, may have contributed to the unsuccessful autorotation following the total loss of engine power.

Probable Cause and Findings

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

The total loss of engine power due to the fatigue failure of the starter-generator input (zerol) gear which failed due to poor maintenance. Contributing to the accident was the unsuccessful autorotation complicated by the setting sun and high density altitude.

Findings

Aircraft	Accessory drives - Failure
Personnel issues	(general) - Maintenance personnel
Environmental issues	(general) - Effect on personnel
Environmental issues	High density altitude - Contributed to outcome

Factual Information

History of Flight

Enroute-cruise	Powerplant sys/comp malf/fail (Defining event)
Autorotation	Loss of engine power (total)
Autorotation	Loss of control in flight

On July 16, 2022, about 1920 mountain daylight time, a Bell UH-1H, N911SZ, was substantially damaged when it was involved in an accident near Chapelle, New Mexico. The pilot, two tactical flight observers, and the rescue specialist sustained fatal injuries. The helicopter was operated as a Title 41 *United States Code* public aircraft flight.

After completing several firefighting missions in support of the New Mexico Forestry Division, the helicopter was fueled at Las Vegas Municipal Airport (LVS), Las Vegas, New Mexico. The helicopter departed LVS about 1838 and flew to the dip site/staging area, operated at the firefighting location, then flew back to the staging area where the remainder of the crew was loaded for the return flight to Double Eagle II Airport (AEG), Albuquerque, New Mexico.

About 1915, the helicopter departed the staging area to the west. The last automatic dependent surveillance-broadcast (ADS-B) data, recorded at 1920, showed the helicopter about 0.5 mile east of the accident site. The helicopter was level, 500 to 600 ft above ground level on a westbound course with a groundspeed of 133 knots (kts).

Onboard flight data indicated that, at 1920:01, the helicopter entered a 484 ft-per-minute (fpm) descent at a groundspeed of 133 kts. The helicopter subsequently began to descend rapidly, and at 1920:13, the last recorded flight data indicated a descent rate of 5,433 fpm and groundspeed of 102 knots.

Two witnesses observing the sunset from a ridge about 0.5 mile east of the accident site reported that the helicopter flew past their location westbound, then rapidly descended without making any turns. After the helicopter impacted the ground, a large plume of dust was observed. (See photo 1.)



Photo 1. Accident Site Area with Dust from Helicopter (provided by witness)

Pilot Information

Certificate:	Commercial	Age:	55, 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:	Yes
Instructor Rating(s):	None	Toxicology Performed:	Yes
Medical Certification:	Class 2 With waivers/limitations	Last FAA Medical Exam:	April 12, 2021
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	March 24, 2022
Flight Time:	(Estimated) 4600 hours (Total, all aircraft), 800 hours (Total, this make and model), 74 hours (Last 90 days, all aircraft), 11 hours (Last 30 days, all aircraft)		

A pilot previously in the unit stated that the accident pilot had accomplished annual flight training at HeliStream, which included autorotation training with turns and touchdowns. This information was consistent with a review of the accident pilot’s logbook.

The accident pilot's last annual training was flown in a Eurocopter AS350. A review of flight records indicated that the accident pilot had not recently conducted emergency flight training in a UH-1.

Aircraft and Owner/Operator Information

Aircraft Make:	Bell	Registration:	N911SZ
Model/Series:	UH-1H	Aircraft Category:	Helicopter
Year of Manufacture:	1970	Amateur Built:	
Airworthiness Certificate:	Restricted (Special)	Serial Number:	70-16431
Landing Gear Type:	Skid	Seats:	15
Date/Type of Last Inspection:	June 24, 2022 Continuous airworthiness	Certified Max Gross Wt.:	9500 lbs
Time Since Last Inspection:	7 Hrs	Engines:	1 Turbo shaft
Airframe Total Time:	7583 Hrs as of last inspection	Engine Manufacturer:	Lycoming
ELT:	C126 installed, activated, did not aid in locating accident	Engine Model/Series:	T53-L703
Registered Owner:	BERNALILLO COUNTY SHERIFFS DEPARTMENT	Rated Power:	1485 Horsepower
Operator:	BERNALILLO COUNTY SHERIFFS DEPARTMENT	Operating Certificate(s) Held:	None

The helicopter was powered by an Ozark Aeroworks engine (formerly Honeywell, AlliedSignal, and Textron Lycoming) and was of a conventional design, with a two-bladed main rotor and a two-bladed tail rotor mounted on a tail boom.

The Bernalillo County Sheriff's Department purchased the helicopter from the US Army on March 11, 1999. It was registered as a government aircraft on March 9, 2000.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	KLVS,6870 ft msl	Distance from Accident Site:	17 Nautical Miles
Observation Time:	19:53 Local	Direction from Accident Site:	16°
Lowest Cloud Condition:	Scattered / 11000 ft AGL	Visibility	10 miles
Lowest Ceiling:		Visibility (RVR):	
Wind Speed/Gusts:	11 knots / None	Turbulence Type Forecast/Actual:	None / None
Wind Direction:	150°	Turbulence Severity Forecast/Actual:	N/A / N/A
Altimeter Setting:	30.23 inches Hg	Temperature/Dew Point:	27°C / 3°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Las Vegas, NM (LVS)	Type of Flight Plan Filed:	None
Destination:	Albuquerque, NM (AEG)	Type of Clearance:	Unknown
Departure Time:	18:44 Local	Type of Airspace:	Class G

Around the time of the accident the sun's elevation was about 6.4° and the azimuth was about 291°.

Wreckage and Impact Information

Crew Injuries:	4 Fatal	Aircraft Damage:	Destroyed
Passenger Injuries:	N/A	Aircraft Fire:	None
Ground Injuries:		Aircraft Explosion:	None
Total Injuries:	4 Fatal	Latitude, Longitude:	35.38004,-105.23736(est)

The wreckage was located in high southwestern desert terrain that was populated with scrub juniper bushes. (See photo 2.) The initial impact was identified by disturbed ground in the shape of the helicopter tail and fuselage. The tailboom was crushed and the tail skid "stinger" was bent upwards significantly, consistent with very hard contact with the ground.

The tail boom separated from the main fuselage, both of which were located about 122 ft west of the initial impact. The main rotor was about 40 ft to the left of the main wreckage, with the main rotor mast fractured immediately below the hub. One main rotor blade was minimally

damaged and the other blade was fractured at the spar. The main rotor blade grips had minimal damage.

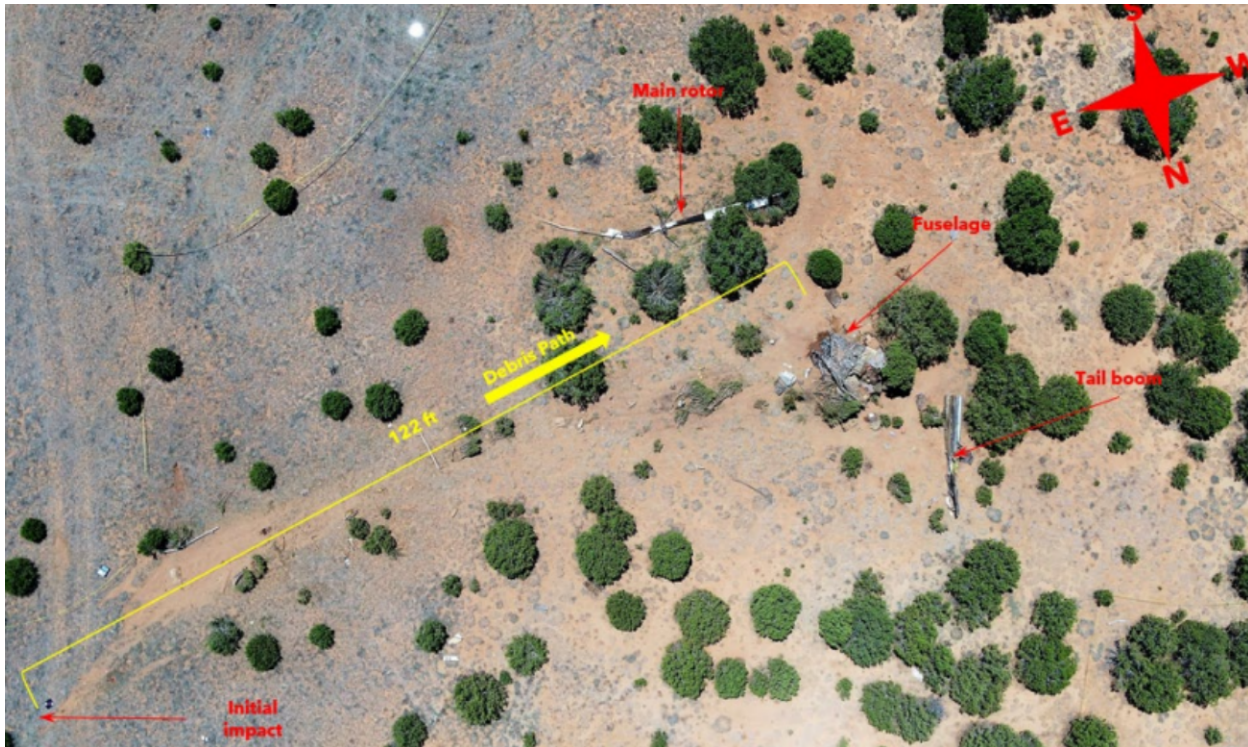


Photo 2. Wreckage at the accident Site

Examination revealed continuity of the rotor drive and flight control systems, and no anomalies were observed with the hydraulic or fuel systems.

A minimal amount of foreign debris, primarily dirt, was observed in the intake, compressor, gas producer, power turbine (PT), and exhaust sections. The PT rotated freely and no metal spray, scoring, scuffing, tip rub, or bending of the blades was noted.

The N1 tachometer-generator was clean but would not rotate. Removal of the starter-generator revealed that the starter-generator drive shaft and input (zerol) gear were both fractured. The starter-generator turned freely by hand via the remains of the input shaft.

Removal of the N1 accessory gearbox (AGB) magnetic chip detector plug revealed a large quantity of metallic chips on the magnetic tip. Multiple metallic fragments were found in all the bearing compartment oil return/scavenge lines; the supply lines were clean of debris or obstructions. Two helical-cut gear teeth were found in the N1 AGB oil, similar to teeth from the zerol gear. Both teeth exhibited expected wear patterns, with no other damage noted.

Metallurgical examination of the zerol gear revealed multiple fatigue fractures, as well as gouging on both the leading and lagging flanks and lands of the gear teeth. The zerol gear was determined to have failed in fatigue from a crack that formed 90° to the original, progressing across the gear. No material anomalies were observed that would result in the crack initiation.

Medical and Pathological Information

An autopsy of the pilot was performed at the University of New Mexico, Office of the Medical Investigator, Albuquerque, New Mexico. The cause of death was blunt force injuries.

Toxicology testing performed at the Federal Aviation Administration Forensic Sciences Laboratory was negative for all screened drugs and alcohol.

Additional Information

Engine Chip Event and Oil Sampling

On September 12, 2021, an engine chip event was documented in the engine logbook. BCSO maintenance personnel stated that a precautionary landing occurred following an engine chip light and a small piece of ferrous metal was found on the magnetic chip plug. The corrective actions taken included draining and flushing of the system, as well as removing, cleaning, and reinstalling the filter elements. No further engine chip lights were reported following the engine chip event.

An oil sample and the chip were sent in for analysis, but no laboratory analysis of the chip was obtained by maintenance personnel to troubleshoot the chip event. The helicopter flew about 17 hours between the chip event and the accident.

The maintenance manual for the accident engine included oil sampling and testing for wear metals, including silicon, aluminum, chromium, copper, iron, magnesium, nickel, silver, and titanium. The maintenance manual stated that the values were not "go/no-go" criteria.

Following the engine installation in 2018, ten oil samples were taken, including the chip event sample.

Between the oil samples taken in May 2020 and April 2021, which involved 232 hours oil life, iron increased from 0.6 part per million (ppm) to 1.3 ppm, an average increase of 0.003 ppm per hour of oil life.

Between the oil samples taken in July 2021 and February 2022, which involved 37 hours of oil life, iron content increased from 1.3 ppm to 1.8 ppm, an average increase of 0.0135 ppm per hour of oil life.

The iron content increased 450% in ppm per hour of oil life between the two sampling periods of May 2020 through April 2021 and July 2021 and February 2022.

Main Generator Removal

On March 22, 2017, the main generator and input quill were removed for weight reduction. An "inop" sticker was placed on the main generator voltmeter on the center console. The UH-1 operating manual emergency procedures includes operating solely on the standby or starter-generator in the event the main generator fails, but not continual operation. According to Bell safety personnel, the configuration of a removed main generator had not been evaluated by Bell for adverse effects to component life, to include vibrations.

Zerol Gear History

A review of US Army records did not identify any failures of the zerol gear similar to that found in the accident. US Army maintenance systems did not have installation or overhaul information for the zerol gear, indicating that it was not a tracked part.

Performance Calculations

Density altitude was calculated as 9,059 ft at the helicopter's cruise altitude. Based on 133 knots groundspeed and reported southeasterly winds at the nearest location, the helicopter's indicated airspeed at its cruise altitude was calculated to be 100 to 110 kts.

Administrative Information

Investigator In Charge (IIC):	Folkerts, Michael
Additional Participating Persons:	Dennis Beattie; FAA FSDO; Albuquerque, NM Gary Howe; Bell Textron Inc.; Fort Worth, TX Wayne Bond; Ozark Aeroworks; Springfield, MO
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Investigation Class:	Class 3
Note:	
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=105488

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