Aviation Investigation Final Report

Location:	Mount Baldy, California	**Accident Number:**	WPR22LA333
Date & Time:	September 4, 2022, 07:57 Local	**Registration:**	N687AM
Aircraft:	Bell 407	**Aircraft Damage:**	Substantial
Defining Event:	Loss of control in flight	**Injuries:**	1 Serious
Flight Conducted Under:	Part 91: General aviation - Other work use		

Analysis

The pilot was conducting flights to transport supplies and people about 4 miles between a lower altitude landing zone (LZ) and a high-altitude LZ. He was flying down-canyon to lose altitude and set up for a steep approach to the lower LZ. As he was maneuvering and slowing the helicopter to land, a low rotor rpm warning occurred. He saw the rotor rpm was about 95% and aborted the landing. He radioed ground personnel that he had a partial engine failure and was looking for a place to land. As he continued to fly down the canyon, he raised the collective and the low rotor rpm warning occurred again. He attempted to land in a clearing but overshot it and landed in trees. He said he did not check the throttle position during the event sequence, but he had maintained 100% main rotor rpm during each offload at the upper LZ.

The engine control unit captured data consistent with main rotor impact. The data showed that during the 12 seconds before the fault, the power lever angle (PLA) readings were between 48° and 50° and the engine was operating consistent with those settings. The normal PLA reading when the throttle is in the FLY position is 70°, and full engine governing is available down to 62° PLA. The pilot's operating handbook states that the throttle should be in the FLY position for takeoffs and landings. It also cautions that failure to position and maintain the throttle in the FLY detent position during normal flight operations can limit available engine power.

There is a detent in the throttle that is engaged by a ball plunger when the throttle is rolled to the FLY position from either the Idle or Max Ng positions. The throttle was manipulated by hand during postaccident examination and, when the throttle was rolled down from the FLY position towards Idle, there was perceivably less tactile resistance than when the throttle was rolled from FLY to Max Ng. Testing of the throttle determined the ball plunger would disengage from the FLY position detent when 4 lb of the force was applied to turn the throttle. The helicopter maintenance manual states 14 to 15 lb of force should be required to move the

throttle through the FLY detent position. Disassembly of the collective assembly revealed the detent where the ball plunger in the throttle engages at the FLY position was worn, which likely reduced the force required to move the throttle out of the FLY position towards IDLE. No other preimpact anomalies were found with the engine or airframe systems.

Maintenance records indicted the throttle friction should have been verified in accordance with the manufacturer's recommended inspection schedule and maintenance procedures. The procedures directed maintenance personnel to set throttle friction to the appropriate amount by adjusting the ball plunger on the throttle. Although the ball plunger disengaged from the FLY position detent in postaccident testing with less force than specified by the manufacturer, it could not be determined if maintenance personnel did not properly adjust the ball plunger in accordance with the manufacturer's specified procedures, or if the worn detent reduced the ability of the ball plunger to maintain the correct torque after being set properly. Although the maintenance procedures did not require inspection of the throttle detent, if the specified throttle friction forces were unable to be achieved during the inspection, this should have provided the opportunity necessary for maintenance personnel to identify and correct the worn throttle detent.

The accident is consistent with the pilot not ensuring the throttle was in the FLY detent position as the helicopter made an approach to land which resulted in reduced engine power, a low main rotor RPM condition, and subsequent impact with terrain. The worn throttle detent bracket likely contributed to the pilot unknowingly rolling the throttle towards idle prior to commencing the approach to land and subsequently not recognizing that the throttle had moved.

Probable Cause and Findings

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

The pilot's failure to ensure the throttle was properly positioned before commencing an approach to land, which resulted in a low rotor rpm condition and impact with terrain. Contributing to the accident was a worn throttle detent.

Findings

Aircraft	Power lever - Fatigue/wear/corrosion
Personnel issues	Use of checklist - Pilot
Personnel issues	Scheduled/routine maintenance - Maintenance personnel
Aircraft	Power lever - Incorrect service/maintenance
Personnel issues	Aircraft control - Pilot

Factual Information

History of Flight

Prior to flight	Aircraft inspection event
Approach	Loss of control in flight (Defining event)

On September 4, 2022, at 0757 Pacific daylight time, a Bell 407, N687AM, was substantially damaged when it was involved in an accident near Mount Baldy, California. The pilot was seriously injured. The helicopter was operated as a Title 14 *Code of Federal Regulations* Part 91 flight.

According to the pilot, the helicopter was being used to shuttle people, water, and equipment in support of a local charity event between a lower LZ at about 4,300 ft mean sea level (msl) and the summit of Mount Baldy, about 4 miles away at 10,064 ft msl. He estimated he would need five flights to complete the mission.

The pilot stated he left the rotor rpm at 100% during the first and second landings and offloads at the summit. After he had dropped off the second load at the summit and was returning to base camp, his intent was to fly down-canyon to lose altitude and set up for a steep approach to the lower LZ. He was slowing from about 60 kts to 40 kts as he turned onto final when he saw the low rotor rpm warning light and heard the low rotor rpm warning horn. He stated that the flight controls were “normal,” and he did not hear the engine sputter. He saw the rotor rpm was about 95%, so he lowered the collective and the rotor rpm increased to 100%. He did not recall looking at the throttle before he aborted the approach, turned down a canyon, and made a mayday call to ground personnel to report that he had a partial engine failure and was looking for a place to land.

The pilot then attempted to raise the collective, the low rotor rpm warning light illuminated again, and he heard the aural tone for the warning horn again. He did not attempt to put the Full Authority Digital Engine Controller (FADEC) into Manual mode because he did not want to divert his attention away from looking for a place to land. While looking for a place to land, the pilot noted several obstacles in the area and decided a clearing was his best option for landing. The pilot stated that he did not autorotate and decided to use the power available to try to land. He subsequently overshot the clearing and landed in trees. The helicopter rolled onto its right side upon landing, substantially damaging the main rotor blades.

The engine control unit (ECU) records snapshot data each time an engine parameter is exceeded; incident recorder (IR) data records 10 lines of data every 1.2 seconds before an exceedance and continues recording data for at least 48 seconds following the last exceedance. In this event, the IR recorded measurable data for nearly 62 seconds.

The data showed primary exceedance messages for Torque Rate, followed almost immediately by Primary Hard Fault and Reversionary Hard Fault, which triggered the IR function of the ECU. The data was consistent with the main rotor impact triggering the IR fault and recording the engine shutting down following the accident. The data contained no additional IR faults or anomalies associated with the accident flight.

The pilot's operating handbook specifies that the throttle should be in the "FLY detent position" before takeoff and landing. It also cautions that failure to position and maintain the throttle in the FLY detent position during normal flight operations can limit available engine power. The pilot has two ways to confirm the throttle is in the FLY position: 1) visually observing that the throttle is in the FLY position according to the bezel marking on the collective stick; or 2) feeling by hand that the throttle remains within the FLY detent. Confirming that the throttle is in the FLY position before landing or takeoff ensures that the engine is being fully governed and, therefore, that full power is available.

The PLA corresponds to the power command sent to the engine via the throttle on the collective stick through the hydromechanical unit (HMU). The IR data indicated PLA values between 48°-50° during the 12 seconds before the IR was activated. The normal PLA value when the throttle is in the FLY position is 70°. However, the FADEC provides full governing (that is, full fuel flow) down to 62° PLA. The data further showed that, even at the lower PLA setting, the engine was performing normally.

A postaccident engine run and test of the engine and ECU to new engine production standards showed that the engine ran satisfactorily at all measured test points and responded properly to all throttle commands.

Postaccident examination of the helicopter verified control continuity from the twist grip throttle to the HMU before removal of the engine for the engine run. The twist grip was manipulated through various positions (Off, Idle, FLY, Max Ng, 48 PLA); the corresponding HMU pointer positions and the PLA 1 sensor reading on the ECU indicated the throttle was rigged correctly.

The twist grip throttle uses a ball plunger to assist in maintaining the FLY throttle position by engaging in a detent within the twist grip assembly. During the postaccident examination, when the throttle was manipulated by hand from the IDLE position to the FLY detent, the detent could be felt when it was reached. When the throttle was rolled from FLY to Max Ng, it could be felt going out of the detent. When the throttle was rolled from the FLY position toward IDLE, there was perceivably less tactile resistance as the ball plunger moved out of the detent.

The collective assembly was removed from the helicopter and examined at a Bell Helicopters laboratory under the supervision of a Federal Aviation Administration inspector. The frictional force required to change throttle positions was measured at different throttle positions. The force required to rotate the throttle and move the ball plunger from IDLE to the FLY detent measured 4 lb. The force required to rotate the ball plunger out of the FLY detent to IDLE

measured 4 lb. The force required to rotate the ball plunger out of the FLY detent to MAX Ng measured 5 lb.

The collective stick was disassembled, and the throttle assembly was examined. Wear was evident where the ball plunger in the throttle control engaged the detent bracket (Figure 1). No other preimpact anomalies were found with the engine or airframe systems.

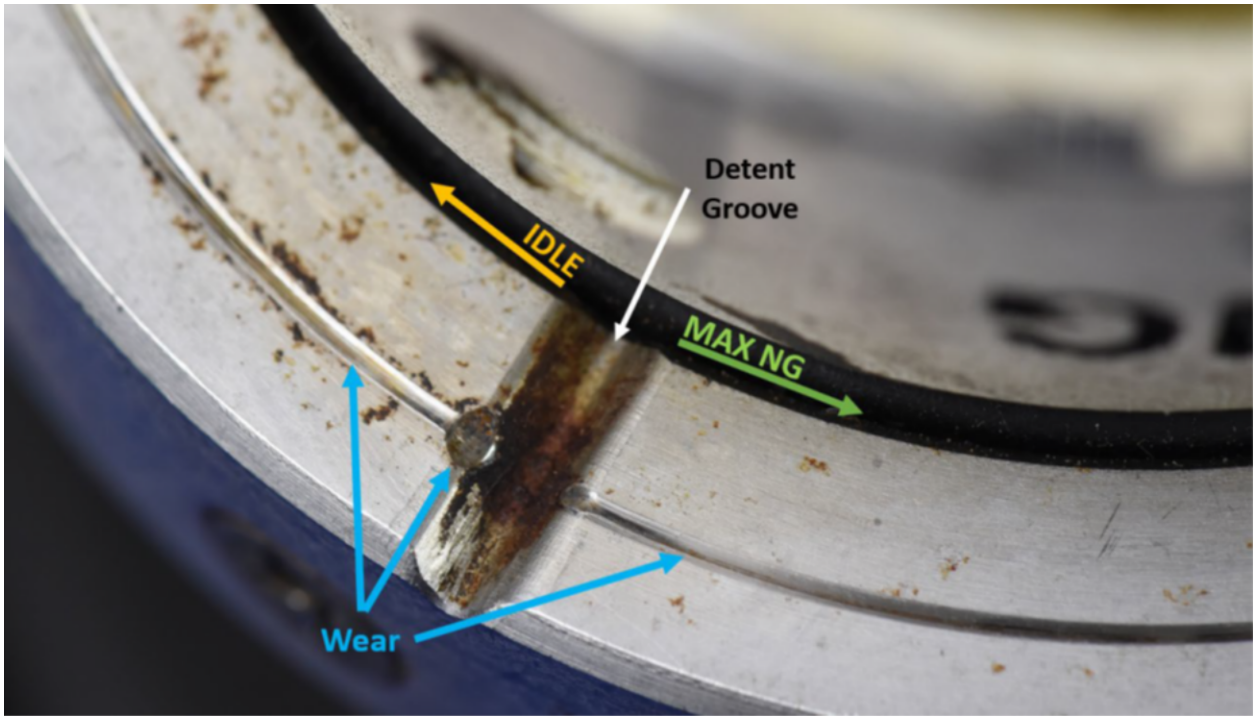

Figure 1. Collective detent bracket wear. (Source: Bell)

The Bell 407 maintenance manual specifies required recurrent inspections of the twist grip throttle within the progressive inspection program (Event No. 3) or the airframe periodic inspections. During these inspections, the throttle friction is checked using Bell maintenance manual procedure DMC-407-A-76-04-00-00A-280A-A, THROTTLE/FLY DETENT Friction Check. This procedure specifies 14–15 ± 0.5 lb of force should be required to move the ball plunger through the detent groove. If the throttle does not meet the friction standards specified, maintenance personnel are to adjust the throttle friction in accordance with Bell maintenance manual procedure DMC-407-A-76-04-00-00A-271A-A, THROTTLE/FLY DETENT Friction Adjustment.

The throttle friction adjustment procedures direct maintenance personnel to adjust the throttle friction by verifying the condition of the ball plunger and adjusting the depth of the ball plunger to apply pressure to the throttle bracket at the detent to achieve the specified friction. Neither the throttle Friction Check nor the throttle Friction Adjustment procedure specifies a check for wear at the FLY detent position.

According to the helicopter's maintenance records, the last Event No. 3 inspection was accomplished May 10, 2022, at a helicopter total time of 6,873.8 hrs. The operator's checklist

for the Event No. 3 inspection included the throttle Friction Check and the throttle Friction Adjustment. The employee who performed the last Event No. 3 inspection was no longer employed with the operator and was not available to verify which maintenance actions they may have performed regarding the throttle friction checks.

Pilot Information

Certificate:	Commercial; Flight instructor; Private	**Age:**	58,Male
Airplane Rating(s):	Single-engine sea	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	4-point
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Helicopter	**Toxicology Performed:**	
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	June 14, 2022
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	October 11, 2021
Flight Time:	3447 hours (Total, all aircraft), 264 hours (Total, this make and model), 3309 hours (Pilot In Command, all aircraft), 28.3 hours (Last 90 days, all aircraft), 8 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Bell	**Registration:**	N687AM
Model/Series:	407	**Aircraft Category:**	Helicopter
Year of Manufacture:	2001	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	53497
Landing Gear Type:	Skid	**Seats:**	4
Date/Type of Last Inspection:	August 30, 2022 AAIP	**Certified Max Gross Wt.:**	5250 lbs
Time Since Last Inspection:	42 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	6943 Hrs as of last inspection	**Engine Manufacturer:**	ALLISON
ELT:	C126 installed, not activated	**Engine Model/Series:**	M250-C47B
Registered Owner:	AIR METHODS CORP	**Rated Power:**	650 Horsepower
Operator:	AIR METHODS CORP	**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:		**Operator Designator Code:**	QMLA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KCCB,1439 ft msl	**Distance from Accident Site:**	8 Nautical Miles
Observation Time:	08:15 Local	**Direction from Accident Site:**	192°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.95 inches Hg	**Temperature/Dew Point:**	31°C / 16°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Mount Baldy , CA	**Type of Flight Plan Filed:**	Company VFR
Destination:	Mount Baldy , CA	**Type of Clearance:**	None
Departure Time:		**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	1 Serious	**Latitude, Longitude:**	34.243,-117.654(est)

Administrative Information

Investigator In Charge (IIC):	Baker, Daniel
Additional Participating Persons:	Jason Trask; Air Methods; Denver, CO Benny Kim; FAA; Riverside, CA Nick Shepler; Rolls-Royce; Indianapolis, IN Beverly Harvey; Transportation Safety Board of Canada Kevin Drew; Air Methods Corp; Greenwood Village, CO
Original Publish Date:	August 21, 2024
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=105859

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