



Aviation Investigation Final Report

Location:	Los Angeles, California	Accident Number:	WPR21LA039
Date & Time:	November 6, 2020, 15:00 Local	Registration:	N109EX
Aircraft:	Agusta A109	Aircraft Damage:	Substantial
Defining Event:	Flight control sys malf/fail	Injuries:	2 Serious, 1 Minor
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled - Air Medical (Organ transport)		

Analysis

The pilot established the helicopter in an approach to land on a rooftop helipad. During the approach, as the helicopter was about 40 ft above the helipad, the helicopter began to yaw to the right despite the pilot’s control inputs. As the pilot continued the approach, he experienced a loss of tail rotor control and attempted to land on the helipad as the helicopter’s right yaw increased. A witness videoed the accident sequence which showed the helicopter rotating clockwise about the vertical axis and rolling to the left before it impacted the helipad. Postaccident examination of the helicopter revealed that the ring nut for the tail rotor duplex bearing was backed out of the sleeve, which resulted in the loss of tail rotor control.

During the investigation, the manufacturer provided historical records of four previous cases that involved ring nut failures. These cases resulted in the manufacturer developing changes to maintenance practices, issuance of European Union Aviation Safety Agency Emergency Airworthiness Directive 2012-0195E in September 2012, and the issuance of Federal Aviation Administration Airworthiness Directive (AD) 2014-02-08, in March 2014, which was superseded by AD 2015-11-08, in June 2015, as a result of a fourth occurrence. The AD added, in part, a daily pilot check to enhance detection of an impending failure of a tail rotor duplex bearing ring nut installation.

The accident pilot and the previous pilot who was assigned to the helicopter reported visually inspecting the two locking wires and signing off on the inspection.

Probable Cause and Findings

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

The loss of tail rotor control due to the separation of the tail rotor duplex bearing ring nut from the thrust sleeve, which resulted in the loss of helicopter control.

Findings

Aircraft

Tail rotor control system - Failure

Factual Information

History of Flight

Landing	Flight control sys malf/fail (Defining event)
Emergency descent	Collision with terr/obj (non-CFIT)

On November 6, 2020, about 1500 Pacific daylight time, an Agusta (Leonardo) A109S helicopter, N109EX, was substantially damaged when it was involved in an accident near the University of Southern California, Keck Medical Center, Los Angeles, California. The pilot and one passenger sustained serious injuries, and one passenger were uninjured. The helicopter was operated as a Title 14 *Code of Federal Regulations* Part 135 helicopter air ambulance flight.

The pilot reported that during a steep approach to the rooftop helipad on the medical center, he decelerated to about 40 to 50 knots and changed the variable engine rpm switch from 100% to 102%. As the helicopter was about 40 ft above the helipad, the pilot noticed a slight yaw to the right that continued despite full left pedal application. The pilot stated that as the helicopter nose cleared the building, it “suddenly and very violently experienced a dramatic increase in right yaw.” The pilot realized the helicopter was going to be uncontrollable, and “dumped the collective” to stay over the helipad. The helicopter impacted the helipad, rolled left, and came to rest on top of the helipad.

The events were consistent with a video captured by a witness located in an adjacent building, which showed the helicopter as it approached the rooftop helipad while slowly rotating clockwise about the vertical axis. The helicopter stopped descending momentarily while it continued to rotate. The helicopter then descended while continuing to rotate an additional 180° as it rolled to the left before it impacted the helipad. The main rotor blades contacted the helipad, followed by the left main landing gear and fuselage.

The helicopter came to rest on its left side while still on the helipad. All major components of the helicopter were located on the rooftop. The fuselage, main rotor system and the tailboom were substantially damaged. The tail rotor assembly along with the 90° gearbox was separated from the end of the tailboom.

Examination of the tail rotor assembly rotating controls revealed that the ring nut was separated from the thrust sleeve assembly (figure 1.). No other mechanical malfunctions or failures were found with the helicopter that would have precluded normal operations.

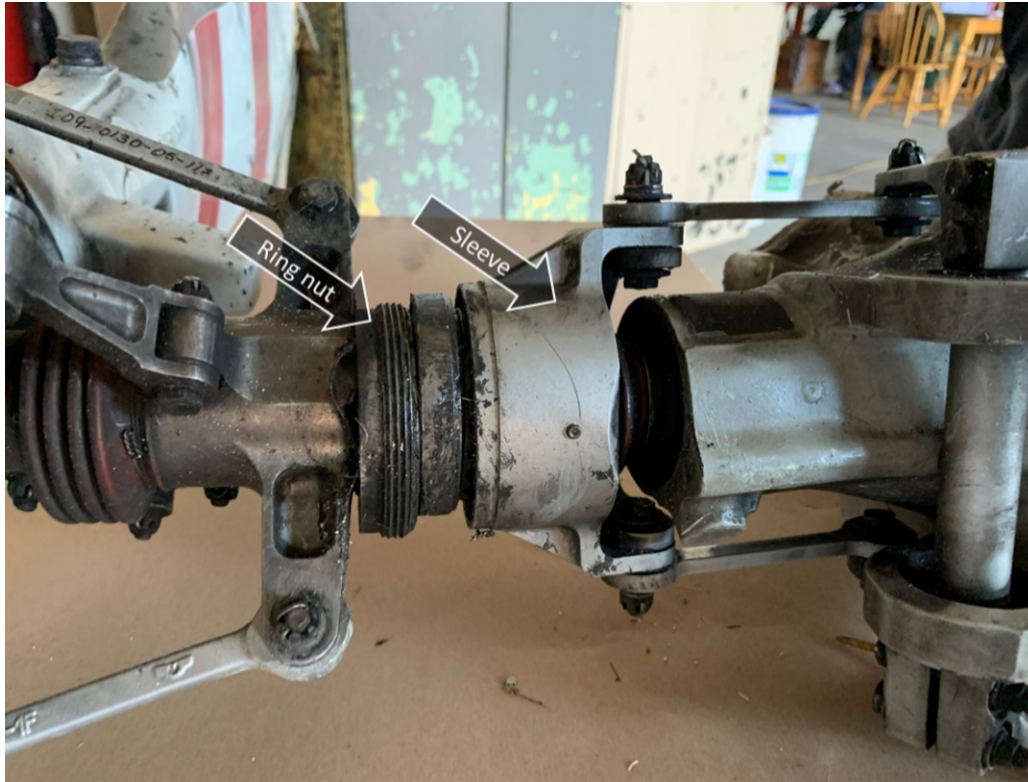


Figure 1. Photo of the tail rotor rotating controls, showing the ring nut, and thrust sleeve. Photo courtesy of the Federal Aviation Administration (FAA).

According to training documents provided by the helicopter manufacturer, the rotating controls are the mechanisms that translate the output from the tail rotor control servo actuator into pitch changes of the tail rotor.

Examination of the tail rotor assembly and 90° gearbox by the National Transportation Safety Board (NTSB) Materials Laboratory revealed a step, or worn footprint, in the bottom surface of the ring nut at the outside diameter edge (figure 2). The threads of the outer diameter of the ring nut and the inner diameter of the thrust sleeve appeared intact. Examination of the grease for trace amounts of required locktite were inconclusive.

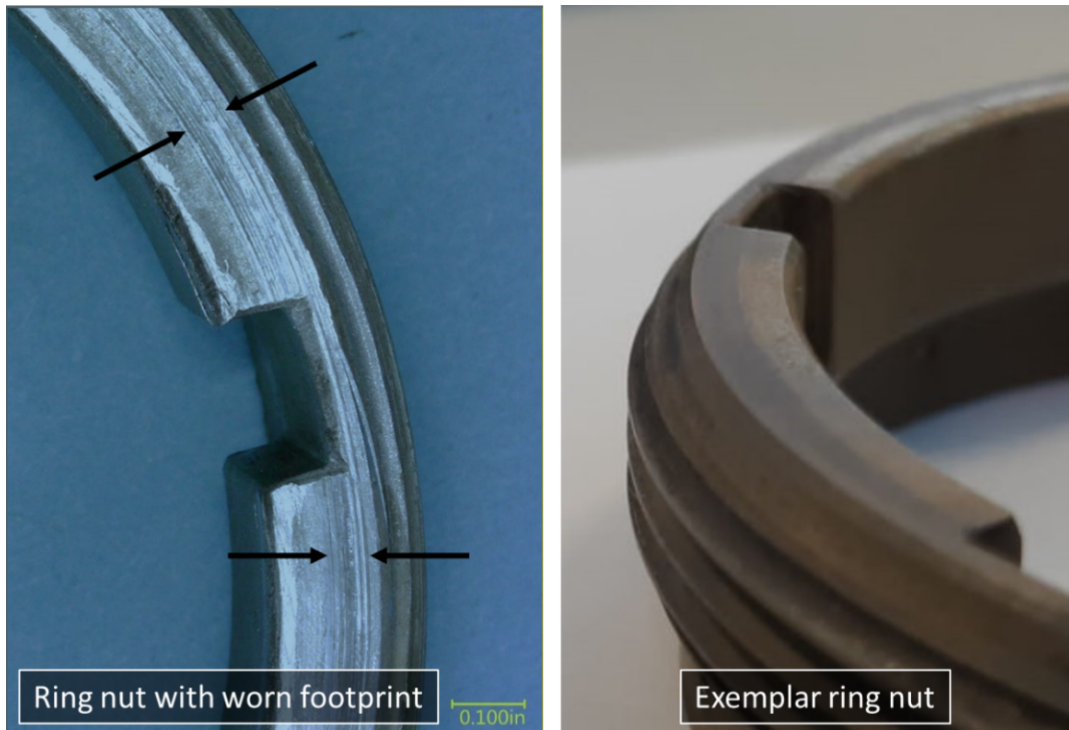


Figure 2. Image showing the step or worn footprint on the accident ring nut, and an exemplar ring nut. Photo of the exemplar ring nut courtesy of Leonardo Helicopters.

During the investigation the manufacturer advised the NTSB that there were four previous cases that were associated with loss of tail rotor control and the associated ring nut.

According to the manufacturer, previous internal investigations that involved ring nut failures resulting from installation issues of the ring nut were notified, investigated, and managed in the past. There were 3 occurrences found that involved the ring nut between December 2010 and October 2014. None of these occurrences were investigated by the NTSB. After the first three occurrences, the manufacturer made changes to maintenance procedures that included increasing the ring nut torque value, dual lockwire application, the application of Loctite to the ring nut, adding a note to the maintenance manual to ensure the duplex bearing is properly seated, and procedures to improve the cleaning and greasing operation of the duplex bearing.

The European Union Aviation Safety Agency (EASA) issued an emergency airworthiness directive (EAD), 2012-1095E, dated September 25, 2012. The reason for the EAD was *“Cases of loosening of the tail rotor duplex bearing locking nut Part Number (P/N) 109-0130-97 have been reported on A109 helicopters. The investigation identified the absence or the damage of one or both of the locking wires securing the tail rotor duplex bearing locking nut P/N 109-0130-97.”*

The helicopter manufacturer issued five Technician Bulletins (Bollettinos Tecnico) in September 2012, for all affected models. The bulletins required, in part, a visual inspection of the lock wire (s) securing the tail rotor duplex locking nut to the housing, periodic inspection (every 25 hours) to verify the condition of the two locking wires until compliance with disassembling and reassembling of the housing and slider group of the tail rotor rotating

controls. The FAA issued Airworthiness Directive (AD) 2014-02-08 on March 7, 2014, based upon the EASA EAD.

Following the issuance of the FAA AD 2014-02-08, a fourth failure occurred on October 21, 2014, after the housing and slider group of the tail rotor rotating controls had been reassembled. Consequently, the FAA superseded the AD 2014-02-08 with AD 2015-11-08, dated June 24, 2015, which included, in part, the removal of the disassembly and reassembly as a terminating action. The AD also included a daily check by the pilot to enhance detection of an impending failure of a tail rotor duplex bearing ring nut installation.

Review of the helicopter maintenance logbooks revealed that the helicopter was maintained in accordance with the manufacturers extended maintenance program. The most recent 400-hour extended maintenance check, which included the disassembly, and inspection of the rotating controls was completed on May 17, 2019, at a Hobbs time of 1,149.2 hours. According to information provided by the operator on the NTSB Form 1620.1, the total times for both engines, about the time of the accident was 1449.1 hours. According to maintenance records, the airframe total time matched the engines total times.

The accident pilot had signed off the tail rotor lockwire inspection on November 6, 2020, at 1120 hours. Prior to that, the previous pilot had signed off the tail rotor lockwire inspection on November 6, 2020, at 0400 hours. Postaccident photos show that part of one locking wire remained attached to the thrust sleeve (Figure 3).

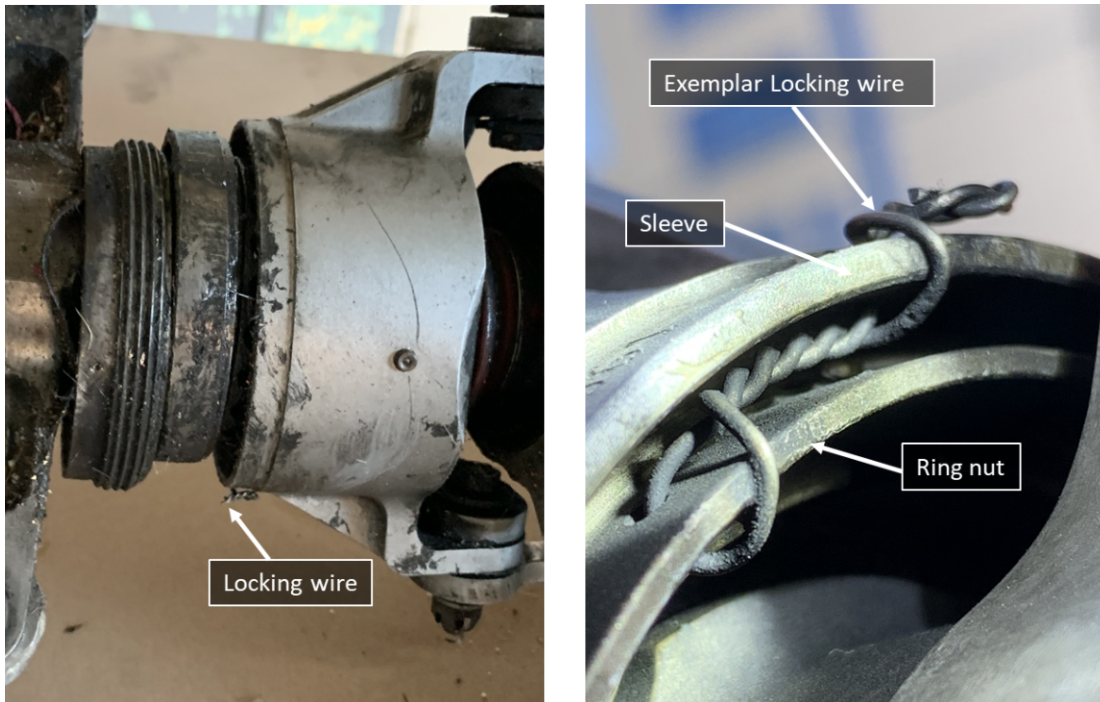


Figure 3. The left photo shows part of one locking wire attached to the accident sleeve, and the right photo shows an exemplar locking wire from a different helicopter. (Photo of the accident ring and sleeve, courtesy of the FAA)

According to the manufacturer a new tail rotor dual lock duplex bearing support has been developed that incorporates a more robust locking system and is compatible with the current duplex bearing. The target for certification is the fourth quarter of 2022 and will be retrofit through service bulletins.

Pilot Information

Certificate:	Commercial; Flight instructor	Age:	45, Male
Airplane Rating(s):	None	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 1 With waivers/limitations	Last FAA Medical Exam:	October 28, 2020
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	April 17, 2020
Flight Time:	(Estimated) 4579 hours (Total, all aircraft), 81 hours (Total, this make and model), 4530 hours (Pilot In Command, all aircraft), 20 hours (Last 90 days, all aircraft), 6 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Passenger Information

Certificate:		Age:	63, Male
Airplane Rating(s):		Seat Occupied:	Left
Other Aircraft Rating(s):		Restraint Used:	3-point
Instrument Rating(s):		Second Pilot Present:	No
Instructor Rating(s):		Toxicology Performed:	
Medical Certification:		Last FAA Medical Exam:	
Occupational Pilot:	No	Last Flight Review or Equivalent:	
Flight Time:			

Passenger Information

Certificate:		Age:	34, Male
Airplane Rating(s):		Seat Occupied:	Right
Other Aircraft Rating(s):		Restraint Used:	4-point
Instrument Rating(s):		Second Pilot Present:	No
Instructor Rating(s):		Toxicology Performed:	
Medical Certification:		Last FAA Medical Exam:	
Occupational Pilot:	No	Last Flight Review or Equivalent:	
Flight Time:			

Aircraft and Owner/Operator Information

Aircraft Make:	Agusta	Registration:	N109EX
Model/Series:	A109 S	Aircraft Category:	Helicopter
Year of Manufacture:	2009	Amateur Built:	
Airworthiness Certificate:	Normal	Serial Number:	22145
Landing Gear Type:	Retractable - Tricycle	Seats:	7
Date/Type of Last Inspection:	October 22, 2020 Unknown	Certified Max Gross Wt.:	7000 lbs
Time Since Last Inspection:	1439.5 Hrs	Engines:	2 Turbo shaft
Airframe Total Time:	1446.7 Hrs as of last inspection	Engine Manufacturer:	Pratt & Whitney
ELT:	C126 installed, not activated	Engine Model/Series:	PW207C
Registered Owner:	Prime Healthcare Air Transportation LLC	Rated Power:	572 Horsepower
Operator:	Helinet Aviation Services	Operating Certificate(s) Held:	Rotorcraft external load (133), On-demand air taxi (135)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	EMT,296 ft msl	Distance from Accident Site:	10 Nautical Miles
Observation Time:	14:45 Local	Direction from Accident Site:	79°
Lowest Cloud Condition:	Scattered / 3200 ft AGL	Visibility	10 miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	10 knots /	Turbulence Type Forecast/Actual:	None / None
Wind Direction:	190°	Turbulence Severity Forecast/Actual:	N/A / N/A
Altimeter Setting:	29.65 inches Hg	Temperature/Dew Point:	22°C / 14°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	La Mesa, CA (03CA)	Type of Flight Plan Filed:	Company VFR
Destination:	Los Angeles, CA	Type of Clearance:	None
Departure Time:	14:33 Local	Type of Airspace:	Class G

Airport Information

Airport:	USC University Hospital (KECK USC) CL00	Runway Surface Type:	
Airport Elevation:	476 ft msl	Runway Surface Condition:	Dry
Runway Used:		IFR Approach:	None
Runway Length/Width:		VFR Approach/Landing:	Full stop

Wreckage and Impact Information

Crew Injuries:	1 Serious	Aircraft Damage:	Substantial
Passenger Injuries:	1 Serious, 1 Minor	Aircraft Fire:	None
Ground Injuries:		Aircraft Explosion:	None
Total Injuries:	2 Serious, 1 Minor	Latitude, Longitude:	34.058037,-118.20811(est)

Administrative Information

Investigator In Charge (IIC):	Salazar, Fabian
Additional Participating Persons:	Rick Lewandowski; Federal Aviation Administration; Los Angeles, CA Frank Motter; Federal Aviation Administration; Van Nuys, CA David Harvey; Federal Aviation Administration; Los Angeles, CA Josh Page; Director of Maintenance Helinet Avn Services; Van Nuys, , CA
Original Publish Date:	January 31, 2023
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=102246

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available [here](#).