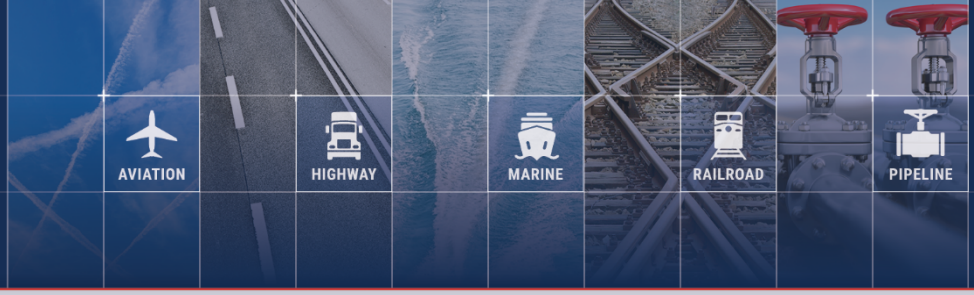

Aviation Investigation Final Report

Location:	Adair, Iowa	**Accident Number:**	CEN22LA146
Date & Time:	March 17, 2022, 14:30 Local	**Registration:**	N500MZ
Aircraft:	Hughes (MD Helicopters) 369	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (partial)	**Injuries:**	1 Minor
Flight Conducted Under:	Part 133: Rotorcraft ext. load		

Analysis

During longline operations, and while flying to a structure, the helicopter sustained a partial loss of engine power. The helicopter was at 90ft above ground level and about 30 kts airspeed, when the pilot lowered the collective to attempt an autorotation. There was insufficient altitude and airspeed to increase main rotor rotation, and the helicopter impacted a muddy grass hill. The helicopter came to rest on its right side. After the helicopter came to rest, the pilot noticed the engine was still, “at a slow run, less than idle.”

The helicopter sustained substantial damage to the fuselage, the main rotor system, and the tail rotor system. During the recovery of the helicopter from the field, it was noticed by the operator that the compressor discharge pressure (Pc) line B-nut connection at the fuel control unit (FCU) was not attached. It appeared the B-nut had backed off the FCU fitting.

A postaccident examination was performed on the airframe with no anomalies noted. The engine was removed from the airframe and an engine test run was performed with no anomalies noted after the Pc line B-nut was properly torqued. During the Pc line B-nut torquing process, a “squeeze out” of pink paint, consistent with torque stripe paint, was observed emanating from the remaining threads on the line.

On the day before the accident, the fuel control unit (FCU) was installed on the helicopter’s turboshaft engine. A calibrated torque wrench was used by the mechanic to tighten the various FCU B-nuts. The mechanic tightened and torqued each B-nut, one at a time, when completing the task. Another mechanic inspected the work after it was completed and found no issues. After the B-nuts were torqued, pink torque stripe paint was applied. Following the FCU installation, the fuel system was purged of air, and a leak check was performed with the helicopter running, an acceptable practice per the engine manufacturer, with no issues noted.

It is likely that the mechanic failed to properly torque the B-nut that secures the Pc line to the FCU, which resulted in a partial loss of engine power due to the Pc line separation. Based on the available evidence, it was undetermined as to why the mechanic failed to properly torque the B-nut.

Probable Cause and Findings

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

The mechanic's failure to properly torque a fuel control unit B-nut, which resulted in a partial loss of engine power, an attempted autorotation, and an impact with terrain.

Findings

Aircraft	(general) - Malfunction
Aircraft	(general) - Incorrect service/maintenance
Personnel issues	Installation - Maintenance personnel
Personnel issues	Forgotten action/omission - Maintenance personnel
Personnel issues	Monitoring equip/instruments - Maintenance personnel

Factual Information

History of Flight

Prior to flight	Aircraft maintenance event
Maneuvering-low-alt flying	Loss of engine power (partial) (Defining event)
Autorotation	Attempted remediation/recovery
Landing-flare/touchdown	Collision during takeoff/land

On March 17, 2022, about 1430 central daylight time, a Hughes (MD Helicopters) 369D helicopter, N500MZ, was substantially damaged when it was involved in an accident near Adair, Iowa. The commercial pilot sustained minor injury. The helicopter was operated as a Title 14 *Code of Federal Regulations (CFR)* Part 133 external load flight.

On the day of the accident, the pilot performed a fuel sample check and the preflight checks with no anomalies noted. The pilot reported he was “hands on” during the preflight and checked the various components that had the recent maintenance work performed on them. The pilot aborted the first start due to a high turbine outlet temperature (TOT). The mechanic adjusted the acceleration settings, and the second start was within TOT limitations. The pilot then departed for the landing zone.

During longline operations, and while flying to a structure, the helicopter sustained a partial loss of engine power. The helicopter was at 90ft above ground level and about 30 kts airspeed, when the pilot lowered the collective to attempt an autorotation. The pilot was unable to point the helicopter into the wind because a powerline was in the direction of the wind, so there was about a 20 kt crosswind from the north (the left side of the helicopter). There was insufficient altitude and airspeed to increase main rotor rotation, and the helicopter impacted a muddy grass hill. The helicopter came to rest on its right side. After the helicopter came to rest, the pilot noticed the engine was still, “at a slow run, less than idle.” The pilot performed an emergency shutdown, and he was able to egress from the helicopter without further incident.

The helicopter sustained substantial damage to the fuselage, the main rotor system, and the tail rotor system. During the recovery of the helicopter from the field, it was noticed by the operator that the compressor discharge pressure (Pc) line B-nut connection (tube coupling nut) at the fuel control unit (FCU) was not attached and was loose around the Pc line. It appeared the B-nut had backed off the FCU fitting.

The company mechanic reported that on March 5, 2022, the current turboshaft engine was installed in the helicopter and the work was performed in accordance with the Rolls-Royce M250-C20 Series Operation and Maintenance Manual. The engine had arrived with all the accessories previously installed except for the starter generator. The tach generators, FCU,

governor, fuel nozzle, and bleed valve were already installed before the engine was received. The helicopter had several abnormal starts after the engine installation work and the maintenance team kept troubleshooting the abnormal starts.

On March 16, 2022, the FCU was removed from the previously removed engine and was installed on the current engine for troubleshooting purposes. A calibrated torque wrench was used to tighten the various FCU B-nuts. The mechanic tightened and torqued each B-nut, one at a time, when completing the task. Another mechanic inspected the work after it was completed and found no issues. After the B-nuts were torqued, pink torque stripe paint was applied. Following the FCU installation, the fuel system was purged of air, and a leak check was performed with the helicopter running, an acceptable practice per the engine manufacturer, with no issues noted.

A postaccident examination was performed on the airframe with no anomalies noted. The engine was removed from the airframe and an engine test run was performed with no anomalies noted after the Pc line B-nut was properly torqued. During the Pc line B-nut torquing process, a “squeeze out” of pink paint, consistent with torque stripe paint, was observed emanating from the remaining threads on the line. In addition to the pink torque stripe paint used, previous torque stripes of green paint and orange paint were observed on the B-nut and on the tube threads. A review of the helicopter maintenance records did not find evidence of any uncorrected mechanical issues with the airframe and the engine.

The mechanic stated in a postaccident interview that the Pc line B-nut that was found loose after the accident is the hardest one to work on in that specific area of the engine compartment. The mechanic believes that while torquing that specific B-nut, the torque wrench contacted the FCU and a false torque reading was likely provided to him.

A review of the height velocity diagram from the MD Helicopters 500D rotorcraft flight manual (RFM) showed that at the time of the accident, the helicopter was operating in a cross-hatched region. The airframe manufacturer states in part:

Flight within the cross-hatched regions represent airspeed/altitude combinations from which a successful autorotation landing may be difficult to perform. Operation within the cross-hatched area should be undertaken with caution.

Title 14 *CFR* Part 133 external load operations typically operate at low altitudes and at low airspeeds. The helicopter was found to be within weight limitations for the flight and for the height velocity diagram. The estimated density altitude for the accident site was 542 ft above mean sea level.

The RFM also lists the various areas that are part of the preflight inspection and states in part:

> *Engine oil, air, and fuel lines – CHECK*

Fuel control, N2 governor, and associated linkages – CHECK

Rolls-Royce Customer Service Letter CSL-A-1166 Maintenance Warning – External Lines discusses failures of tube assembles for various causes and states:

Failure to properly torque tube coupling nuts can cause leakage if under torqued, which can result in fuel or oil leaks or engine power loss.

The Rolls-Royce M250-C20 Series Operation and Maintenance Manual provides a warning that states:

Failure to properly install, align, and tighten fuel, oil, and air fittings and tubes could result in an engine failure.

The make and model helicopter has a required engine compartment placard, which the accident helicopter had installed, that has the same warning listed above in the Rolls-Royce M250-C20 Series Operation and Maintenance Manual.

The Federal Aviation Administration Safety Team (commonly known as the FAASTeam) has published FAASTeam Notice 4301 Maintenance Safety Tip – The "B" Nut Can Be Deadly. This document discusses B-nuts and states in part:

We disconnect and connect them many times during our careers - right? However, do you "tighten" or "torque" this simple critical component? No matter how simple this component is, it requires a specific "torque" to keep it reliable in maintaining plumbing system integrity. You may have seen a maintenance record entry where the sign-off stated, "Tightened B nut." Does this mean it was tightened enough to stop a leak, or was it tightened to a specific torque? If you are just tightening the "B" nut, you could be setting the stage for future failure or fracture.

Just get the tools you need to get it done right!

Another "gotcha" is finger tightening then "forgetting" to torque the "B" nut. A high risk of this occurring can be distractions (like telephone calls) and interruptions (like multi-tasking) while on the job.

A good technique to follow is if you connect a "B" nut, finish the job with the proper torque. Otherwise, tag it or write it up so it is not overlooked, especially if you leave the job site or another aviation maintenance technician finishes the job!

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	42,Male
Airplane Rating(s):	None	**Seat Occupied:**	Left
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 Without waivers/limitations	**Last FAA Medical Exam:**	November 8, 2021
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	March 12, 2022
Flight Time:	5715 hours (Total, all aircraft), 4031 hours (Total, this make and model), 5559 hours (Pilot In Command, all aircraft), 49 hours (Last 90 days, all aircraft), 20 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Hughes (MD Helicopters)	**Registration:**	N500MZ
Model/Series:	369 D	**Aircraft Category:**	Helicopter
Year of Manufacture:	1977	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	770159D
Landing Gear Type:	None; High skid	**Seats:**	2
Date/Type of Last Inspection:	March 9, 2022 100 hour	**Certified Max Gross Wt.:**	3000 lbs
Time Since Last Inspection:	17.2 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	15124.7 Hrs as of last inspection	**Engine Manufacturer:**	Rolls-Royce
ELT:	C126 installed, activated, did not aid in locating accident	**Engine Model/Series:**	250-C20R/2
Registered Owner:	Winco, Inc.	**Rated Power:**	450 Horsepower
Operator:	Winco, Inc.	**Operating Certificate(s) Held:**	Rotorcraft external load (133), Agricultural aircraft (137)
Operator Does Business As:	Winco, Inc.	**Operator Designator Code:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KADU,1287 ft msl	**Distance from Accident Site:**	15 Nautical Miles
Observation Time:	14:30 Local	**Direction from Accident Site:**	312°
Lowest Cloud Condition:		**Visibility**	10 miles
Lowest Ceiling:	Broken / 6000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	12 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	360°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	30 inches Hg	**Temperature/Dew Point:**	5°C / 3°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Adair, IA	**Type of Flight Plan Filed:**	None
Destination:	Adair, IA	**Type of Clearance:**	None
Departure Time:		**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Minor	**Latitude, Longitude:**	41.532256,-94.66946(est)

Administrative Information

Investigator In Charge (IIC):	Hodges, Michael
Additional Participating Persons:	Luis Deliz; FAA Des Moines FSDO; Ankeny, IA Joan Gregoire; MD Helicopters; Mesa, AZ Nick Shepler; Rolls-Royce; Indianapolis, IN Trever Walker; Winco, Inc.; Aurora, OR
Original Publish Date:	February 2, 2023
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=104795