



Aviation Investigation Final Report

Location:	Arcadia, Iowa	Accident Number:	CEN22LA351
Date & Time:	August 1, 2022, 09:15 Local	Registration:	N169AA
Aircraft:	BELL HELICOPTER TEXTRON 206B	Aircraft Damage:	Substantial
Defining Event:	Loss of engine power (total)	Injuries:	1 Minor
Flight Conducted Under:	Part 137: Agricultural		

Analysis

The pilot reported that he was completing an aerial application flight about 6 ft above the corn field when the engine sustained a loss of power. The helicopter descended into the corn and impacted the field. A small postcrash fire ensued near the engine and was extinguished.

Postaccident examination revealed all external air, fuel, and oil line connections were tight except for the pneumatic air line (Pc line) B-nut connecting the power turbine governor (PTG) to the fuel control unit (FCU). The Pc line was not connected to the FCU and a gap was noted between the B-nut and FCU union. Residual torque paint was identified; however, there was no new-effective torque paint identified on any B-Nut. It appeared the B-nut had backed off the FCU fitting. This Pc is one of several that use air pressure to communicate fuel scheduling demands between the PTG and FCU. The security of this line is necessary for proper engine operation. Operation of the engine without the B-nut properly connected would result in the FCU reducing fuel to a sub-idle condition, with the engine not capable of producing power for continued flight. There were no other mechanical functions or failures that would have precluded normal operation.

Maintenance was performed on the helicopter 23 days and 12 flight hours before the accident. It is likely that the maintenance personnel did not properly torque this B-but or apply torque stripe paint, which resulted in a disconnection of the B-nut and a loss of engine power.

Probable Cause and Findings

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

Maintenance personnel's failure to properly torque a fuel control unit B-nut, which resulted in a loss of engine power at low altitude and an impact with terrain.

Findings

Aircraft	Fuel controlling system - Incorrect service/maintenance
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Factual Information

History of Flight

Maneuvering

Loss of engine power (total) (Defining event)

On August 1, 2022, about 0915 central daylight time, a Bell 206B helicopter, N169AA, was substantially damaged when it was involved in an accident near Arcadia, Iowa. The pilot sustained minor injuries. The helicopter was operated as a Title 14 *Code of Federal Regulations* Part 137 aerial application flight.

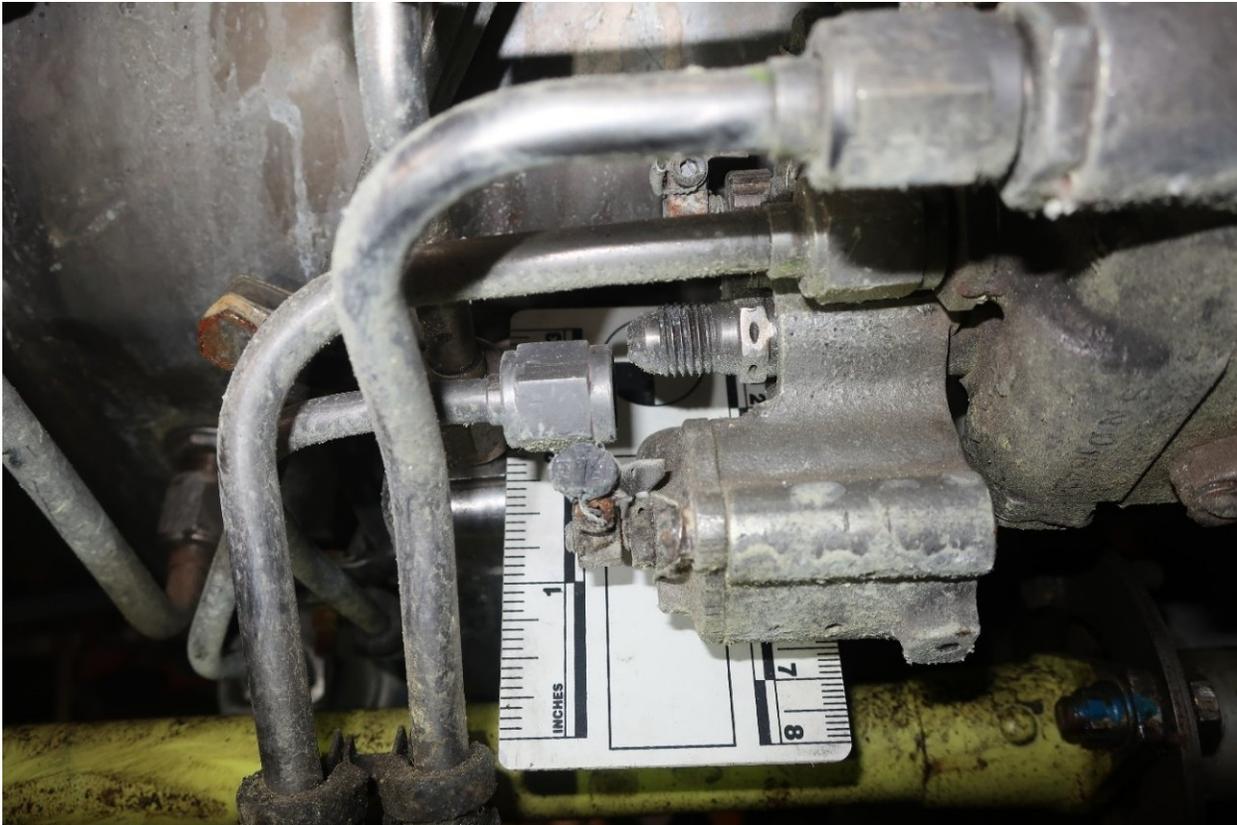
The pilot reported that he was completing an aerial application run about 6 ft above the corn field when the engine sustained a loss of power. The helicopter descended into the corn and impacted the field. A small postcrash fire ensued near the engine and was extinguished. The pilot stated that the helicopter recently had significant maintenance performed and he had only flown it about 12 hours since then.

Postaccident examination of the helicopter revealed thermal damage and soot noted on the top of the engine and cowling with fire retardant residue noted. The engine compressor turbine (N1) system was not examined. The engine power turbine (N2) system was locked and the No. 5 bearing area of the exhaust collector was buckled. The fourth stage turbine wheel appeared normal when viewed from the exhaust collector but was covered in fire retardant residue.

A fuel sample was taken from the aircraft fuel filter bowl; the fuel was clear and appeared normal. The fuel filter element was clear of contamination. An oil sample was taken from the aircraft-mounted scavenge oil filter bowl and was dark brown in appearance. The filter element was clear and some minor non-ferrous debris was noted in the bowl, consistent with carbon particles. The pending bypass button was not extended.

Linkages from the collective to the PTG and from the throttle twist grip to the FCU were secure. The FCU throttle input lever was rigged correctly and contacted the minimum and maximum stops when the throttle was rotated to the cut off and fly position respectively. The PTG rotated through about 20° when the collective was moved from full down to full up.

All external air, fuel, and oil line connections were at least finger tight except for the Pc line B-nut connecting the PTG to the FCU. The Pc line was not connected to the FCU and a gap was noted between the B-nut and FCU union (Figure 1). Residual torque paint was identified; however, there was no new-effective torque paint identified on any B-Nut. This Pc line is one of several that use air pressure to communicate fuel scheduling demands between the PTG and FCU.



Figure

1. Disconnected Pc line B-nut that connects the PTG to the FCU.

The only anomaly observed that would have precluded normal engine operation was the disconnected B-nut on the Pc line.

On July 9, 2022, about 23 days before the accident flight, a maintenance facility completed 100-hour engine and airframe inspections, 300-hour engine and airframe inspections, a 12-month airframe inspection, an engine oil change, and many other inspection items. Additional maintenance work included removing the turbine assembly for an over-temperature inspection and turbine outlet temperature indicator reset due to the over-temperature event. During a postmaintenance engine start attempt, the fuel management system failed to properly control the temperature. The engine start was aborted with no exceedances noted. A fuel nozzle was removed, and a newlyoverhauled fuel control unit was installed. A postmaintenance ground run was completed. The logbook noted that an independent control check was performed for security and safety of, among other things, the fuel control linkage at the control lever and the droop compensator at the governor control arm.

On July 10, 2022, a postmaintenance ground run and test flight were completed and the helicopter was returned to service.

On July 12, the helicopter was flown from the maintenance facility in Langley Regional Airport (CYNJ), British Columbia, Canada, to Bellingham International Airport (KBLI), Bellingham, Washington. Helicopter total time was 13,248.3 hours.

According to Rolls-Royce, the B-nut that was found loose is difficult to access when other tubes are installed. Rolls-Royce designed, developed, and released a special tool to access this B-nut. On October 24, 2016, it was released to the field via commercial service letter (CSL) 1273. The CSL provides details on how to manufacture the tool locally and the tool is also available for purchase. Operators are advised that torque paint/slippage indication is to be applied to all B-nuts per the Rolls-Royce operation and maintenance manual (OMM). Strict adherence to the specified manuals is essential to the safe and reliable operation of the engine. Failure to maintain the engine in accordance with the OMM and supporting customer publications can result in a decrease in airworthiness of the engine.

Pilot Information

Certificate:	Commercial	Age:	78, Male
Airplane Rating(s):	Single-engine land; Multi-engine land	Seat Occupied:	Right
Other Aircraft Rating(s):	Helicopter	Restraint Used:	Unknown
Instrument Rating(s):	Airplane	Second Pilot Present:	No
Instructor Rating(s):	None	Toxicology Performed:	
Medical Certification:	Class 2 With waivers/limitations	Last FAA Medical Exam:	June 9, 2022
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	July 21, 2020
Flight Time:			

Aircraft and Owner/Operator Information

Aircraft Make:	BELL HELICOPTER TEXTRON	Registration:	N169AA
Model/Series:	206B	Aircraft Category:	Helicopter
Year of Manufacture:	1973	Amateur Built:	
Airworthiness Certificate:	Normal	Serial Number:	990
Landing Gear Type:	Skid	Seats:	5
Date/Type of Last Inspection:	July 10, 2022 Unknown	Certified Max Gross Wt.:	
Time Since Last Inspection:		Engines:	1 Turbo shaft
Airframe Total Time:	13248 Hrs as of last inspection	Engine Manufacturer:	Rolls-Royce
ELT:	Not installed	Engine Model/Series:	250-C20
Registered Owner:	PIERCE ASSOCIATES LLC	Rated Power:	420 Horsepower
Operator:	On file	Operating Certificate(s) Held:	Agricultural aircraft (137)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	KCIN,1204 ft msl	Distance from Accident Site:	11 Nautical Miles
Observation Time:	09:15 Local	Direction from Accident Site:	91°
Lowest Cloud Condition:	Few / 10000 ft AGL	Visibility	9 miles
Lowest Ceiling:		Visibility (RVR):	
Wind Speed/Gusts:	4 knots /	Turbulence Type Forecast/Actual:	/
Wind Direction:	30°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	29.98 inches Hg	Temperature/Dew Point:	22°C / 19°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Arcadia, IA	Type of Flight Plan Filed:	None
Destination:	Arcadia, 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:	On-ground
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 Minor	Latitude, Longitude:	42.050422,-95.033367(est)

Preventing Similar Accidents

Ensure B-nuts Are Properly Secured (SA-086)

The Problem

A B-nut is a common term for a nut that provides the clamping force to create a reliable seal in lines (such as fuel, oil, or air lines on a reciprocating or turbine engine) installed on an aircraft. If a B-nut is improperly secured (either torqued too much or not enough), a loss of engine power or an engine fire could result. Under- or over-torqued B-nuts could cause fuel, oil, or air leaks depending on where the B-nuts are installed; over torqued B-nuts could also result in deformation and damage to a line. Fuel or oil leaked onto a hot engine could result in a fire.

B-nuts are exposed to vibration and thermal expansion and contraction during aircraft operations; therefore, it is critical that maintenance personnel ensure that the B-nuts are properly secured.

What can you do?

- Ensure that the proper type of B-nut is used for the maintenance task and that the B-nut does not have any pre-existing damage, especially to the threads or the sealing surfaces. If a B-nut (or any hardware) appears questionable, remove it from service—when in doubt, throw it out!
- Follow procedures from the maintenance manual and the manufacturer's guidance (including service bulletins and letters) to ensure that all steps are taken to complete a

task or inspection. Remember that some B-nuts may be in hard-to-access locations; as a result, additional time and effort might be needed for the task.

- Ensure that the proper tools are used for tightening B-nuts and that torque wrenches are calibrated; check to confirm that the calibration is current.
- Develop a process to ensure that B-nuts that have been tightened during maintenance are also torqued as part of the task. Ensure that proper torquing practices are followed. Use appropriate checklists.
- During maintenance work and inspection intervals, inspect B-nuts for indications of slippage, cracking, misalignment, looseness, and leakage and ensure that the B-nuts are intact and safety wired (if required).
- Make every effort to avoid distractions while performing maintenance. Set a reminder about the remaining checklist items if you need to step away from a task before completing it.
- Perform the required leak checks after the task is completed.
- Properly apply torque stripe paint to the B-nuts, after they have been tightened and torqued, to provide a visual aid for identifying a B-nut that has become loose or is otherwise not properly secured. Remove any previous torque stripe paint before applying the new torque stripe paint.
- Upon completion of a maintenance task, inspect the work. If another mechanic is available, ask them to inspect the work as well.
- Seek out industry best practices for tightening and torquing B-nuts.
- For maintenance management personnel, incorporate procedures for properly securing B-nuts into maintenance training programs and safety management systems.

See <https://www.nts.gov/Advocacy/safety-alerts/Documents/SA-086.pdf> for additional resources.

The NTSB presents this information to prevent recurrence of similar accidents. Note that this should not be considered guidance from the regulator, nor does this supersede existing FAA Regulations (FARs).

Administrative Information

Investigator In Charge (IIC):	Lindberg, Joshua
Additional Participating Persons:	Luis Deliz; Federal Aviation Administration; Ankeny, IA Jon Michael; Rolls-Royce; Indianapolis, IN Nora Vallée; TSB Canada
Original Publish Date:	June 20, 2024
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=105642

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](#).