National Transportation Safety Board
Office of Aviation Safety
Washington, DC 20594

CEN23LA035

WRECKAGE EXAMINATION

Group Chair's Factual Report

May 3, 2022

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A. ACCIDENT

Location: Greenville, IL
Date: November 2, 2022
Time: 2014 CDT
0114 UTC
Helicopter: Bell 206B3/ N61KH

B. WRECKAGE EXAMINATION

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Party Coordinator	Don Pruett Kash Helicopter Services Mt Vernon, IL

C. DETAILS OF THE EXAMINATION

The wreckage examination of the helicopter was conducted at the Kash Helicopter Services facility in Mt Vernon, IL, on December 6, 2022 (Figure 1). The helicopter was manufactured by Bell Helicopter in 1977, as a model 206B III, serial number (SN) 2255 (Figure 1). It had accumulated 15,563.8 flight hours total time at the time of the accident

Figure 1. Helicopter situated for examination.

1.0 Helicoper Description

The Bell 206B is a single-engine helicopter of conventional layout certified for flight in VFR only. It has a teetering main rotor of comparatively high rotational inertia that is controlled through servo actuators. The aircraft is powered by a Rolls-Royce M250-C20B turboshaft engine mounted on the fuselage roof behind the main rotor transmission. A freewheel unit, mounted on the front of the engine accessory gearbox, delivers power forward to the main transmission and aft to the tail rotor gearbox.

2.0 Wreckage Documentation

2.1 Fuselage

Fuselage was placed on aircraft jack stands. The tail boom had separated at station 205.76, the tail boom attachment bulkhead. Both left and right-side cockpit windscreens had broken out, and both cockpit doors had been removed. The right-side landing skid had separated at the skid saddles. The forward right cross tube was displaced upward, and the aft right cross tube had pushed up into the aft fuselage damaging the fuel tank. The tailboom had separated into three sections starting at the tail boom attachment bulkhead with a rotor strike evident at the horizontal stabilizer. The vertical stabilizer had been liberated from the end of the tail boom. The upper deck had a 45° crack between the servo support and the hydraulic pressure filter. The engine, drive shaft, transmission, and tail rotor drive shaft were connected

and moved in concert smoothly when rotated by hand. The main rotor was attached to the rotor mast.

The engine barrier filter consisted of two metal screen elements. There were two differential pressure sensors, one electronic that would trigger a warning in the cockpit if the differential pressure exceeded a set threshold, and a mechanical device that recorded the highest differential pressure on a scale from 2-9 where any recording above 9 would require filter servicing. The device read 6, which was marked as in the "safe zone."

2.2 Cockpit

The cockpit structure was intact. The pilot and copilot seats had displacement deformation to the right of the cockpit. The right seat had the cyclic, collective, and pedals installed; the left seat had only the pedals installed. The instrument panel and center console remained in place with very little observable damage (Figure 2). Battery power was applied to the helicopter and the GEN FAIL, BAGGAGE DOOR, ROTOR LOW RPM, ENG OUT, and TRANS OIL PRESS lights illuminated. The Hobbs meter read 4,452.4-hours.

Figure 2. Cockpit

2.3 Flight Controls

Flight control continuity was established from the cockpit to the upper flight controls by manipulating the cockpit controls and observing appropriate movement of the stationary swashplate and movement up to the rotor head. The red pitch

change link had separated mid span and the white pitch link remained connected at both ends (Figure 3). The antitorque pedals were moved and the rear fuselage bell crank moved in concert. The rear fuselage bell crank extending connecting rod had separated at the rod end connection. Tail rotor control continuity aft of the rear fuselage section was established thru multiple breaks of the control rod to the tail rotor gear box.

Figure 3. Main rotor head showing the fractured red pitch change link.

The flight control servos were attached to the mounting fixture. All servo hydraulic lines were connected. Each servo had a plastic bag zip tied to the end to collect leaking hydraulic oil. The hydraulic reservoir had a 2 centimeter diameter impact mark on its lower left side that aligned with a flight control bracket and nut (Figure 4). The reservoir and sight glass had residual oil and hydraulic oil was observed on the deck beneath the reservoir and pump.

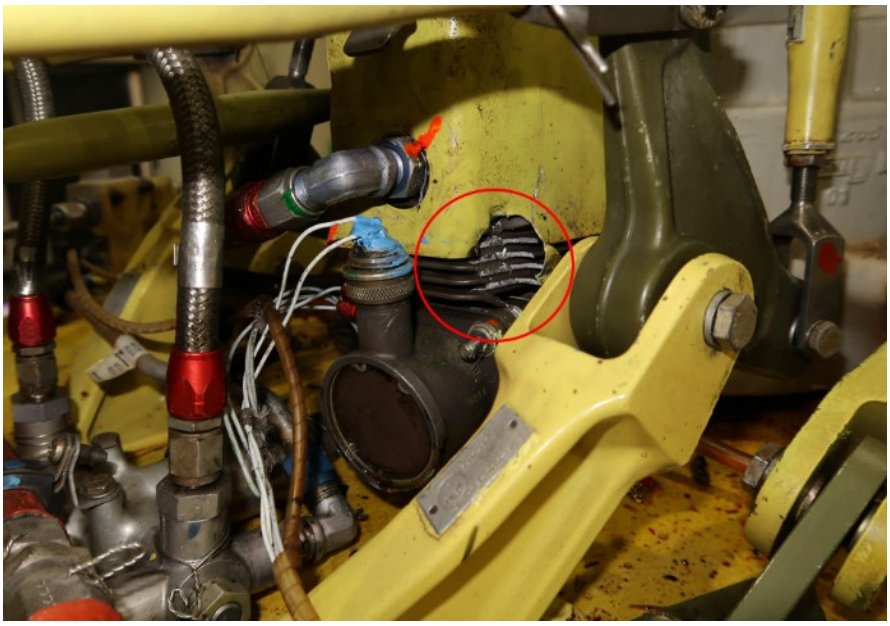

Figure 4. Hydralic reservoir damage shown in the red circle.

The tail rotor head remained attached to the tail rotor gear box (Figure 5), and pitch change on both blade roots was demonstrated through manual manipulation of the tail rotor control rod bell crank. Both tail rotor blades had fractured a few inches outboard of their blade roots.

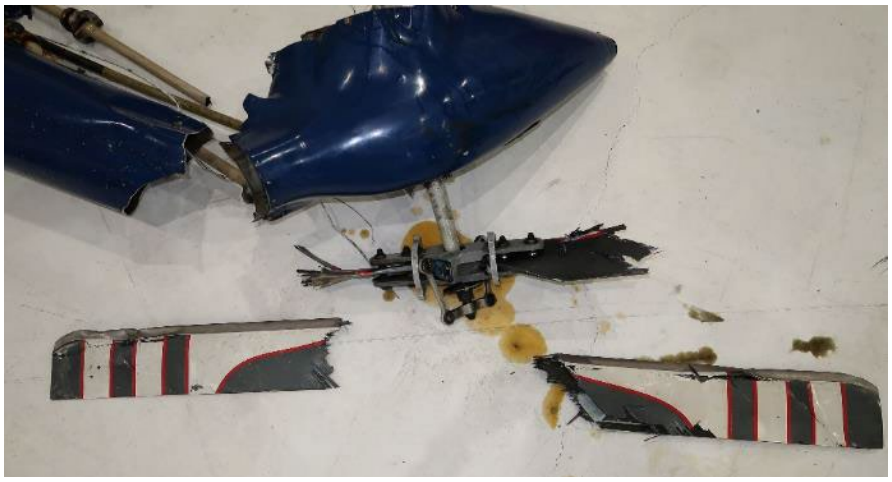

Figure 5. Tail rotor assembly.

2.4 Rotor Drive System

The drive shaft was connected to the engine and transmission. The KAflex flexures of the main driveshaft left some deep rotation marks on the isolation mount below the forward driveshaft attachment and circular scoring marks were observed on the shaft at the firewall location. The transmission stop pin had contacted the support plate attached to the isolation mount, creating impact damage from transmission rocking. The freewheel unit rotated freely in the counterclockwise

direction and engaged in the clockwise (drive) direction. The transmission rotated freely and smooth with no binding when the main rotor was moved by hand. The transmission magnetic drain plug had no metal particles on the magnet but some metallic looking flakes along the plug edge. The transmission mounts (link assemblies) were securely connected to the airframe and transmission on both left and right sides.

The tail rotor drive shaft had separated into 3 segments, consistent with the tail boom separations. The forward tail rotor drive segment had pulled out of the splined end, and the tail rotor gear box (TRGB) drive spline had pulled out of its drive shaft at the opposite end. The tail rotor drive shaft rotated when the main rotor was moved. The TRGB case had a fracture around the pitch change input lever. The TRGB gear train operated freely when manipulated by hand.

2.5 Fuel System

The fuel tank had been breached by the right rear landing gear cross tube and most of the fuel had drained out. When looking through the breeched hole in the fuel bladder some fuel was observed, and the fuel pumps suction screens were clear of debris. The wire harnesses to the fuel pumps had been severed by the landing gear skid cross tube. The fuel tank was drained and both forward and aft fuel pumps were removed. External power was applied to both fuel pumps and both ran. Both pumps were submerged in water, energized, and produced a steady flow of water out their pressure ports. The fuel lines at the airframe fuel filter were disconnected and water passed through both fuel tank to fuel filter and fuel filter to engine lines to confirm that there was no line obstruction or restriction.

The following fuel samples were taken and retained for possible analysis (Figure 6).

A. Engine fuel pump filter. Straw colored fuel. A couple of flakes of red torque stripe fell in to the bowl while it was being removed.

B. Airframe fuel filter drain. Fuel was clear with some black particles settled out.

C. Airframe fuel filter bowl. There was brown sediment in the filter bowl.

D. Aircraft fuel filter (taken the day after the accident).

E. Fuel from fuel farm tank nozzle at Greenville, IL, (taken the after the accident).

F. Fuel from fuel farm tank filter at Greenville, IL, (taken the day after the accident).

Figure 6. Photo of the fuel samples that were retained with the enigne. (Source: Rolls-Royce)

The fuel samples were placed in the engine crate and were included with the engine for transport to Rolls-Royce.

3.0 Engine Documentation

The accident engine was a Rolls-Royce model 250-C20B, SN CAE822827F, with a 420 shaft horsepower rating (Figure 6). The engine had accumulated a total time (TT) of 33,298.6-hours, and 482.10-hours time since overhaul (TSO).

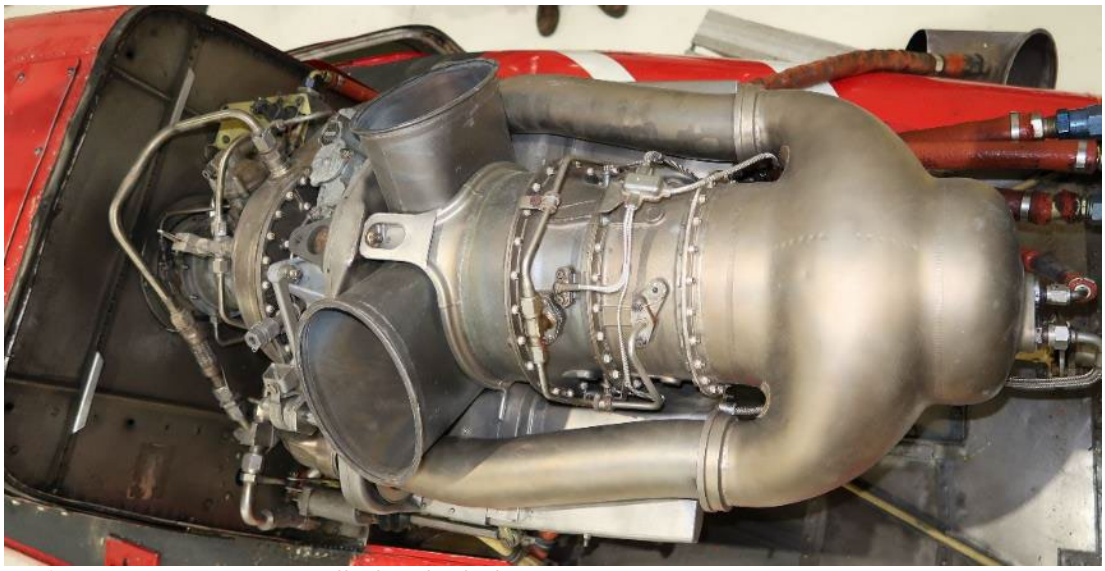

Figure 7. Engine as installed in the helicopter.

Engine control continuity from the collective to the engine was established by moving the collective up and down, and the twist grip to the OFF, IDLE, and FLY positions with corresponding inputs on the engine fuel control. The power turbine governor lever pointed to the 35° position when the collective was full down and 55°

when the collective was full up. When the collective was raised to its limit and the beep switch moved to max, the power turbine governor lever pointed to 60°, and when the collective was moved full down with full minimum on the beep switch, the power tubine governor lever pointed to 30°.

The external engine oil tank, mounted behind the aft engine compartment bulkhead, had split open horizontally along the tank seam. The oil filter bypass button was extended. The oil filter was removed for examination. Oil was present in the filter bowl and element. No particles, chips, or debris were noted on the filter or bowl, and the oil was dark brown in color.

There was no external damage to the engine identified. Visual examination of the front support inlet guide vanes and compressor section was unremarkable with no blade damage evident. Visual examination of the power turbine (4th stage turbine wheel) through the exhaust showed all blades present and undamaged. The compressor section turned freely by hand and was continuous to the starter. The power turbine turned freely by hand and was continuous to the main rotor. All external lines were secure when checked by hand. A pneumatic line leak check was conducted on the engine with a soap-water solution was sprayed on the air lines; no air leaks were detected. The upper and lower engine magnetic chip detectors were examined and found to be clean.

The engine was removed from the helicopter. The freewheel unit was removed from the engine, and the engine placed in a shipping box for further examination and testing at Rolls-Royce.

4.0 Maintenance Records Review

The following table is a summary of the significant maintenance activity involving the accident helicopter during the preceeding six months prior to the accident.

Table 1. Maintenance record review.

Date	ACTT[1]	Significant Maintenance Activity
4/29/2022	15,170.2	Replaced main rotor tension-torsion straps. Overhauled blade grips.
4/27/2022	15,170.2	50-hour inspection.
5/2/2022	15,178.5	Installed isolar spray equipment.
5/11/2022	15,202.8	1200-hour inspection. Inspected pilots and copilots cyclic. 100 hour KAflex inspection.

[1] ACTT – Aircraft total time

5/12/2022	15,208.1	Event 2 of 300-hour progressive inspction. 100 hour airframe inspection.
5/13/2022	15,214.0	50-hour inspection.
5/15/2022	15,227.2	150-hour inspection.
7/6/2022	15,206.6	50-hour main and tail rotor lubrication.
7/8/2022	15,267.1	Event 3 of 300-hour progressive inspection. Removed and replaced engine air filters.
7/14/2022	15,302.3	100-hour isolar spray system inspection and 100-hour Kaflex inspection.
7/16/2022	15,311.5	50-hour main and tail rotor lubrication.
7/18/2022	15,320.3	Event 4 of 300-hour progressive inspection.
7/20/2022	15,337.8	Cleaned and serviced engine air filters.
7/22/2022	15,352.5	50-hour main and tail rotor lubrication.
7/25/2022	15,367.8	Removed main rotor assembly. Removed and replaced latch bolts. Replace main rotor assembly.
7/28/2022	15,381.5	Event 5 of the 300-hour progressive inspection.
7/29/2022	15,390.5	50-hour main and tail rotor lubrication. 150 and 300-hour engine inspection.
8/5/2022	15,427.1	100-hour inspection.
8/8/2022	15,443.3	50-hour main and tail rotor lubrication.
8/12/2022	15,488.2	Event 1 of the 300-hour progressive inspection. 50-hour main and tail rotor lubrication. 100 hour KAflex inspection.
8/31/2022	15,518.2	Removed main rotor hub for overhaul
9/19/2022	15,519.2	Reinstalled main rotor hub. Performed track and balance. 50-hour main and tail rotor lubrication.
9/23/2022	15,524.9	100-hour inspection.
10/3/2022	15,547.5	Event 2 of 300-hour progressive inspection. 300-hour engine inspection.
10/7/2022	15559.2	50-hour main and tail rotor lubrication. Installed isolar spray equipment.

Submitted by:

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