National Transportation Safety Board

Office of Aviation Safety

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CEN22FA100

WRECKAGE EXAMINATION

Group Chair's Factual Report

May 31, 2022

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A. ACCIDENT

Location: Houma, LA
Date: January 14, 2022
Time: 1001 Central standard time (CST)
1501 Universal coordinated time (UTC)
Helicopter: Bell 407 / N167RL

B. WRECKAGE EXAMINATION GROUP

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C. DETAILS OF THE EXAMINATION

1.0 Helicopter Information

The Bell Helicopter Model 407[1], serial number (SN) 53167, was a single engine, seven-seat light helicopter. Standard configuration provides for one pilot and six passengers. The fuselage consists of three main sections: the forward section, the intermediate section, and the tailboom section. The forward section utilizes aluminum honeycomb and carbon graphite structure and provides the major load carrying elements of the forward cabin. The intermediate section is a semi-monocoque structure which uses bulkheads, longerons, and carbon fiber composite side skins. The tailboom is an aluminum monocoque construction which transmits all stresses through its external skins.

The helicopter was powered by a Rolls-Royce, Model 250-C47B turboshaft engine. The main rotor is a four-bladed, soft-in-plane design with a composite hub and individually interchangeable blades. The tail rotor is a two-bladed teetering rotor that provides directional control. Basic helicopter landing gear is the low skid type.

2.0 On-scene Wreckage Documentation

The wreckage was located 19 miles east of Houma, Louisiana, in a deltaic coastal marsh, and was completely submerged in marsh water and mud except for the tailboom and some sections of main rotor blade (Figure 1). The wreckage was removed using self-propelled swamp excavators and placed on floating barge platforms.

Wreckage coordinates: N029° 29.4785' / W090° 25.7634'

Figure 1. Helicopter impact area.

[1] BHT-407-MD-1, Sec 1-2. Helicopter description.

3.0 Wreckage Examination

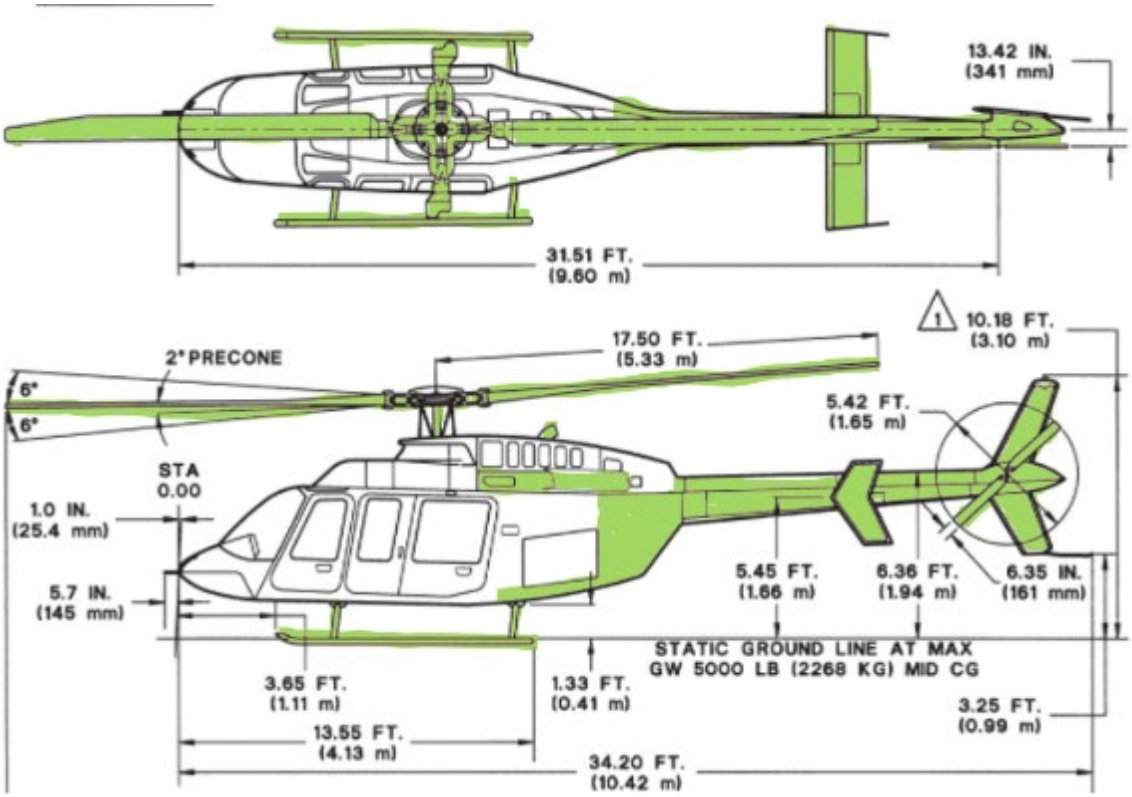

Figure 2. Green highlight represents airframe sections recovered and examined.

3.1 Fuselage

The forward fuselage section that includes the cabin was highly fragmented. The nose section was not recovered. The upper cowlings and fairings were recovered and were highly fragmented. All skid components were recovered. The forward and aft skid cross tubes were fractured just above the saddles and the skids were slightly splayed in aft displacement. Both skid tubes were fractured aft of the aft saddle on both sides. The floats remained attached to the skids but not deployed. The aft cross tube remained attached to the fuselage. The intermediate fuselage section that included the aft floor of the baggage compartment was recovered including the tail rotor servo. The tailboom had fractured forward of the intercostal support and was located with the main wreckage. The right horizontal stabilizer remained attached to the tailboom; finlets were folded inward. The left horizontal stabilizer was attached to the tailboom and fractured chordwise about 12 inches from the root. The separated portion of the left horizontal stabilizer was with the wreckage. The vertical fin remained attached to the tailboom and exhibited leading edge indentations on the upper portion.

The engine airframe oil filter was examined; no metal particles were identified, and organic particles/particulate matter, which was mixed with oil, was drained from

the bowl (organic/mud were from the fractured oil ports). An oil petroleum odor was observed. The airframe fuel filter bowl was damaged on its side with a gouge. The filter element was removed and was cut open. No particulates or debris was observed in the filter pleats. The aircraft fuel shut off valve was removed, and compressed air passed through the valve indicating it was in the open position.

3.2 Cockpit

The cockpit and cabin were highly fragmented. Flight crew seat cushions and the audio panel control box were recovered. The instrument panel frame was recovered; turn and slip indicator (digital), outside air temperature (OAT) indicator (digital), ACH 1000 control head receiver (Blue Sky Network[2]) remained in the panel. All other instruments/gauges were not present. Bendix-King transponder and Garmin GNC 420 AW GPS (Global Positioning Satellite)/communications transceiver were identified with the recovered wreckage. Table 1 provides the readings of the recovered cockpit instruments.

Table 1. Cockpit instruments recovered.

Power Turbine (Np) % rpm	R=90%, T=70%
Fuel Quantity	No reading (digital)
Transmission Oil Temperature/Pressure	No reading (digital)
Engine Oil Temperature/Pressure	No reading (digital)
Attitude Gyro	Destroyed
Gas Producer rpm (Ng)	No reading (digital)
Measured Gas Temperature (MGT)	No reading (digital)
Torque (TRQ)	No reading (digital)

3.3 Flight Controls

The forward flight controls (routed under the front seats to the control column broom closet) were destroyed or damaged due to ground impact. The pilots cyclic (right seat) was fractured at the base, the hand grip was not present. A portion of the red float activation handle remained attached to the cyclic stick. The collective torque tubes had separated from structure and were fragmented. The collective was not recovered. The antitorque pedals were not recovered. The antitorque pedal restrictor control unit was recovered with significant fracturing of the bracket assembly. The control column “broom closet" was recovered with control tubes present but fractured at the lower mixing unit and at the upper bell cranks. The bell cranks were

[2] Blue Sky Network allows inflight satellite communications.

not recovered. All three roof mounted servo actuators were recovered and had been liberated from the servo actuator support assembly. The left lateral control tube from the servo was fractured at the forward rod end threads and bent at the aft clevis. The control tube from the left lateral bell crank was attached to the stationary swash plate. The right lateral control tube was separated at the lower rod end and attached to the stationary swashplate. The right lateral bell crank was not present. The collective bell crank had fractured from the support frame, the collective control link remained attached to the bell crank and collective lever. All collective lever assembly hardware remained connected. The rotating swashplate (swashplate outer ring) and both drive links were present and attached to the mast. One drive link was fractured at the swashplate connection, the other fractured at the upper vertical arm. The red and blue pitch change links lower ends remained attached to the swashplate outer ring. The blue and red upper pitch change links remained attached to their respective pitch horns. The blue pitch horn was bent downwards, the red pitch horn was bent up slightly. The green and orange swashplate arms were fractured at the arm ears, both pitch horns were fractured and missing. The tail rotor control tubes remained in place under the transmission deck. Tail rotor control continuity was established from the fractured control tube at the forward end of the transmission to the tail rotor through multiple fractures to include the pitch change linkage of the tail rotor blades.

3.4 Main Rotor Drive System

The main rotor driveshaft (KAFlex) was fractured near the transmission input adapter. Main rotor powertrain continuity was established by turning the yoke by hand and observing the rotation of the mast through the transmission to the power input quill. No binding or abnormal sounds observed during rotation. The transmission upper and lower chip detectors were checked, no chips observed. There was a trace amount of transmission oil present but compromised by marsh water. The transmission remained attached to the pylon assembly which remained attached to the roof structure of the helicopter (Figure 3). All four live mounts remained in place. The freewheeling assembly could not be rotated by hand due to a fractured case.

Figure 3. Transmission, transmission mount, mast, and main rotor head.

3.5 Main Rotor Head

The main rotor cover and main rotor Frahm damper assembly had been removed prior to flight. The mast nut remained in place, and all arms of the hub upper plate were deformed upwards. All up-stop assemblies were present and severely damaged. The red down stop assembly was broken off; all three other down stop assemblies were damaged. All four yoke arms were intact and exhibited delamination of the composite structure (Figure 4). The inner elastomeric pivot bearings (feathering bearings) of the blue and orange blades had been pulled out, the red and green elastomeric bearings were in place. The blue arm of the hub lower plate was severely bent downwards, and the red arm slightly bent. Observations while on-scene showed all four blades remained attached to their blade grips. The blades were removed by the recovery personnel for transporting the wreckage.

Figure 4. Main rotor head.

3.6 Main Rotor Blades

Portions of all four rotor blades were recovered (Figure 5).

Blue Blade, Part Number (PN): 407-015-001-111 Mod to -117 FM1A, Serial Number (SN): A-530

The blue blade length measured 15 feet 6 inches. The trim tab was present on the blades trailing edge.

Orange Blade, PN: 407-015-001-117 Mod to -117 FM1A, SN: A-1265

The orange blade length measured 14 feet long. The afterbody portion was missing the outboard 5 feet 3 inches. The leading edge was buckled at the 5 foot point.

Green Blade, PN: 407-015-001-117 FM1A, SN: A-530

No data plate was found on the green blade. The part number and serial number were recorded from the maintenance records. The green blade length measured 15 feet 6 inches; the weight pocket was missing where the blade was fractured. The blade center afterbody was not present between 4 feet 4 inches out to 9 feet. There was a leading-edge fracture at 14 feet 5 inches.

Red Blade, PN: 407-015-001-117, SN: A-1119

The red blade length measured 15 feet 6 inches. There was a leading-edge fracture at the 6 foot location, and the blade afterbody was missing extending outboard from the 2 foot point.

The likely rotor blade impact sequence based on blade damage progression was: orange, red, green, and blue.

Figure 5. Main rotor blade layout.

3.7 Tail Rotor Drive System

The forward short shaft (steel) remained attached to the freewheel unit. The steel shaft was fractured about 12 inches aft of the freewheel unit attach point. The oil cooler blower "Squirl cage" was present but was unable to be rotated due to damage. The oil tank was present but severely damaged. The oil cooler was attached to the blower. The remaining section of the steel short shaft that attaches to the oil cooler blower was not present. The aft short shaft had separated from the oil cooler aft spline. The drive shaft had separated in torsion overload. Rotational scoring was observed on the No. 1 tail rotor drive shaft section, which remained on the tailboom. The tail rotor drive shaft sections 2 through 4 remained in place on the tailboom and attached to the tail rotor gearbox (TRGB) (Figure 6). The No. 1 Thomas coupling (or coupling disc pack) exhibited warping, numbers 2, 3, and 4 Thomas couplings and hanger bearing were undamaged. Rotational continuity was observed from the aft short shaft through the tail rotor gearbox to the tail rotor with no binding or abnormal sounds observed. The chip detector was checked, no chips observed. A trace amount of oil remained in the TRGB and was compromised by water.

Figure 6. Tailboom layout.

3.8 Tail Rotor

Both tail rotor blades remained attached to the yoke. The tail rotor pitch links remained attached to the crosshead with all associated hardware present. One tail rotor flap stop had fractured off; the other was undamaged. One blade had a leading-edge indentation about 10 inches from the blade tip. No other damage was observed.

3.9 Engine

The engine was a Rolls-Royce 250-C47B turboshaft engine, SN CAE 847201. At the time of the accident, the engine had accumulated 15,401.5 hours' time since new (TSN). The inlet guide vanes were crushed (Figure 10). The compressor blades exhibited leading edge hard body damage and bending opposite the direction of rotation. Clean fuel was present throughout the engine fuel system up to the fuel spray nozzle. The oil filter was clean and not in bypass. The entire engine was packed full of mud, and minor hard body damage to the first stage turbine blades was evident. The KAFlex shaft was fractured in overload. The freewheel unit was seized and unable to be rotated by hand; damage to the case was observed. The magnetic chip detectors had water and mud but no ferrous debris. The auxiliary gearbox was punctured and full of water. The N1 and N2 turbines could not be rotated by hand. Marsh water had done extensive corrosion to the auxiliary gearbox case. The hydraulic mechanical unit (HMU) manual mode piston was extended, the power lever arm was fractured, and internal damage to the HMU observed consistent with impact. The engine control unit (ECU) memory board was retained to be sent to Triumph for data download.

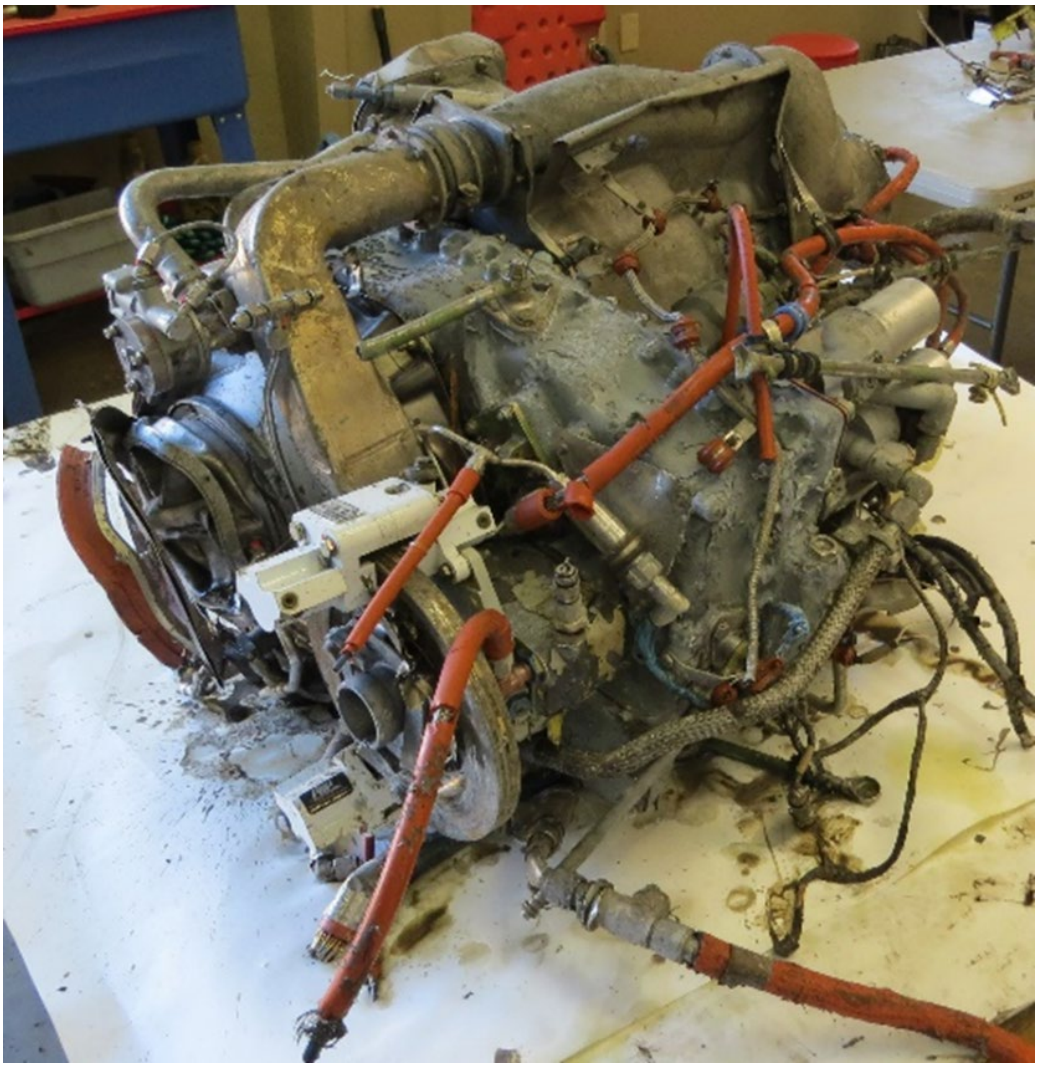

Figure 7. Engine on the examination table.

Figure 8. Inlet section of the engine exhibiting crushed inlet guide vanes.

Submitted by:

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