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Contact: MD Helicopter - Examination Summary

Wreckage Examination

The aircraft wreckage was recovered to a secure location in Clinton, AR, and the wreckage exam was conducted there on 9 February 2021.

Two large green Dumpster in a Bag[®] Bagster[®] bags were observed on the hangar floor, and they appeared to contain wreckage debris. The main rotor blades, main rotor assembly and main transmission (what remained), tailboom (multiple sections), and tail rotor assembly were also observed on the hangar floor.

Systems Examination

Airframe, Tailboom, Empennage, and Landing Gear

Airframe. The major sections of the airframe include the lower, forward, and aft fuselage sections. The lower fuselage section consists of the center beam, cockpit seat support structures, cockpit and passenger/cargo floors, jack fittings, and four major bulkheads attached to the center beam assemble. The forward fuselage section consists of the cockpit enclosure, windshields, and cockpit and passenger/cargo compartment doors. The aft fuselage section consists of the forward and aft canted frames, mast support structure, aft boom fairing, engine air inlet installation, and engine compartment firewall installation.

The airframe exhibited extensive thermal damage, most of which was reduced to ash during the post-impact fire. Few identifiable components remained, including

what appeared to be the left-hand cockpit door frame and thermally damaged portions of the forward windshield frames.

Tailboom. The tailboom assembly is a stressed, tapered cone that houses the tail rotor drive shaft, tail rotor control rod, and an electrical conduit.

The tailboom was separated from the aft fuselage boom fairing tail cone between station 185.99 ring and canted station 197.78 frame fitting where the tailboom attaches. Extensive thermal damage was observed in the area of this separation. Damage consistent with up to three main rotor blade strikes was observed on the tailboom. The aft end of the tailboom was fracture separated about 27 inches forward of the aft end, and damage consistent with a main rotor blade strike was observed on the tail rotor drive shaft in that location.

Empennage. The empennage consists of a vertical stabilizer and a horizontal stabilizer with two tip plates on either end. The stabilizers are attached to the tailboom by two aluminum frames.

The empennage remained attached to the aft end of the tailboom. The lower aft end of the vertical stabilizer, as well as the tail skid assembly, was coated with mud. Deformation was observed on the lower leading edge of the upper half of the vertical stabilizer. Wrinkling was observed on the leading and trailing edges of the upper half of the vertical stabilizer. The inboard leading edge of the left hand side of the horizontal stabilizer exhibited a gaping tear in the skin, as well as deformation of the leading edge inboard of the tear. Both the upper and lower portions of the right hand tip plate appeared bent inboard about 20 degrees.

Landing gear. The landing gear are skid-type landing gear. They are connected to the fuselage by two struts. Each strut has a side brace and a damper, both of which are attached near the strut elbow to provide stability and absorb/dissipate recoil shock respectively.

The right hand skid tube was fractured just forward of the forward strut foot; the forward strut remained attached, along with portions of the brace and damper; the aft strut was fractured just above the foot. The forward and aft struts from the steps upward, including the fairings, brace and damper, exhibited thermal damage. The left hand skid tube was fractured about mid-way between the forward and aft strut feet. The portion of the skid tube forward of the fracture was not found in either of the two large green bags. The portion of the left hand skid tube observed exhibited thermal damage. The left hand strut remained attached to the skid tube and the fairing exhibited thermal damage. The tail skid assembly at the bottom of the vertical stabilizer was coated with mud but appeared undamaged.

Cockpit, Cabin, Electrical System, and Instruments and Avionics

The cockpit and cabin were indistinguishable due to post-impact fire damage.

Electrical System. The electrical system is a direct current system with electrical power supplied by a 24-volt nickel-cadmium battery and a 28 volt, 85 amp engine-driven generator.

The electrical system exhibited extensive thermal damage, most of which was reduced to ash during the post-impact fire. The battery and some electrical wiring, although thermally damaged, were observed in the wreckage debris.

Instruments and Avionics. The instrument panel contains all standard flight, navigation, and engine instruments with the exception of an outside air temperature gauge and magnetic compass.

The instruments and avionics exhibited extensive thermal damage. The instrument panel was located in one of the large green bags. It was set aside at the request of the NTSB for analysis of the caution/warning light bulb filaments at a later date.

Flight Control Systems

The flight control system consists of conventional helicopter flight controls, including collective, cyclic, and anti-torque controls. The flight controls are usually installed on the left hand side of the cockpit, but, optionally, can be installed on the right hand side or both the left and right hand sides.

Cyclic. The cyclic pitch control system is fully mechanical. Movement of the cyclic control stick, along with movement of the collective control stick, is transferred to the main rotor swashplate through control tubes, mixing units, and pitch control rods to the main rotor blades. The pilot's cyclic control stick grip houses a five-position toggle switch for cyclic trim control, which actuates one of two trim motors depending on the position of the switch.

Cyclic pitch control continuity could not be established due to thermal damage to the flight control systems.

Collective. The collective pitch control system is fully mechanical. Movement of the collective control stick, along with the cyclic control stick, is transferred to the main rotor swashplate through control tubes, mixing units, and pitch control rods to the main rotor blades. The pilot's collective control stick consists of a start button and

related housing, throttle twist grip and friction mechanism, collective stick tube and friction mechanism, and gas producer control shaft.

Collective pitch control continuity could not be established due to thermal damage to the flight control systems.

Anti-torque. The anti-torque control system is fully mechanical. Movement of the tail rotor control pedals is transferred to the tail rotor swashplate through tail rotor control rods to the tail rotor blades.

Anti-torque control continuity could not be established due to thermal damage to the flight control systems; however, that portion of the control tube in the aft section of the tailboom moved appropriately when the tail rotor blades were manipulated by hand.

Engine and Engine Controls

Please refer to the related Rolls-Royce report for detailed information.

Engine. The accident helicopter was powered by a Rolls-Royce model 250-C20B turboshaft engine, serial number CAE-835942.

The engine exhibited extensive thermal damage. It was readied for shipment, placed in a shipping container, and the container was sealed. The engine will be shipped to another location for further examination.

Engine Controls. The N1 and N2 turbines are exhaust-gas coupled, and the output of both turbines must be controlled by a fuel control unit (N1) and a power turbine governor (N2), which are mounted on the rear side of the accessory gearbox.

The accessory gearbox was thermally damaged and reduced to ash.

The throttle twist grip on the collective stick is rotated by the pilot to control N1 via the fuel control unit. The collective stick is raised or lowered by the pilot to control N2 via the power turbine governor.

Engine control continuity could not be established due to thermal damage to the flight control systems.

Powertrain

The powertrain transmits torque produced by the engine to the main rotor and anti-torque systems via the main transmission. From the engine, torque drives the overrunning clutch, main transmission drive shaft, oil cooler blower, and main transmission. From the main transmission, torque drives the main rotor drive shaft, tail rotor drive shaft, and tail rotor transmission.

Overrunning Clutch. The overrunning clutch, located between the engine and the main transmission drive shaft, acts as a freewheeling unit if the engine fails to deliver power or the main rotor system turns faster than the engine output speed.

The overrunning clutch exhibited extensive thermal damage and was unable to be functionally tested. It remained attached at the engine side, but the coupling between the overrunning clutch and the main transmission drive shaft was partially separated.

Main Transmission Drive Shaft. The main transmission drive shaft, located between the overrunning clutch and main transmission, transmits engine torque to the main transmission.

The main transmission drive shaft exhibited extensive thermal damage along with a dent at the upper end of the shaft. The coupling between the main transmission drive shaft and the overrunning clutch was partially separated; the upper end remained attached to the transmission input coupling.

Oil Cooler Blower. The belt-driven oil cooler blower, located above and parallel to the main transmission drive shaft, cools the engine and main transmission oil.

The oil cooler blower assembly was not identifiable in the wreckage debris.

Main Transmission. The main transmission transmits torque from the engine to the main rotor drive shaft and tail rotor drive shaft at reduced speeds.

The main rotor transmission was thermally damaged and reduced to ash with the exception of some of its internal gears.

Main Rotor Drive Shaft. The main rotor drive shaft, located between the main transmission and main rotor hub assembly and inside the static mast, turns the main rotor hub assembly.

The main rotor drive shaft was observed inside the static mast. The lower end of the main rotor drive shaft remained splined to the output gear of the main transmission and the upper end was bolted to the main rotor hub. Extensive thermal

damage was observed on the static mast and visible portions of the main rotor drive shaft.

Tail Rotor Drive Shaft. The tail rotor drive shaft, located between the main transmission and the tail rotor transmission and inside the tailboom, turns the tail rotor transmission.

The tail rotor drive shaft was fracture separated into at least three segments. That segment(s) between the main transmission and the forward fracture of the tail boom was not observed in the wreckage debris. The next segment from the forward fracture to the aft fracture of the tailboom was observed inside that tailboom section. The last segment was observed in the aft section of the tailboom and remained attached at the tail rotor transmission. The last segment exhibited damage consistent with a main rotor blade strike. When that portion of the tail rotor drive shaft was rotated by hand, the tail rotor assembly rotated as appropriate.

Tail Rotor Transmission. The tail rotor transmission, located between the tail rotor drive shaft and tail rotor assembly, changes the direction of drive 90 degrees, increases output shaft speed, and serves as the attach point for the tail rotor assembly.

The tail rotor transmission rotated smoothly when the tail rotor assembly was rotated by hand; no unusual sounds were heard. The tail rotor transmission chip detector was removed and found to be free from visible particulate matter.

Main Rotor System

The main rotor system utilizes a five-bladed, fully-articulated main rotor assembly. The main rotor assembly is mounted on the main rotor drive shaft. The main rotor drive shaft is splined into the main rotor transmission. The main rotor drive shaft rotates within a static mast bolted to the mast support structure. The main rotor blades and pitch housings, including the lead-lag links, are secured to the main rotor hub by laminated steel strap packs.

The main rotor system exhibited extensive thermal damage. The main rotor hub, including the main rotor blades and pitch housing, remained attached to the main rotor drive shaft. One main rotor blade was bent upward about 180 degrees just outboard of the root fitting doubler. All five main rotor blades had been cut off to facilitate recovery of the wreckage. The main rotor blades exhibited various degrees of deformation including warping, bending, trailing edge separation, and chord-wise scratching, along with thermal damage. All five main rotor blade dampers remained attached and intact. Four main rotor blade pitch links remained attached and intact;

one was bent and fractured about mid-span. Three main rotor blade pitch horns were intact; two were fractured. The main rotor hub rotated when the main rotor drive shaft was rotated by hand using the main transmission output gear.

Anti-torque System

The anti-torque system utilizes a two-bladed tail rotor assembly. The tail rotor installation includes a pitch control assembly, drive fork, pitch control link assemblies, two tail rotor blades, a tail rotor hub assembly, and a tension torsion strap.

The tail rotor blades appeared worn, but otherwise, the tail rotor assembly was unremarkable.

Fuel System

The fuel system is a suction-type system with two interconnected fuel cells located beneath the passenger/cargo compartment floor. It is equipped with a submergible, single stage, centrifugal, constant displacement type start pump mounted in the left-hand fuel cell on the tank sump plate. When the start pump is on, fuel is drawn in through the pump inlet by suction; when off, fuel is drawn in through a second parallel port, or bypass inlet, by the engine-driven fuel pump.

No fuel system components were identifiable in the wreckage debris.