

National Transportation Safety Board

Office of Aviation Safety

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WPR23LA107

WRECKAGE EXAM

6/14/2023

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A. ACCIDENT

Location: Somerton, AZ

Date: 2/13/2023

Time: 0700 AM MST

Helicopter: OH-58C/N36FA

B. WRECKAGE EXAM

Participants

Subject Matter Expert Nick Shepler
Rolls Royce Engines
Indianapolis, Indiana

Subject Matter Expert Daniel Gilligan
FAA FSDO
Scottsdale Arizona

Acting IIC Paul Basti
NTSB, Western Pacific Region
Seattle, WA

Stephen Stein
NTSB, Western Pacific Region
Seattle, WA

C. SUMMARY

On February 6, 2023, about 2135 mountain standard time, a restricted category Bell OH-58A helicopter, N36FA, was substantially damaged when it was involved in an accident near Yuma, Arizona. The commercial pilot sustained minor injuries. The helicopter was operated as a Title 14 Code of Federal Regulations Part 137 agricultural aerial application flight.

The pilot reported that after the night application of chemical insecticide, he landed on the load truck and the chemical hopper was filled with 50 gallons of water. He maneuvered the helicopter to an open field in low light conditions and expelled the water to rinse out the applicator system. While he was maneuvering about 30 to 40 feet above ground level, with a speed near effective translational lift at 80% torque, the helicopter suddenly started to bounce and yaw. The pilot heard the turbine engine spool down as he held full throttle position and the engine lost all power. The pilot arrested his forward movement by raising the nose. He then leveled the helicopter and started to descend. The pilot raised the collective to control the descent, but the helicopter landed hard. Subsequently, the main rotor blade struck and severed the tail rotor driveshaft and the main rotor blade mast was damaged. The main rotor blades separated from the mast and landed about 100 feet from the helicopter.

D. ENGINE

The aircraft displayed damage consistent with vertical impact resulting in partially bent cross tubes, fractured main rotor mast, loosely dislodged lower side mounting of main rotor transmission, and disconnected from the engine.

There was no evidence of pre-impact fire, damage, or malfunction of the engine.

The engine was securely attached to the respective mount struts on the gearbox.

The shaft assembly KAflex configuration flex-links were fractured at the main rotor transmission input drive coupling. The shaft remained securely intact at the freewheeling engine unit connection.

The KAflex drive shaft assembly had fractured in the individual strap/flex links at the main rotor transmission input flange connection.

The cockpit controls to the power turbine governor and fuel control unit were continuous with full range of travel to their respective control linkage rod ends.

An unknown quantity of JET A fuel remained in the fuel tank. The tank was dipped with using a wooden stick which indicated that the fuel was filled approximately 4 inches from the bottom of the tank. Fuel did not circulate to the inlet of the engine pump when the boost pumps were energized. The airframe fuel filter was clean with minor debris visible in the filter bowl.

Oil was present in the airframe tank, the supply and scavenge lines to and from the engine and in the bottom of the engine gearbox. Both magnetic chip detectors did not show any visible debris.

Hand rotation of N1 & N2 continuity was observed to be smooth and unobstructed.

All engine B-nuts and fittings were checked by hand for proper torque and found to be at least hand tight and majority marked with torque paint.

The tail rotor drive shaft was securely attached to the power turbine shaft through the accessory gearbox and the splined drive adapter at the aft firewall.

The inlet barrier filter was entirely covered with brown, sand-dust consistent with the environment where the helicopter was being stored but did not show any penetration of this on its reverse side. The inlet bypass filter door was not open.

ENGINE CONTROL

Cockpit controls up to the power turbine governor and fuel control unit were continuous to each individual control linkage rod end.

The power turbine governor demonstrated continuity from the cockpit collective control, and the input lever was capable of full travel within the minimum and maximum stop region when disconnected from the input linkage, and following engine removal.

The fuel control unit demonstrated continuity from the cockpit collective control and the input lever was capable of full travel within the minimum and maximum stop region.

The compressor bleed valve was securely mounted to the scroll assembly. The poppet valve appeared clean and smoothly travelled its full stroke with no indication of radial movement or binding when actuated manually by hand.

ROTOR

N1 & N2 rotors freely rotated by hand with no audible obstruction or resistance.

Continuity throughout the N1 rotor system from the compressor rotor 1st stage blades to the starter generator cooling fan was demonstrated.

Continuity throughout the N2 rotor system from the 4th stage power turbine wheel to the KAflex drive shaft assembly and the tail rotor drive shaft was demonstrated.

COMPRESSOR

The compressor front support guide vanes (struts) were contaminated with sand and dirt deposits consistent with the environment where the helicopter was being stored postaccident.

The guide vane struts, and visible compressor blades did not display any visible evidence foreign object damage or puncturing.

TURBINE

The 4th stage turbine blades, surrounding turbine section and exhaust plenum appeared undamaged, and showed no evidence of thermal stress.

There was no evidence of oil wetting on the tunnel adjacent to or on the 4th stage turbine wheel. Random amounts of surface rust or equivalent was observed on the internal surfaces of the support. Both exhaust stacks were damaged, consistent with contact from the main rotor.

OIL SYSTEM

The oil tank filler cap was securely installed. The tank was nearly full of oil and appeared clean and clear with no abnormal odor.

Airframe interface oil lines including those to and from the oil tank, torque meter oil pressure and engine oil pressure hoses revealed presence of oil.

FUEL SYSTEM

The master fuel valve lever was observed in the ON position. A visual assessment of the fuel remaining found approximately 5 gallons of clean and clear fuel.

The fuel quantity gauge, when energized, did not display an accurate depiction of the actual amount of fuel on board, registering near zero.

The fuel supply hose from the airframe fuel filter canister to the engine fuel pump inlet was removed. Fuel dripped from the engine fuel pump after the hose was removed.

The fuel supply hose from the outlet of the check valve downstream of the fuel control unit was removed at the fuel spray nozzle. Approximately 1 tablespoon of clean fuel was collected. The fuel spray nozzle was removed and inspected. The spray face contained a normal layer of uniform light layer of black soot. The distribution holes were all clear and unobstructed.

The airframe fuel filter was full of clean, clear fuel. The internal fuel filter was clean and void of any captured debris with the pleats.

AIR SYSTEM

Visual inspection of the compressor discharge system including all plumbing & B-nut connections from the compressor scroll to the power turbine generator and fuel control unit appeared intact and undamaged.

E. AIRFRAME EXAMINATION

1.1 Fuselage

The fuselage sustained minor damage from the nose to the beginning of the tailboom. The tail boom received substantial damage along the top, about 24 inches forward of the 90° gearbox. The SatLoc CPU was recovered from the cockpit and retained for further examination.



Figure 1. N36FA, right-side view.



Figure 2. Left-side view.

1.2 Tailboom

The tailboom remained attached to the fuselage and exhibited one area of damage along the top, about 24 inches inboard of the 90° gearbox. The tail rotor driveshaft cover, tail rotor drive shaft exhibited sideward impact marks consistent with contact with the main rotor blades. The right-side elevator exhibited denting and deformation.



Figure 3. Tailboom, right-side view.



Figure 4. Right-side elevator.



Figure 5. Tailboom, left-side view.

1.3 Main Rotor and Tail Rotor Systems

The main rotor blades and rotor hub (yoke) separated from the mast. The main rotor blades were removed from the yoke during recovery. The top of the mast exhibited a fracture and the remnant of the mast remained secured inside the yoke. The top of the mast was cut about 18 inches below the fracture and retained for further examination.

One blade (S/N: CSFS999) exhibited some damage to the tip but no other damage. The other blade (T-FS-451) exhibited a downward bend about 36 inches inboard of the root of the blade. The bend also exhibited inward crushing consistent with contact with the exhaust pipes of the engine. The tip of the blade also exhibited damage consistent with contact with the tail rotor drive shaft cover, tail rotor drive shaft and upper tailboom.



Figure 6. Blade T-FS-451, top view.



Figure 7. Blade CSFS-999, top view.



Figure 8. Blade T-FS-451 underside view. Note the damage near the root.



Figure 9. Blade CSFS-999, underside view. Note the damage at the tip.



Figure 10. Main rotor yoke assembly.



Figure 11. Upper section of mast in yoke.

The mast exhibited a fracture separation in an area not normally associated with a mast bumping event. The area of yoke to mast contact was not deformed and exhibited signs of normal yoke stop to mast contact. The mast was not dented inward. There was a slight deformation to the mast, near the area of separation. The stub of the mast remained inside the yoke and was secured with the retention nut.

One pitch control tube remained attached to the blade pitch horn, while the other separated from the pitch horn. Both pitch control tubes separated from the rotating swashplate.

The rotating and non-rotating swashplate remained secured to the top of the transmission and exhibited normal appearance and functionality. The mixing assembly exhibited normal appearance and functionality. The hydraulics remained secured to the top of the fuselage and exhibited normal appearance. The hydraulics were not tested for pressure.



Figure 12. Swashplate.

The transmission remained attached to the transmission deck by the two beams. The lower mount separated from the transmission. When visually examined, the four mounting studs exhibited fracture separations. The deck under the transmission exhibited downward denting consistent with contact from the transmission. The transmission rotated freely. The sprag clutch rotated freely in one direction and engaged when rotated in the opposite direction, consistent with normal operation.



Figure 13. Lower transmission mount.



Figure 14. Lower transmission. Note the four sheared attachment studs.

The KAflex drive shaft remained secured to the engine output quill but partially separated from the transmission input quill. Some rotational scoring was observed on the components surrounding the drive shaft.



Figure 15. KAflex drive shaft. The damaged end attached to the transmission.

Tail Rotor Assembly.

The tail rotor assembly remained attached to the 90° gear box output shaft and exhibited no damage. The tail rotor drive shaft exhibited a fracture separation about 24 inches from the 90° gearbox.



Figure 16. Tail rotor assembly and vertical stabilizer.



Figure 17. Right-side tail rotor assembly and vertical stabilizer.

1.4 Landing Gear

The landing gear consisted of skids and cross tubes. The right cross tube exhibited slight bending outwards that allowed the fuselage to assume a lowered appearance when viewed from the front of the helicopter. The right top step exhibited a downward bend consistent with contact from the right chemical tank.



Figure 18. Right-side landing gear, showing downward dent to the upper step.

1.5 Cockpit

The cockpit exhibited no damage. All instruments remained secured in their mounts. When battery power was applied, all indications appeared normal. The fuel gauge registered a jump but settled down to near empty.



Figure 19. Cockpit view of the instruments panel.

1.6 Survivability

The helicopter did not exhibit any compromise of the living space inside the cockpit.

1.7 Fuel/Fuel System

When visually inspected there appeared to be about 4 inches of fuel remaining in the tank. When power was applied and the fuel boost pump was switched to the ON position, the amber fuel pump light on the caution panel illuminated. No sound of the boost pump was heard, and fuel did not flow from the fuel line to the fuel filter. The fuel filter was located on the engine deck and when opened, exhibited clean amber colored fluid consistent with jet fuel. The filter element exhibited a clean appearance with no contaminants visible.



Figure 20. Residual fuel in deck-mounted fuel filter and filter element.

1.8 Flight Control Continuity

Fight control continuity was established from the cyclic and collective control to the hydraulic servos and from the hydraulic servos to the non-rotating swashplate.

Flight control continuity was established from the anti-torque pedals to the tail rotor pitch control rods.

Continuity was established from the throttle twist grip to the fuel control, and from the collective to the fuel governor.



Figure 21. Cyclic control and anti-torque pedals.



Figure 22. Collective control.