

National Transportation Safety Board

Office of Aviation Safety

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AIRFRAME AND ENGINE EXAMINATION REPORT

August 24, 2022

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A. OCCURRENCE

Location: Coalinga, California
Date: February 16, 2022
Time: 2140 Pacific standard time
Helicopter: UH-1H / N72297

B. AIRFRAME AND ENGINE EXAMINATION REPORT

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SUMMARY

Examination of the airframe and engine were conducted at a secured facility, on August 24, 2022. The helicopter fuselage was secured to a large forklift. The tailboom, main rotor system, tail rotor system, engine and two large metal containers of parts were made available inside the facility for examination. After the examination, the engine was placed inside a crate for shipping to Springfield, Missouri for further examination by the type certificate holder. The K-Flex driveshaft and one tail rotor drive shaft were prepared for possible shipment to the NTSB materials laboratory. A Satloc GPS unit was recovered. Coordination with the manufacturer revealed the unit did not contain non-volatile memory. The caution panel, Rotor RPM, Fire, Caution Lights were recovered for further examination.

C. DETAILS OF THE INVESTIGATION

1.0 Accident Site

The helicopter came to rest on its left side, in an orchard, as shown in Figure 2. The orchard was at an elevation of about 385 ft mean sea level, and consisted of trees, spaced about 15 ft apart, at a height of about 12 ft. An area of disturbed ground and felled trees extended back from the helicopter about 120 ft, on a bearing of 170° magnetic. The fuselage had rotated about 180° to face the direction of travel.

2.0 Airframe Examination

Cockpit Documentation. The cockpit area was without doors or windshields. The right-side pilot seat was secured to the rails and was the only seat in the helicopter. The left and right pilot's floor was intact but crushed aft and upwards. The anti-torque pedals were substantially damaged and crushed aft at both pilot stations. The left and right cyclic controls remained attached to the floor. The right-side collective control remained attached to the floor. The left-side collective control separated from the floor and was recovered from the wreckage.

Several floor panels were removed to gain access to the flight control push-pull tubes and bellcranks.

Flight control continuity was established for the cyclic and the collective, from both pilot stations to the respective hydraulic servos. The cyclic control system exhibited fractures in the vicinity of the cyclic mixing unit at the center floor flight control bay. Cyclic continuity was reestablished from the flight control bay to the lateral hydraulic servo (left side) and longitudinal hydraulic servo (right side). Both cyclic hydraulic servo rods remained secured to the non-rotating swashplate but separated from the hydraulic servos.

Continuity for the collective control was established from the right-side collective, and the left side of the left pilot's seat, to the collective hydraulic servo. The hydraulic servo to collective lever trunnion bearing separated from the collective lever. Continuity was reestablished from the collective lever to the scissors and sleeve assembly.

One drive link remained attached to the rotating swashplate and continuity for that side remained intact to the associated blade pitch horn. The other drive link separated from the rotating swashplate along with the associated scissors assembly. The scissors assembly remained attached to the stabilizer control bar and continuity continued for that side to the associated blade pitch horn.

Anti-torque control continuity was established from both left and right-side anti-torque pedals to the tail rotor control hydraulic servo, to the break where the tail boom was removed during recovery. Anti-torque control continuity was reestablished from the break at the end of the tailboom to the silent chain that connects to the 90° gearbox. The silent chain exhibited a break in one of the links, consistent with the separation of the 90° gearbox and tail rotor assembly. Throttle continuity was established from the right-side collective throttle grip to the engine bay.

Instruments:

Altimeter: 99,600 feet MSL (29.13 in hg)

VSI: 190 feet down

Magnetic compass: 285°

Dual Tachometer: Rotor: 0 RPM, Engine: 0 RPM

Airspeed Indicator: 0 knots

Torque gauge: 0 PSI

N1: 0.0

Exhaust gas temp: 40°C

Fuel Pressure: 0 PSI

Fuel Quantity: 100 pounds

Oil Pressure: 0 PSI

Engine Oil Temp: -65

Transmission Oil Press: 0 PSI

Transmission oil Temp: -65

Load Meter: 0

DC Volts: 0

AC Volts: 0

Hobbs meter: 6679.0

Throttle: Less than full RPM (fly position) Note. The throttle as disconnected from the fuel control during removal of the engine.

Significant switches:

Hydraulic: ON

Force Trim: ON

Collective Landing light switch: ON

Search Lights: Left: ON; Right Side: switch broken but appears to be ON.

Cabin Heating: ON

Main Generator: OFF

Voltmeter: Essential Bus

Battery: OFF

Search lights: Left and right: ON

Starter Generator: OFF

Non-essential buss: Normal

AC Power: Main ON

2.1 Fuselage

Fuselage. The entire nose area of the helicopter, from the aft end of the chin bubbles at the bottom, to aft of the green house window on the roof was fragmented and separated from the helicopter. The windshield assembly was fragmented and separated from the helicopter. The instrument panel was partially separated from the

cabin and rested on the center consol. The windshield center post remained attached to the bottom.

The right side of the helicopter exhibited upward crushing from the pilot's crew station to the forward area of the cabin. The floor remained elevated from the upwards crushing. The right-side door separated from the fuselage. The pillar aft of the pilot's door and forward of the jump door, separated from the floor, fractured in two, and remained attached at the ceiling. The jump door separated from the fuselage. The right-side sliding cargo door had been removed prior to the accident flight. A large dent was present just above the forward cross tube. The upper and lower fuselage sections above and below the sliding cabin doors, kept their integrity and exhibited little deformation.

The fuselage aft of the cabin area exhibited substantial damage at the lower section, with inward crushing near the bottom of the fuselage. The lower access panel had separated, and that area was deformed. The last three feet of the aft fuselage deformed downward. The engine bay panel remained attached to the fuselage and exhibited minor damage.

The tailboom was removed from the fuselage during recovery and exhibited some damage along the tail rotor drive shaft covers. The right-side synchronized elevator separated from the tailboom.

The vertical stabilizer (fast fin) remained attached to the tailboom. The 90° gearbox separated from the top of the vertical stabilizer. The silent chain from the anti-torque control cables to the 90° gearbox, separated at one link. The cables remained attached to the large bellcrank inside the tailboom. The control tube to the large bellcrank was cut during the removal of the tailboom. The vertical stabilizer driveshaft cover exhibited damage at the top, near the 90° gearbox. The entire 90° gearbox mount had separated from the top of the vertical stabilizer. The tail skid did not exhibit abnormal upward bending, consistent with a tail strike. The 42° gearbox remained attached to the end of the tailboom.

The left side of the tailboom exhibited substantial damage with inward crushing near the root end of the synchronized elevator. The left-side synchronized elevator remained attached to the tailboom but exhibited substantial bending and crushing from the leading edge aft. There was a large gouge into the sheet metal of the tailboom just above and forward of the synchronized elevator.

The left side of the fuselage was substantially damaged, beginning at the heavily damaged nose section which was unrecognizable. The pillar aft of the pilot's station and in from of the small jump door had separated at both the top and bottom. The

left-side sliding cargo door had been removed prior to the accident flight. The jump door separated from the helicopter. The left-side pilot's door separated from the fuselage. No recognizable fuselage remained forward of the pilot's door station. A large composite chemical tank was mounted in the cabin area. The tank was loose in the cabin. A hydraulic pump was mounted on the left-rear wall of the cabin and connected to a pump mounted on the left side of the tank.

The underside of the helicopter exhibited substantial damage with upward crushing near the nose area. The left, forward section had been crushed inward. The mid-section of the belly sheet metal exhibited upward crushing, tearing and absence of large amounts of sheet metal near the fuel bladders. An area aft of the rear cross tube exhibited a large tear in the sheet metal. The entire underside of the helicopter exhibited the appearance of contacting and scraping the terrain. The junction of the underside of the fuselage and the tailboom exhibited a gray appearance along with some upward crushing of the sheet metal.

The top of the helicopter exhibited substantial damage with downward crushing in the forward section above the pilot's stations. The area forward of the greenhouse windscreens was absent. The doghouse engine cowlings were absent. The transmission separated from the fuselage above mounts, leaving the transmission mounts attached to the fuselage. The transmission was located near the wreckage. The base flange of the transmission had areas where the flange was missing. The input quill retained parts of the driveshaft remaining attached. When tested at the examination facility, the transmission rotated smoothly with no noise or metal to metal sounds. The overrunning clutch operated normally.

The 90° gearbox remained intact. No oil was observed leaking from it. The oil filler cap was secure at the port. The 42° gearbox remained attached to the tailboom. All driveshaft sections.

The tail rotor drive shaft disconnected near the transmission output quill. The fracture was uniform around the driveshaft but did not appear to have been cut by a foreign object.

The helicopter was equipped with skids and cross tubes for main landing gear. Both skids separated from the cross tubes. The forward cross tube remained attached to the fuselage at both saddles. The cross tube had displaced aft. The right side of the cross tube fractured about 30 inches from the saddle. The left side fractured at the saddle. The aft cross tube remained attached to the fuselage at the saddles. The right side of the cross tube separated about 30 inches from the saddle, and the left side of the cross tube separated about 30 inches from the saddle. The right skid
Hydraulics. The helicopter was equipped with hydraulic servos for the lateral (left side of transmission), longitudinal (right-side of transmission), collective (rear of the transmission) and tail rotor. All servos remained attached at their respective mounts,

and all servo travelled through their full travel limits. The hydraulic fluid was clear and red. The hydraulic oil filter was clean with no contaminants in the pleats. The impending bypass button was not popped.

The caution panel, rotor RPM, fire and caution lights were recovered for further examination. Upon examination, no filaments were found to be stretched.

3.0 Engine Examination

The engine remained partially attached to the fuselage at the mounts. The 4th stage turbine did not exhibit damage but would not turn unless heavy force was used. The 1st stage compressor blades exhibited damage to the leading edge. A thin piece of titanium fire wall had wrapped around the output shaft. The engine was shipped to the manufacturer's laboratory when it underwent additional examination under oversight of the NTSB. According to the NTSB investigator in attendance, "We found tree debris and airframe wire braid between the compressor inlet guide vanes consistent with ingestion at impact. When we half cased the axial compressor, all rotor blade stages exhibited hard body impact damage and trailing edge tip bending opposite the direction of rotation, both of which are strong indications of power. We also reviewed the photos of the firewall wrapped around the PTO/short shaft and agree that's further evidence of power at impact."

The engine to transmission driveshaft (K-Flex) separated from the helicopter. All pieces were accounted for. All breaks in the flexors appeared to have a rough grainy texture along with battering on some.

4.0 Main Rotor and Tail Rotor Examinations

The helicopter was equipped with original equipment manufacturer (OEM) main rotor blades. (Serial numbers: A-143, and A-145). A-143 appeared to have more damage than A-145. About 4 ft of A-143 was not recovered. Both blade spars separated from their respective afterbodies and exhibited significant upward bending, consistent with excessive blade coning. Both blades exhibited chord-wise striations consistent with contact with trees. Both blades remained attached at their respective blade grips and drag braces. The stabilizer bar assembly remained attached to the mast and exhibited minor damage. All control tubes and pitch change links remained attached to their attachment points on the stabilizer bar or mixer. One stabilizer bar control tube remained secured to the separated scissor. The scissor exhibited a fracture of the bearing race. The associated swashplate drive link had separated from the swashplate but remained attached to the scissor. The trunnion bearing that secures the separated drive link remained attached to the drive link at the clevis. The associated swashplate race for the separated trunnion exhibited a fracture at the trunnion bearing hole. The opposite side main rotor control

assembly remained secured and exhibited minor damage. All of the opposite side components were accounted for and remained secured to their respective attachment points.

The main rotor assembly remained attached to the transmission. The swashplate support, and swashplate exhibited minor damage.

The tail rotor assembly separated from the top of the vertical stabilizer. Both blades exhibited heavy damage with fracturing of the composited blade material. Both blade roots remained attached to the hub. One blade retained most of its leading edge. The leading edge exhibited heavy chordwise bending. The other blade lost all material about 10 inches from the blade root. Most of the composite blade fragments were accounted for. The hub remained attached to the drive shaft, which remained attached to the 90° gearbox. Both pitch change links remained attached at both ends.

Submitted by:

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5.0 PHOTO GALLERY



Figure 1. N72297 at the accident site. Front view.



Figure 2. Underside view.



Figure 3. Rear underside view.



Figure 4. Rear topside view.



Figure 5. Topside view.



Figure 6. Main rotor system.



Figure 7. Tail rotor system.



Figure 8. T-53-L13



Figure 9. Lower transmission and the mounts.



Figure 10. N72297 at the recovery site. Front view.



Figure 11. Left-side view.



Figure 12. Rear view.



Figure 13. Right-side view.



Figure 14. Right-side view.



Figure 15. Pilot's station.



Figure 16. Left-side view of the cockpit area.



Figure 17. Instrument panel.



Figure 18. Right-side anti-torque pedals.



Figure 19. Right-side cyclic control stick and collective control stick.



Figure 20. Access panel underneath the right-side seat.



Figure 21. Center floor, flight control bay.



Figure 22. Lateral and longitudinal hydraulic servos.



Figure 23. Tail rotor drive shaft, at the transmission output quill.



Figure 24. Tail rotor drive shaft that was connected to the transmission output quill. See photo 23.



Figure 25. Tail rotor and 90° gear box.



Figure 26. Fuel filter.



Figure 27. Transmission and main rotor system.



Figure 28. Transmission and main rotor system.



Figure 29. Main rotor blades.



Figure 30. K-flex drive shaft.



Figure 31. Front of engine with a piece of fire wall removed from around the output shaft.



Figure 32. Engine prior to the crate being closed.



Figure 33. Engine inlet showing damage to a 1st stage compressor blade and the variable inlet guide vanes.



Figure 34. Rear view of engine, showing no damage to the 4th stage turbine wheel.



Figure 35. Search lights switches in the ON position.