



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety

June 8, 2021

AIRFRAME AND ENGINE EXAMINATION

ERA21FA200

This document contains 15 embedded photos.

(15 Pages)

1.0 EXAMINATION PARTICIPANTS:

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2.0 SUMMARY

The examination of N4528T was conducted on June 8, 2021, at Atlanta Air Recovery, Griffin, Georgia. Examination of the airframe revealed that both main rotor blades were fractured near their outboard ends. The outboard segments of both main rotor blades did not exhibit significant fragmentation or spar fractures (aside from the primary blade fracture). The tail gearbox was separated from the airframe. The tail gearbox mounts were fractured and exhibited signatures consistent with overload. Impact damage to the lower vertical fin appeared consistent with tail rotor blade contact. One tail rotor blade was fractured in two locations, one at the root end about 5 inches from the outboard blade attachment bolt, and another fracture at the tip end. At the tip end fracture, the leading edge was crushed in the direction opposite of normal rotation. At the [separated] tip end section, the inboard surface of the blade skin had a red-colored transfer marking. The other tail rotor blade was fractured in one location near the tip end about 13.5 inches from the outboard blade attachment bolt.

Examination of the engine revealed no anomalies.

Review of the logbooks revealed that the last annual inspection was completed February 16, 2021, at Hobbs time 1,389.3 hours, total engine time of 3,584.7 hours, and 1,389.3 hours since overhaul. The Hobbs meter at the time of the accident showed 1,465.3 hours.

3.0 HISTORY OF FLIGHT

On May 2, 2021, at 1318 eastern daylight time, a Robinson R-44 helicopter, N4528T, was substantially damaged when it was involved in an accident near Wingate, North Carolina. The pilot was fatally injured. The helicopter was being operated as a Title 14 *Code of Federal Regulations* Part 137 aerial application flight.

The commercial pilot was spraying fungicide on a wheat field when the accident occurred. According to several witnesses, this was the first time they had observed the northwest portion of the field, which contained multiple power lines, being sprayed via aerial application. The

helicopter had been applying fungicide all morning, operating about 15 ft above the 3-ft-tall wheat during the spraying operation. The pilot's wife reported that after landing, having lunch and loading more fungicide, the pilot took off to begin spraying where he left off. Images recovered from a GPS application on the pilot's tablet computer showed that the helicopter took off, flew to where the pilot left off, and completed its first pass in a northerly heading. The helicopter then turned and flew over the field on a southerly heading. The data correlated to the helicopter's flight track ended in the vicinity of where the helicopter's main wreckage came to rest.

Witnesses in a nearby home reported that they heard a loud noise and simultaneously lost electricity to their home. They then looked out their window and saw the helicopter as it descended in a nose-down attitude before it impacted the field in the vicinity of the power lines. One of the witnesses stated that it appeared as though the helicopter became entangled in the wires before it descended nose-first into the ground.

The helicopter impacted and severed an energized wire, also known as a "primary wire" that was oriented about 228° magnetic and measured about 29 ft above ground level at its lowest point over the wheat field. The wire spanned about 345 ft between two utility poles, 264 ft of that span over the wheat field. Two additional power lines spanned other portions of this northwesterly portion of the field.

The helicopter came to rest on its left side. The fuselage was crushed and deformed aft. The tail boom remained attached to the main fuselage; however, the empennage, composed of the upper and lower vertical stabilizers, horizontal stabilizer, the tail rotor and its gearbox, were separated from the tail boom. The windscreen and door windows were separated from the fuselage and fragmented. Both main rotor blades remained attached to the hub. One blade was bent downwards about 2 ft outboard of the blade grip, and the other was bent downward and in a U-shape. The agricultural hopper remained partially attached to the fuselage. It was breached and its lower side was crush-damaged. The engine compartment and engine remained intact.

The empennage was located 99 ft and 336° from the main wreckage. The lower vertical stabilizer sustained trailing edge impact and semi-circular crush damage just below the horizontal stabilizer. The tail rotor gearbox was intact but separated from its airframe mount and was located about 112 ft and 208° from the main wreckage. The tail rotor hub remained attached to the tail rotor gearbox output shaft and portions of the two tail rotor blades remained attached to the hub. One tail rotor blade was missing about 5 inches of its tip end and the other tail rotor blade was missing about 2 ft of its outboard span. One of these sections was not recovered. The leading edges of both tail rotor blades exhibited impact damage. A fractured segment of one of the tail rotor blades, measuring about 18 inches in length, was located 170 ft and 44° from the main wreckage. The tip portion of one of the fractured tail rotor blades, measuring about 5 inches, was located 119 ft and 3° from the main wreckage. The tip portion exhibited impact scars consistent with a wire strike as well as impact with the tail rotor guard.

Charlotte-Monroe Executive Airport (EQY) was located about 12 miles northwest of the accident site. At 1253, the reported weather included scattered clouds at 3,800 ft. A review of

astronomical data from the National Oceanic and Atmospheric Administration revealed that at the time of the accident, the sun was located at an azimuth of about 180° and an elevation of about 71°.

4.0 DETAILS OF THE EXAMINATION

4.1 Airframe Examination

All portions of the helicopter were accounted for during the examination except for 4 inches of one tail rotor blade and one of the four tail gearbox mounting flanges. The airframe was whole except for separation of the empennage (vertical fin and horizontal stabilizer) from the tail boom, the left and right skid tubes, and the rear skid crosstube (which remained attached to the helipod tank). The cockpit area was crushed inward primarily in the aft direction. The tail boom exhibited no significant deformation. The lower vertical fin had impact damage primarily on its left side, from its trailing edge going forward. The impact had a shape consistent with the tail rotor blade airfoil.

The tail gearbox was separated from the airframe. Portions of the two tail rotor blades remained attached to the hub. Rotation of the tail rotor was possible and continuity through the gearbox was confirmed. The tail rotor pitch change mechanism was actuated with no evidence of binding.

Tail rotor blade S/N 6275 was fractured in two locations, one at the root end about 5 inches from the outboard blade attachment bolt, and another fracture at the tip end. The mid-span segment of blade was about 14.5 inches in length. At the tip end fracture, the leading edge was crushed in the direction opposite of normal rotation. At the [separated] tip end section, the inboard surface of the blade skin had a red-colored transfer marking.

Tail rotor blade S/N 6274 was fractured in one location near the tip end about 13.5 inches from the outboard blade attachment bolt.

The flex plate arms connecting to the tail gearbox input flange (yoke) was bent aft. The tail gearbox input flange (yoke) arms were bent forward. The tail rotor drive shaft was continuous with no fractures; it was relatively straight. The forward flex plate (between the tail rotor drive shaft and the pulley shaft) was intact with no evidence of deformation or fractures. Rotational scoring was present on the box frame at the forward end of the tail boom due to contact with the flex plate attaching hardware. The hangar bearing remained installed.

The four pulley belts were intact and showed no evidence of anomalous wear or damage. Both upper and lower pullies were undamaged. The belts were numbered/indexed and cut. Functionality of the clutch was confirmed via rotation of the upper pulley. Rotation of the pulley shaft resulted in a corresponding rotation of the main rotor and tail rotor drive shaft, confirming continuity of drive.

The two main rotor blade pitch links were fractured at their upper rod end threads. The three push-pull tubes between the stationary swashplate to the servos were continuous but bent. The stationary and rotating scissor links were intact and remained attached to their respective swashplates.

The two main rotor blades remained attached to the main rotor hub but had multiple chordwise bends. Both blades' outboard ends were fractured and separated, one about 5.5 feet and the other about 6.5 feet from the tip end. The leading edges of both tip ends did not exhibit significant damage. The 6.5-foot segment of blade had a portion of its tip end cap fractured and separated.

Cockpit Flight Controls

The cyclic and collective controls are present in the main wreckage. The left (removable) collective control and the left rudder pedals were found under the aft left seat, presumably a storage location. The cyclic torque tube was fractured midspan. The left and right roll push-pull tubes remained connected to the aft end of the cyclic torque tube. The fore/aft bellcrank was partially separated and resting on the aft end of the cyclic torque tube. The vertical fore/aft push-pull tube remained connected to the bellcrank. The rod end that connects the fore/aft bell crank to the fork was fractured at the lower end threads with signatures consistent with overload. The base of the cyclic control was not visible due to crushing of the cockpit. The cyclic and collective controls remained connected at their base but could not be moved due to crushing of the cockpit.

Tail Rotor Controls

The tail rotor control push-pull tubes were continuous from the aft cabin bulkhead to the empennage separation point. The tail rotor controls were not visible forward of the aft cabin bulkhead due to crushing of the cockpit. The right seat pedal set was present in the crushed cockpit. The push-pull tube fracture near the tail gearbox exhibited multiples scores on the tube consistent with contact with the rotating flex plate.

Airframe Exam Photos



Figure 1: Wreckage viewed from front left



Figure 2: Wreckage viewed from tail



Figure 3: Empennage



Figure 4: Tail rotor blades



Figure 5: Fractured tail rotor blade



Figure 6: Close up view of wire strike impact signatures



Figure 7: Exemplar 3/16-inch diameter wire

4.2 Engine Examination

As first viewed, the engine remained attached to the airframe through the tubular mount. Some of the mount tubes were impact damaged. The induction air box was partially crushed. The exhaust and induction tubes were intact, and no damage was noted. The aircraft was suspended from a crane, the engine cowling removed, and the engine partially disassembled to facilitate the examination.

The crankshaft was rotated by turning the engine cooling fan. Continuity of the crankshaft to the rear gears and to the valve train was confirmed. Compression and suction were observed from all six cylinders. The interiors of the cylinders were observed using a lighted borescope and no anomalies noted.

Both magnetos remained attached to the engine and no damage was noted. Both magnetos produced spark from all ignition towers when the magnetos were rotated by hand.

The spark plugs exhibited gray coloration and worn normal condition. The #1, #3 and #5 bottom spark plugs were oil soaked.

No damage to the ignition harness was noted.

The starter remained attached to the engine. No damage was noted and it was not removed.

The alternator remained attached to the engine. No damage was noted and it was not removed. The alternator belt remained in place.

Oil was observed in the engine. The oil suction screen and oil filter were unobstructed.

Fuel System

The carburetor remained attached to the engine and no damage was noted. The throttle cable remained attached to the carburetor throttle control arm. The arm was positioned about 1/8 inch from the full throttle stop. The mixture control cable remained attached to the carburetor mixture control arm. The arm was positioned near the idle cut off stop. The cockpit throttle and mixture controls were impact damaged.

Fuel drained from the carburetor fuel inlet hose when it was removed. The carburetor was removed and partially disassembled. The carburetor float bowl was about half full of a blue liquid with an odor consistent with aviation gasoline. No damage to the brass floats or other internal components was noted. The carburetor fuel inlet screen was unobstructed.

4.3 Engine Exam Photos



Figure 8: Engine with cowling removed (right)

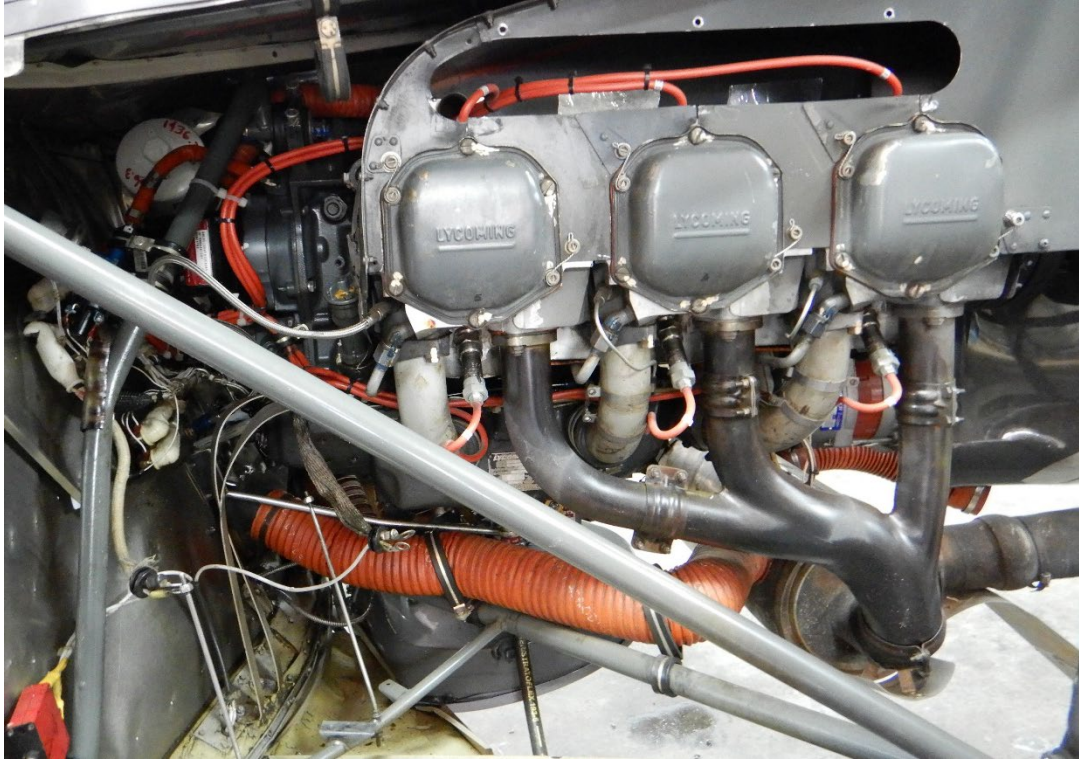


Figure 9: Engine with cowling removed (left)

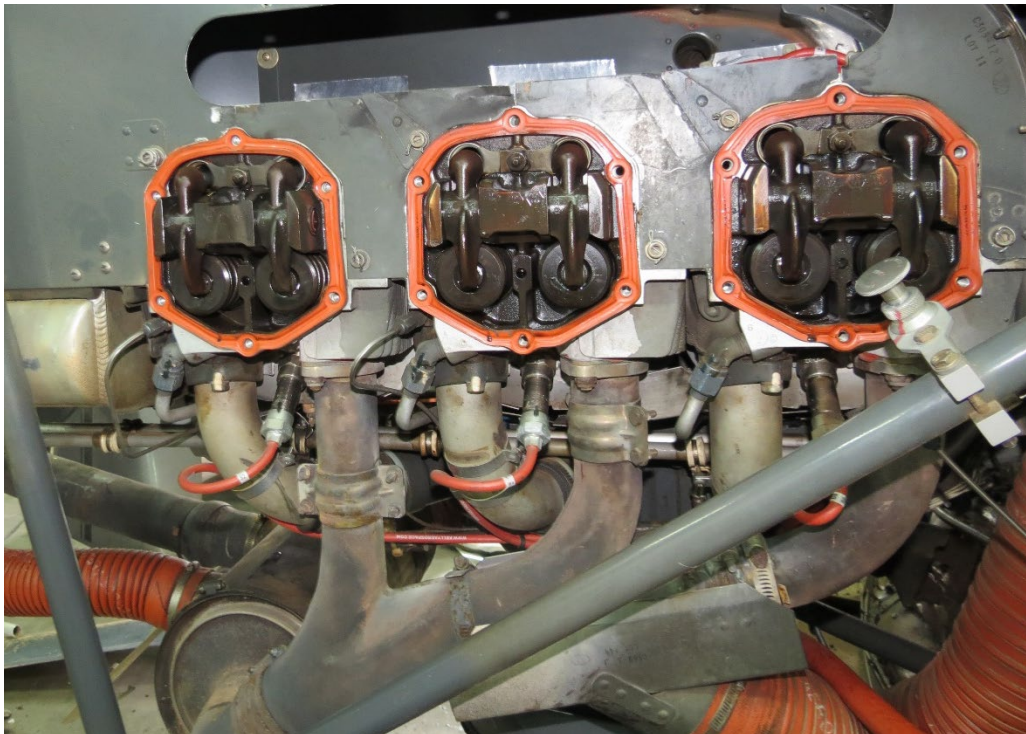


Figure 10: Engine (right) with rocker covers removed



Figure 11: Engine (left) with rocker covers removed



Figure 12: Sparkplugs



Figure 13: Oil filter

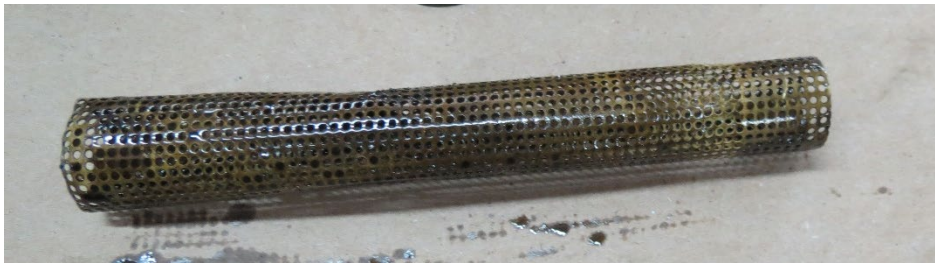


Figure 14: Oil suction screen

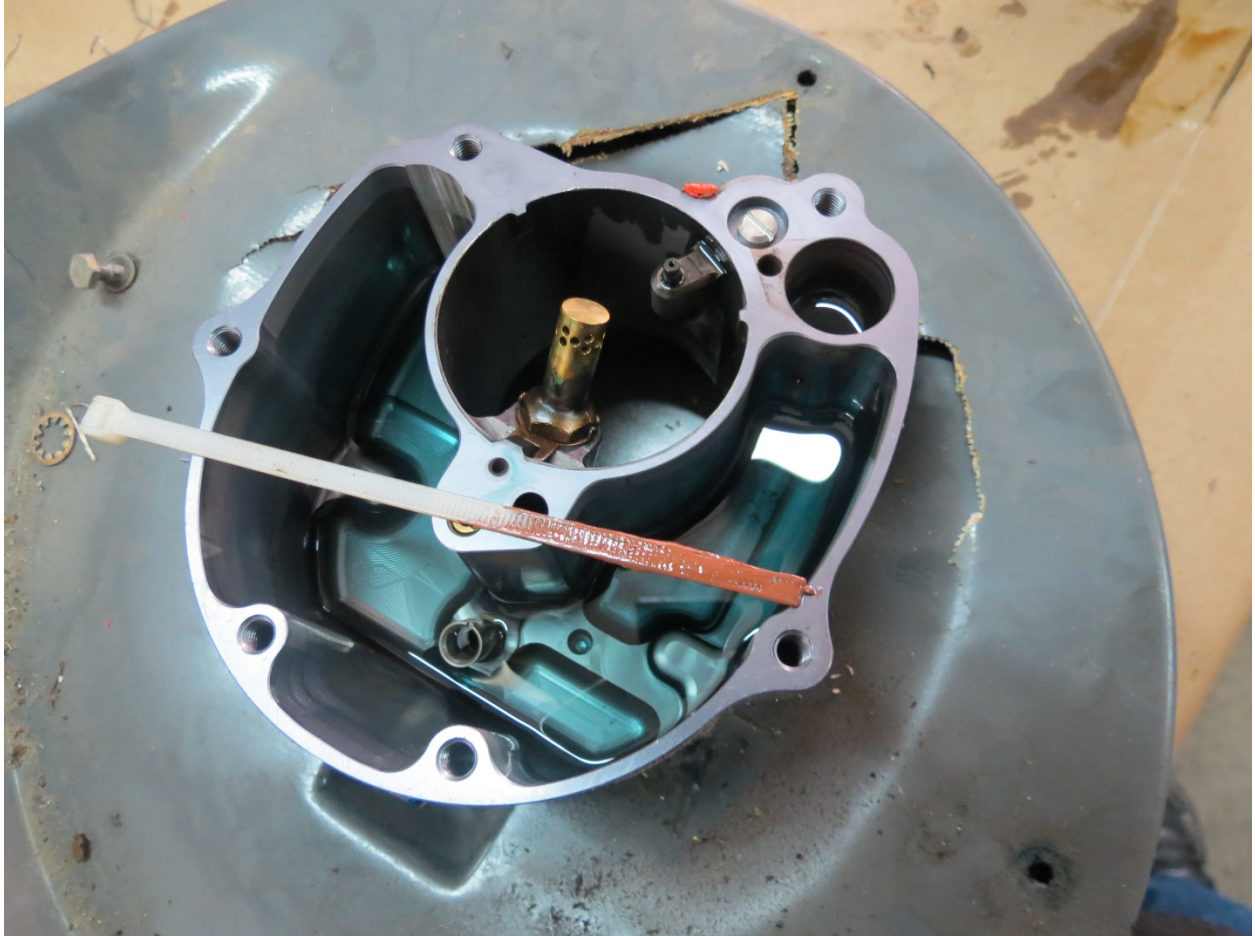


Figure 15: Carburetor bowl with fuel and test stick showing no water contamination