



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

May 1-2, 2019

AIRFRAME AND ENGINE EXAMINATION

WPR19FA123

This document contains 21 embedded photos.

A. ACCIDENT

Location: Kailua, Hawaii
Date: April 29, 2019
Aircraft: Robinson R44, Registration N808NV, Serial #0926
NTSB IIC: Samantha Link

B. EXAMINATION PARTICIPANTS:

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C. SUMMARY

Examination of the airframe and engine was conducted on May 1-2, 2019 at the facilities of Mid Pacific Aero Services in Honolulu, Hawaii.

D. DETAILS OF THE INVESTIGATION

1.0 Airframe Examination

- The auxiliary fuel tank was mostly whole and found pressed into other airframe components. It exhibited impact related damage
 - The outer shell exhibited extreme thermal damage
 - The bladder exhibited thermal damage
 - The filler cap was still secured on the filler neck
 - The vent lines were observed to be clear of debris/blockages
 - The crossover line was found separated in the middle of the line
 - The fuel tank screen was clear of debris
- The main fuel tank was found separated from the helicopter (note: it was found separated from the main wreckage on scene as well)
 - The outer shell exhibited impact related damage, and the bladder was not compromised
 - About 13 gallons of fuel was removed from bladder
 - The filler cap was found secured on the filler neck
 - Both the crossover and fuel feed fittings were observed secured in place, although the hoses were found separated from the fittings.
 - Both the vent system tubes and the vent lines were found clear of debris
 - The hoses were disconnected from the vent tubes
 - The check valves were not observed
 - The fuel tank screen was clear of debris
- The fuel valve knob was found in the “on” position
 - The knob was found disconnected and the tube was fracture separated consistent with overloaded
- The fuel valve itself was found in the open position
- The Gascolator was void of fuel
 - No debris was present in the bowl and very light debris was observed in the screen
- The tail rotor flight controls:
 - The dash 11 push pull tube at the anti-torque pedals was found fracture separated consistent with overload
 - The forward rod end of the dash 17 push pull tube was fracture separated consistent with overload. The mating piece was not present. A second break was noted 8 inches after the fracture, and a third break was noted 26 inches aft of the separation.

- There was no apparent twisting observed at the fracture points
 - The tail rotor pitch control moved freely when manipulated by hand
- The main rotor flight controls:
 - Due to the deformation of the airframe, the collective was seized and unable to be manipulated by hand
 - The cyclic control was manipulated by hand and moved left, right, forward, and aft
 - A disconnect consistent with impact damage was observed at the lower end of the left lower vertical tube
 - A disconnect consistent with impact damage was observed below the aft servo
 - Disconnects consistent with impact damage were observed at the upper rod end of both pitch control links.
 - One pitch horn and the attached rod end were fracture separated and not located
- Drivetrain:
 - The lower sheave appeared serviceable
 - V-belts
 - One V-belt was intact, but out of the grooves
 - Three V-belts were fracture separated consistent with overload and appeared serviceable.
 - The actuator:
 - Was found disconnected at the upper support bearing
 - The upper and lower support bearings rotated freely
 - The actuator switched sustained impact related damage
 - The actuator motor was found separated from its housing
 - The actuator was extended 1.2 inches between the scissor mounts, which is consistent with normal.
 - The upper sheave appeared serviceable
 - Rotational scoring was observed on the forward face along with scoring on the nearby support tubes
 - The aft face had single impact marks adjacent to the centering strut
 - The sprag clutch operated properly
 - The forward flex plate was disconnected consistent with overload
 - The main rotor gearbox housing was observed fractured in several places
 - The main rotor driveshaft was seized and would not rotate by hand.
 - It was bent at about a 20-degree angle above the swash plate

- The intermediate flex coupling was found disconnected at both yokes
- Tail rotor driveshaft
 - There were three breaks through the tail rotor driveshaft.
 - A small section of driveshaft (about 8 inches) was fractured separated and not located.
 - There was no apparent twisting observed at the fracture points.
 - Aft flex coupling appeared normal
 - The driveshaft was bowed
 - The driveshaft damper bearing rotated freely when manipulated by hand
 - The housing was observed separated from the bearing
 - The support was disconnected on one side of the bulkhead
 - The scissors moved freely
 - Tail rotor gearbox output shaft rotated more than 360 degrees by hand
 - Blue oil was visible in sight gauge
 - Output shaft was straight
 - Overall, the tail rotor exhibited minimal damage prior to recovery
 - No indications of rotation at impact
 - No damage to leading edge or tips of tail rotor blades
- Main rotor blades
 - The pitch change bearings in both blades rotated smoothly when manipulated by hand
 - Both droop stop tusks were in place and undamaged
 - The droop stop bolt at the nut end was sheared but remained in place
 - Arc shaped scoring was observed on both sides of the main rotor hub adjacent to the pitch horns
 - Consistent with extreme coning, and the blades were pitching while in that position
 - Main rotor teeter and coning bearings moved freely
 - Blue blade
 - The inboard portion of the blade exhibited severe thermal damage
 - No score or impact marks were observed on the leading edge
 - The tip cover was intact
 - Trailing edge outboard portion exhibited slight impact damage

- In the afterbody of the blade, about 58 inches from the outboard tip, was contact damage that appeared to be the same shape as the left skid toe.
 - About 140 inches from the blade tip, the spar was bent down about 90 degrees
 - Red blade
 - About 70 inches from the blade tip, the after body section was fracture separated. (on scene examination indicated this occurred in flight)
 - The spar was fractured and bent forward in the direction of rotation about 94.5 inches from the blade tip.
 - The beginning of rotation scoring from the blade leading edge chordwise to the trailing edge was observed about 65.5 inches from the tip.
 - Inboard from the approximate 65-inch mark, on the lower surface of the blade, was a spanwise dent that extended about 45 inches long. Within the dent were equal spaced score marks which were about 2 3/8 inches apart. This spacing is consistent with the row of screws in the windshield bow
 - About 27.5 inches from the root fitting the main rotor spar was fractured and bent downward.
 - The afterbody sustained impact damage
- Landing gear
 - Both toe sections were separated at the strut mounts
 - The aft and front cross tubes were straight
 - The aft cross tube was fractured at the left elbow
 - The cross tube elbow showed no indication of rotation
 - The left skid tube was fractured forward of the aft strut
 - The left skid toe exhibited impact related damage to its leading edge which appeared to match the damage in the blue main rotor blade
 - The forward left elbow was partially fractured
- The cabin
 - Airframe exhibited heavy impact damage to the left side
 - Seats
 - The left front seat structure was completely collapsed outboard to inboard

- The aft left seat structure exhibited crushing damage outboard to inboard
 - The front right seat structure sustained impact damage to its right side
 - The aft right seat structure was partially collapsed
- Seatbelts
 - The aft right inertia reel operated properly, and the other three exhibited impact damage.
 - All four seatbelts were found unbuckled at time of the examination
- The instrument counsel was separated from the keel panel
 - It was found on scene completely separated, and outside of, the main wreckage.
 - The left corner of the counsel was bent inward toward the passengers.
 - The warning lights were removed from the counsel and the filaments were examined:
 - Low RPM – filaments were destroyed
 - Low fuel – the coils were broken and tight
 - TR chip – the coils were broken and tight
 - Starter on – the coils were broken and tight
 - Carbon Monoxide – exhibited tight coils
 - MR Chip – the coils were tight
 - MR Temp – the coils were broken
 - Clutch – the coils were damaged
 - Gov off – the coils were tight
 - Oil – the glass was damaged, and the coil was stretched and broken
 - Engine fire – the coils were tight
 - Alt – the coils were damaged
 - Brake – The supports were off center, but the coils were tight
- The forward left roof and floor/chin exhibited damage consistent with contact from the main rotor blade
- Both right doors exhibited impact related damage
- Both left doors were not present
 - According to the operator they were not installed during the accident flight
- The removable flight controls were not installed and were found stowed under the aft right seat

- The vertical firewall exhibited severe impact damage to its left and lower sides
- The horizontal firewall exhibited severe impact damage throughout
- Both the upper and lower steel tube frames sustained impact damage with multiple fractures in the tubing
- The tailcone exhibited impact damage at the forward end (bay one and two)
 - A small dent was observed on the upper surface of tailcone (bay number 7), adjacent to the tip of tail rotor blade
 - The upper vertical stabilizer exhibited impact damage to the leading edge at the upper tip
 - The tail skid tube was not damaged
 - The tail rotor guard was not damaged
- The mast fairing exhibited impact and thermal damage
- The engine cowling exhibited severe impact damage
- The cooling fan exhibited rotational scoring on its aft face
 - The scoring appeared light grey with a red tint, which is consistent with the paint on the engine cowling.
 - The lower half of the cooling fan was also flat at the 6 o'clock position.
- The inside of the cooling fan scroll exhibited rotational scoring
- The oil cooler exhibited an about one-inch deep indentation consistent with contact with the starter ring gear.
 - The indentation exhibited both grinding and teeth impression marks
- Powerplant controls
 - The fuel mixture knob was found in the full rich position
 - It operated smoothly when manipulated by hand.
 - The carburetor heat knob was found unlocked and raised about 0.8 inches
 - The mixture control cable was pulled out from the mixture arm on the carburetor
 - The hardware on mixture arm remained secured
 - The mixture arm return spring was bent and separated from its mount
 - The airbox was found separated from the carburetor and sustained slight thermal damage and impact related damage
 - The air filter appeared serviceable
 - The carburetor heat control cable was pulled out of the carb heat slider valve
 - Carb heat slider valve was found in the full hot position
 - The governor switch was found on

- All circuit breakers were popped or up, with the exception of the engine tach and gauges
- The battery ground cable exhibited impact related damage and was found disconnected from the structure.
 - The battery was located outside of the cabin tethered by the positive cable.

1.1 Airframe photos



Figure 1: Main Rotor Blades Overall (Blue then red blades)

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Figure 2: Rotational Scoring in the Red Blade



Figure 3: Afterbody damage to the Blue Blade Compared to the Left Skid Toe



Figure 4: The Cooling Fan



Figure 5: Oil Cooler

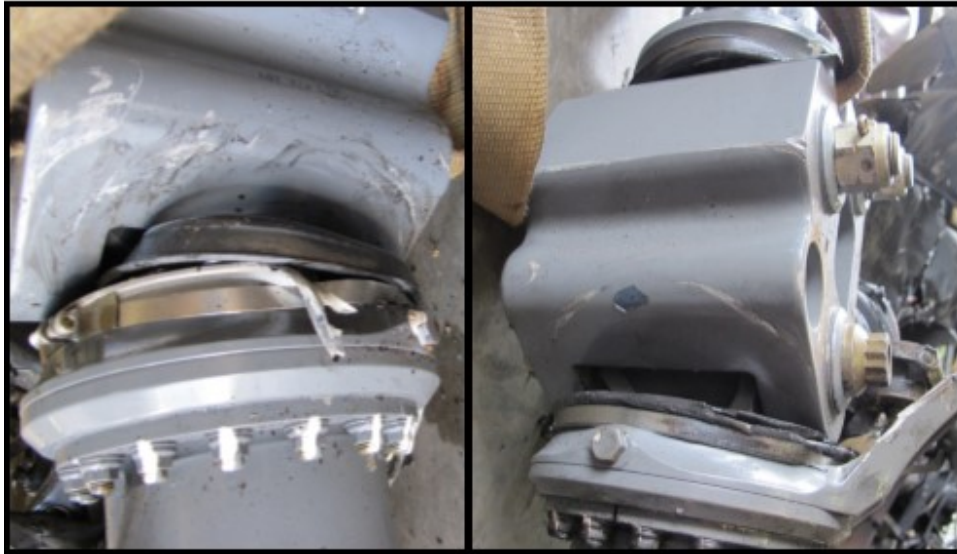


Figure 6: Main Rotor Hub

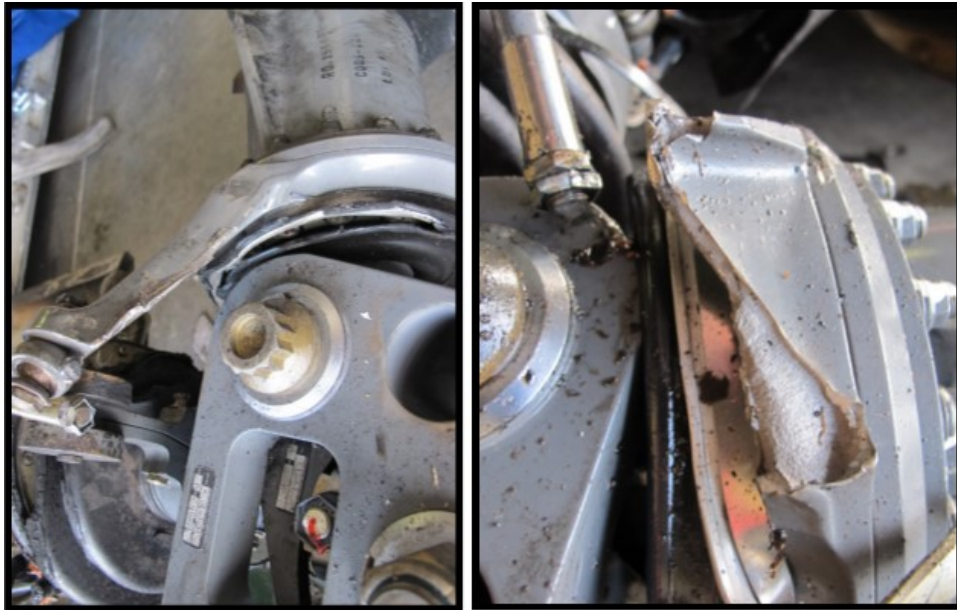


Figure 7: Pitch Horns



Figure 8: Main Rotor Driveshaft



Figure 9: Droop Stop Bolt

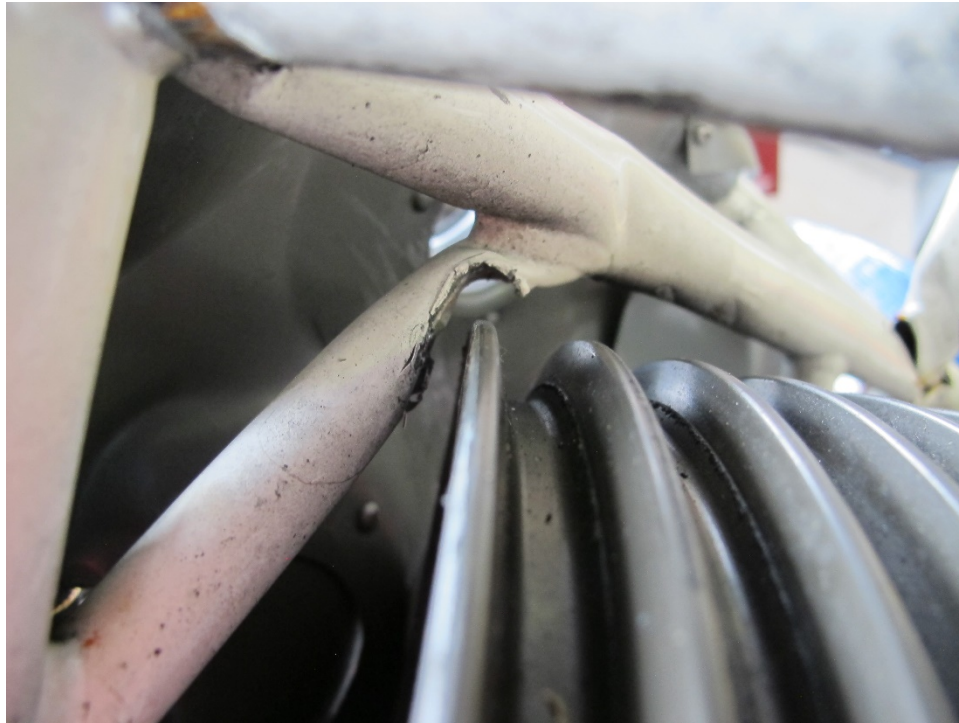


Figure 10: Upper Sheave to upper frame contact



Figure 11: V-Belts



Figure 12: Instrument Counsel



Figure 13: Significant left side fuselage damage (Nose of Airframe Looking Aft)



Figure 14: Landing Gear Assembly

2.0 Engine Examination

- The engine was removed from the airframe
 - There were no obvious signs of catastrophic anomalies prior to impact
- The number 1 and 3 Cylinder heads were fracture separated
 - The cylinders were heavily fragmented
 - Valves, rocker arms, springs, and push rods were heavily damaged and found fracture separated from the engine
 - The number 1 and 3 cylinders were removed from the engine.
- The spark plugs were removed from the engine
 - The spark plugs from cylinders 2, 4, and 6 exhibited normal operating wear signatures
 - The spark plugs from cylinders 1, 3, and 5 exhibited impact damage
- The engine was borescoped and exhibited normal operating signatures.
- The crankshaft was rotated by hand and continuity was established throughout
 - Thumb compression was established on Cylinders 2, 4, 5, and 6.
 - Thumb compression could not be tested for on cylinders 1 and 3 due to impact related damage.
 - The crankshaft appeared to be slightly bent

- An O-ring, which was painted grey, was observed slightly extruding from the number 5 cylinder
- The muffler and exhaust were fracture separated from the engine
 - They were flattened
- Magnetos
 - The left magneto was found broken at the flange. When rotated, spark was obtained throughout.
 - The right magneto was found separated from the engine
 - When rotated, no spark was obtained
 - Condenser exhibited impact related damage
- The oil sump was fracture separated from the engine
 - The pickup screen was clear of debris
- The carburetor was fracture separated from the engine and partially broken apart
 - The fuel line was disconnected at carburetor
 - The Inlet screen was clear of debris
- Alternator and starter were fracture separated from the engine.

2.1 Engine Photos



Figure 15: Cylinders 1, 3, and 5



Figure 16: Cylinders 2, 4, and 6

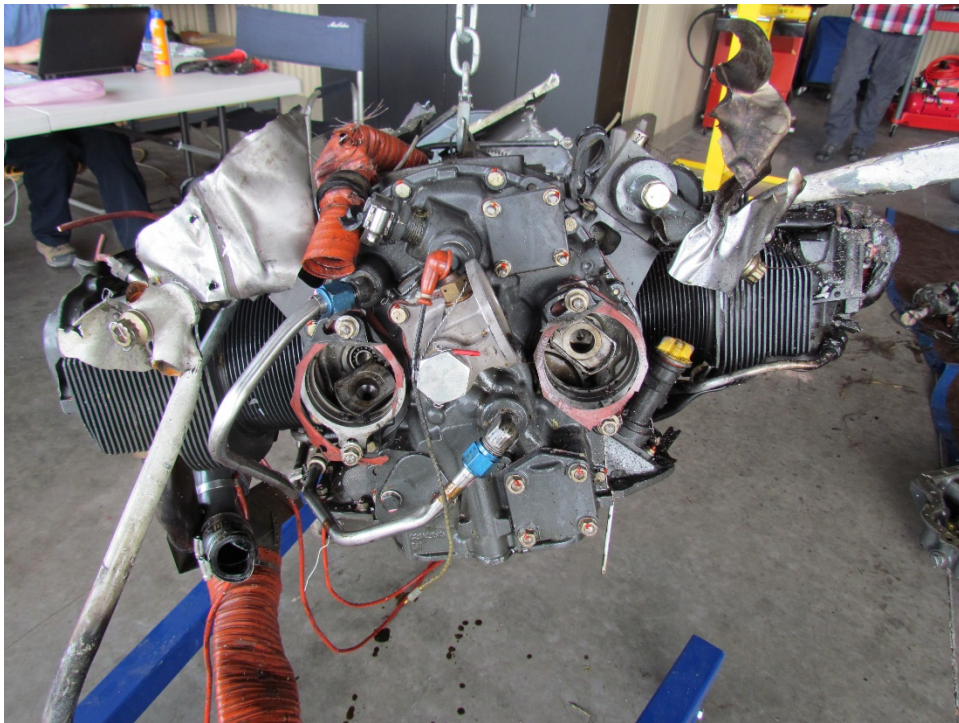


Figure 17: Accessory Section of Engine

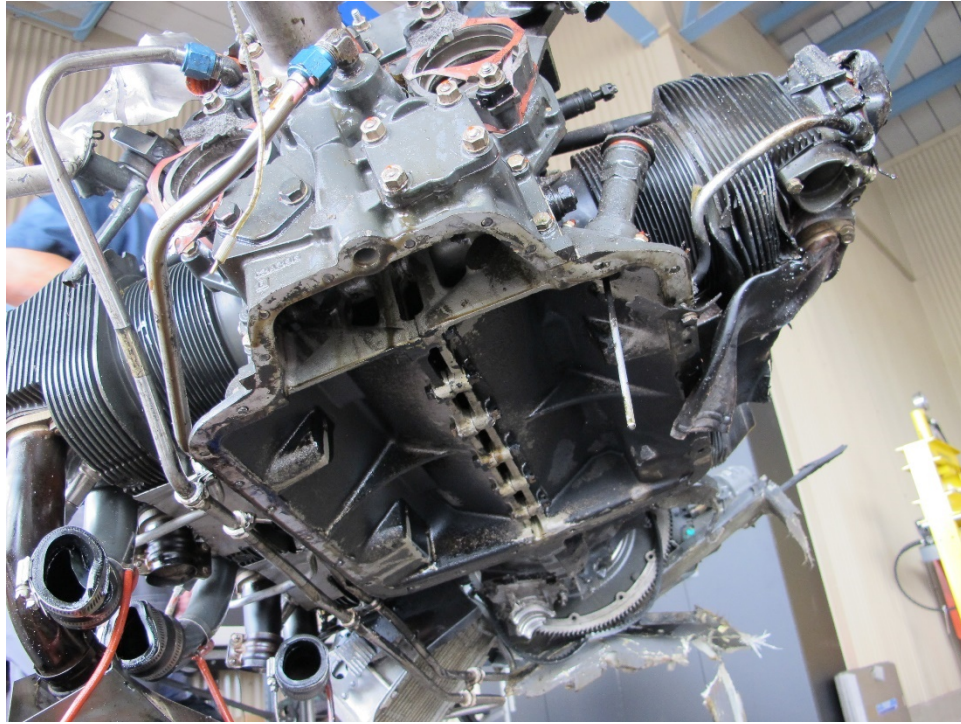


Figure 18: Underside of Engine



Figure 19: Extruding O-ring on Number 5 cylinder



Figure 20: Magnetos



Figure 21: Spark Plugs for cylinders 2, 4, 5, and 6

END.

Submitted by: Samantha Link