



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

Date: May 20, 2019

SUMMARY OF AIRCRAFT EXAMINATION

(WPR18FA016)

This document contains 20 embedded photos.

A. ACCIDENT

Location: Arlington, Washington
Date: October 24, 2017
Aircraft: Robinson R22, N8537J
NTSB IIC: Thomas M. Little

B. EXAMINATION PARTICIPANTS

Thomas M. Little
Senior Aviation Accident Investigator
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C. SUMMARY

On October 24, 2017, about 1315 Pacific daylight time, a Robinson R22 Alpha helicopter, N8537J, was substantially damaged following impact with water while performing a low-level maneuver at King Lake, located about 6 nautical miles east-southeast of Arlington, Washington. The commercial pilot was fatally injured, and the sole passenger sustained minor injuries. Visual meteorological conditions prevailed for the local flight, which was operated in accordance with Title 14 *Code of Federal Regulations* Part 91, and a flight plan was not filed. The flight had departed the pilot's residence, which was located about 1,350 ft south-southwest of the accident site, about 5 minutes prior to the accident.

D. DETAILS OF THE EXAMINATION

1.0 Accident Site Examination

An initial examination of the accident site was performed National Transportation Safety Board (NTSB) investigator-in-charge (IIC) about two hours after the event. The examination revealed that the helicopter had impacted water at about the mid-lake area and had sunk in about 30 feet of water. Aside from remnants of the main rotor blades which were recovered and placed on shore, no other components of the helicopter were recovered at that time. The helicopter was recovered from its submerged resting place to the south shore of the lake during the afternoon of October 30th. An examination of the helicopter post recovery revealed the helicopter was

primarily intact, with the exception of the aft tail boom and right wind screen, each of which had separated during the accident sequence.



Figure 1 - picture of helicopter post-recovery from lake

A postaccident examination of the airframe and engine was conducted on December 12, 2018. As a result of the examinations, no evidence of preimpact mechanical malfunction was noted that would have precluded normal operation.

2.0 Follow-up examination notes

The following compilation of data is the result of examination notes taken by the NTSB IIC and representative from Robinson Helicopters during a detailed examination of the helicopter, which was performed on December 12, 2018, at the facilities of AV-Tech Services, Auburn Municipal Airport, Auburn, Washington.

2.0.1 Airframe examination notes

The airframe was mostly intact but exhibited extensive damage on the upper fuselage area. The cabin roof, windshield, and door frames and fuel tanks were damaged. However, photos of the

aircraft being recovered from the lake indicate that most of the damage to the cabin roof occurred during aircraft recovery. The fuel tanks were buckled in some areas, and the mast fairing was damaged. Both windshields were fractured, and the pilot door was broken and detached from the aircraft. The tailcone was separated at the aft end of the third bay, and at the forward end of the fifth bay. The fourth bay was not present for the examination. There was scoring, some which penetrated the tailcone skin from the inside, visible in several areas of the tailcone. There was a tear in the tailcone skin on the right side, on the third and fifth bays. The empennage was intact, but there was damage on the upper vertical stabilizer. The tail rotor visual guard and tail skid did not appear to be damaged.

Non factory-installed brackets were visible on both sides of the aircraft in the vicinity of the engine compartment. Their purpose was not evident.

Cockpit and cabin

None of the removable controls were installed at the time of the examination.

The mixture control was in the full rich position. The mixture guard was located in the baggage compartment under the pilot seat.

The carburetor heat control was full down. The trim lever was fully extended.

Photographs of the aircraft upon removal from the lake show the ignition key present and in the "Both" position. The key was not present at the time of the examination.

The collective was in a full up position. The pilot's throttle twist grip was in a mid-travel position. Both shoulder harness inertia wheels functioned normally.

The aircraft had a non-factory installed Lowrance Airmap 2000c GPS mounted to the top of the cyclic with a RAM mount. The unit was retained by the NTSB to determine if there was any information that could be recovered from the unit's memory. There was a non-factory installed audio control unit installed on top of the console. There were various other non-factory installed modifications in the cockpit.

A subsequent examination of the Lowrance Airmap 2000c GPS by the NTSB IIC revealed that the component had been compromised during the accident sequence to the extent where no usable data could be extracted from the unit.

The aircraft was equipped with non-factory installed Tech-tool doors on both sides. Additional items in the cabin included a folding stool.

The landing gear was intact and attached to the airframe. It exhibited no obvious damage. There was non-factory installed devices on the bottom of both skids, possibly to extend skid life, but the purpose of the devices was not completely clear.

A post-recovery examination of the airframe failed to reveal any anomalies with the helicopter that would have precluded normal operation.



Airframe from the front



Aircraft from the left side

13.2

Figure 2 - Photos of front and left side of helicopter



Aircraft from the left side



Aircraft from the rear

13.3

Figure 3 - Photos from left side and rear of helicopter



Aircraft from the right side



Damage to the cabin roof

13.4

Figure 4 - Photos of right side of helicopter and damage to cabin roof



Pilot's side door



Tailcone and empennage

13.5

Figure 5 - Photos of pilot side door, tailcone and empennage

2.0.2 Engine examination and associated component notes

Powerplant

The engine, which had been submerged in about 31 ft of fresh water until it was recovered 6 days after the accident, exhibited very little visible damage. After the aircraft was delivered to Av-Tech Services, Av-Tech preserved the engine by removing the spark plugs and filling the cylinders and crankcase with diesel fuel. The engine was free to rotate at that time, according to Av-Tech representatives. The post-recovery examination of the engine failed to reveal any anomalies that would have precluded normal operation.



Engine right (aircraft left) side



Engine left (aircraft right) side

10.2

Figure 6 - Photos of left and right side of engine

The oil coolers did not come into contact with the starter ring gear. The alternator cooling fan and drive pulley did not come into contact with the starter ring gear.

The engine cooling fan scroll inlet ring had a circular score on the surface adjacent to the engine cooling fan inlet ring.

The upper sheave exhibited circular scoring on the aft surface. The belt tension actuator exhibited scoring on the surface that is adjacent to the upper sheave. The scoring was in a direction parallel to the direction of movement of the sheave.

The engine was free to rotate a few degrees at the time of the investigation, but the preservative diesel fuel prevented the engine from rotating more than that.

Powerplant Controls

The mixture control was in a full rich position in the cabin. The mixture control lever on the carburetor was in a full rich position, and the return spring was in place. The mixture control cable housing was not secure in the AN742-3 clamp, but the mixture control functioned normally when the control in the cabin was actuated. The cable housing extended approximately 1 to 1.5 inches from the end of the AN742-3 clamp.

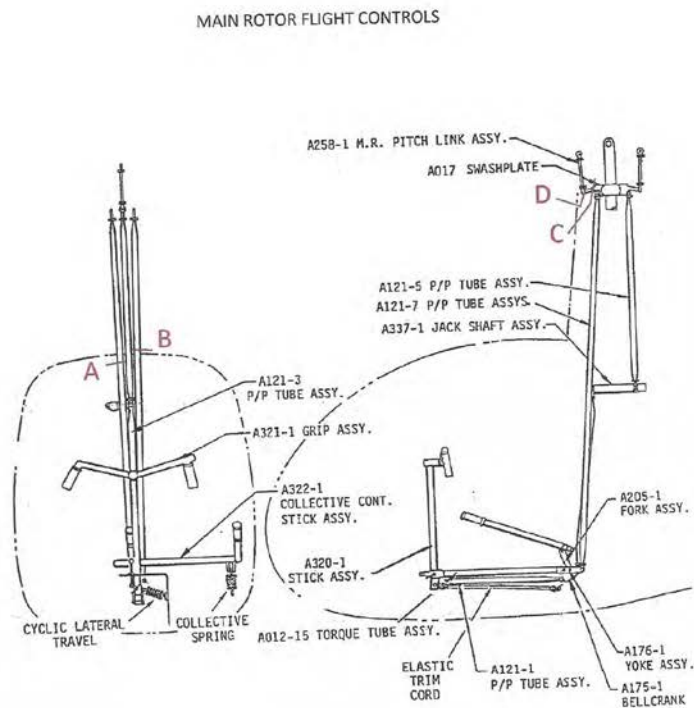
The carburetor heat control was in the full off position in the cabin. The slider valve in the airbox was in the off, or cold, position. The slider valve operated normally when the control in the cabin was actuated.

The throttle twist grip was in a mid-travel position. The throttle arm on the carburetor was in a full-on position. The overtravel spring compressed and extended normally.

The helicopter's chip detector with adhering foreign debris, was shipped to the NTSB Materials Laboratory in Washington, D.C. for examination and analysis of the debris in question by a materials engineer. Upon completion of his examination, the engineer reported that no very large particles were found while examining the chip detector. The engineer stated that the consistency of the grease appeared normal, although no consistency testing was performed. The tiny particles (<50mils) in the grease were determined to be trace metallic (primarily iron oxide) and ubiquitous dirt consistent with normal engine wear.

Flight Controls

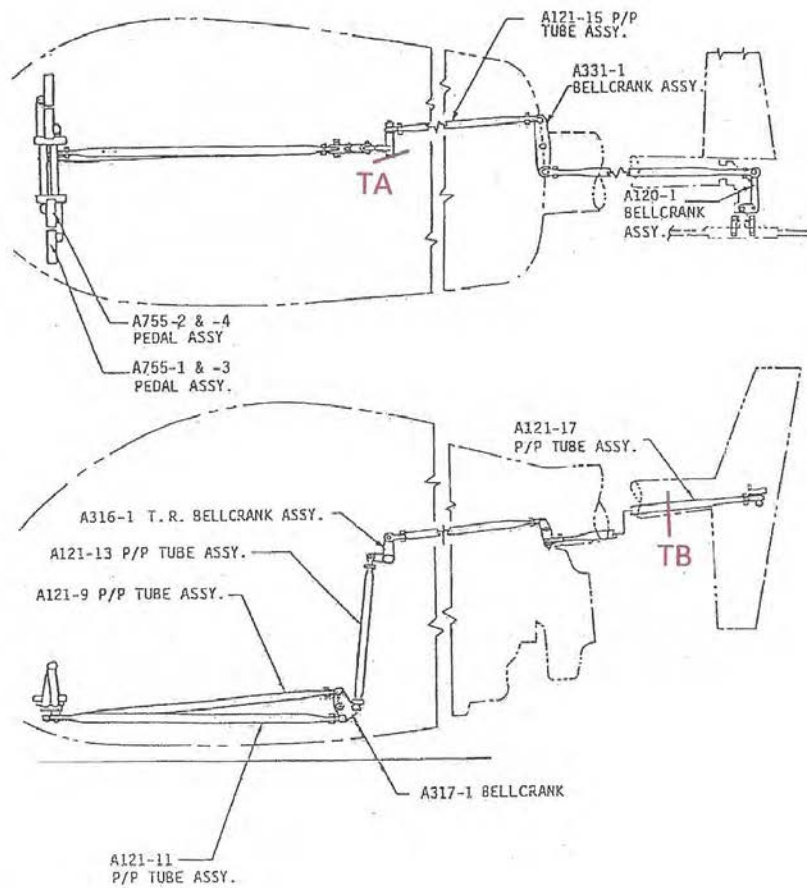
The flight control system had disconnects at the locations indicated on the following diagrams:



12.2

Figure 7 - flight control disconnects located at positions A, B, C & D
(courtesy of Robinson Helicopters)

TAIL ROTOR FLIGHT CONTROLS



12.3

Figure 8 - flight control disconnects located at positions TA & TB
(courtesy of Robinson Helicopters)

The upper swashplate arm that the drive scissor assembly attached to was fractured and was not present for the examination. (Disconnects C and D). Photos of the mating fracture surface were sent to the NTSB laboratory for examination. The lab concluded that the fractures were overstress, or impact related.



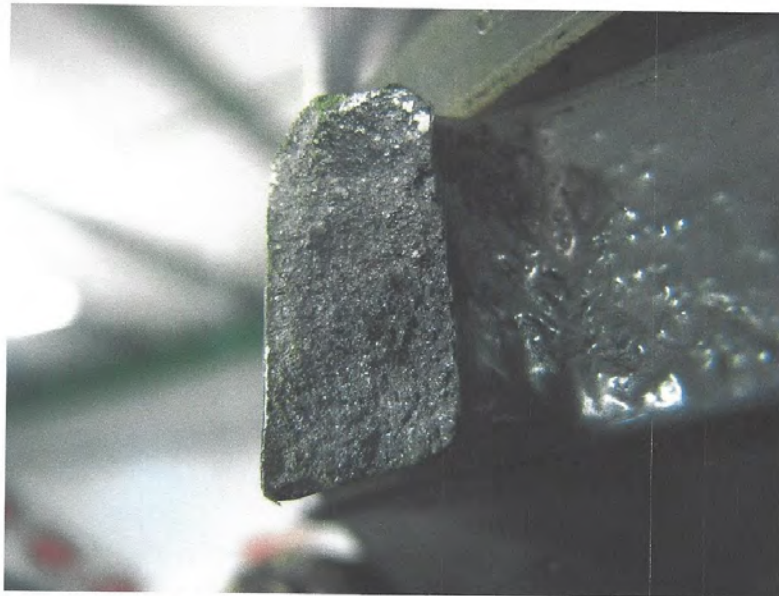
Disconnect C at the swashplate arm



Fracture surface of Disconnect C at the swashplate arm

12.7

Figure 9 - Photo of fracture surface of Disconnect C at swashplate arm



Fracture surface of Disconnect C at the swashplate arm



Disconnect D at the swashplate drive scissor and lower pitch control rod bolt

12.8

Figure 10 - Photos of Disconnect C at swashplate arm and Disconnect D at the swashplate drive scissor

No evidence of pre-impact failures of the control system was found.
The tail rotor pitch change slider was free to slide along the tail rotor gearbox output shaft.

Driveline

The drive belts were intact and showed no signs of rolling and were in place on the lower sheave grooves. The belts were displaced forward at the upper sheave, one strand of the forward belt was off the sheave on the forward side. The belt tension actuator was intact, and the distance between the anti-rotation scissors was approximately 1.5 inches.



The drive belts, from the right side of the aircraft



The drive belts at the upper sheave

11.3

Figure 11 - photos of drive belts

The lower actuator bearing rotated, but rotation was constrained to the amount the bearing could be rotated after the belt tension actuator was disconnected at the upper bearing. The upper bearing rotated a full turn, but it felt a little bit ratchety. The sprag clutch locked and free-wheeled normally. The forward flex coupling showed no apparent damage.

The main rotor gearbox was fractured at the base of the mast tube. Photos of the mating fracture surfaces were sent to the NTSB laboratory for examination. The lab concluded that the fractures were overstress, or impact related.



Figure 12 - main rotor gearbox fracture

The main rotor shaft was bent forward approximately 20 degrees. Dark liquid was visible in the sight glass. The gearbox rotated approximately 25 degrees, but movement was limited by the bent main rotor shaft. The chip detector was removed and there appeared to be a little material on the magnet. The chip detector was retained for further analysis.

The elastomeric teeter stop for main rotor blade serial number 3420D was split horizontally through the middle, and the retention bracket was bent slightly. The teeter stop for main rotor blade serial number 2322D did not appear to be damaged. The droop stops and droop stop tusks were intact and in place. There was no visible scoring on the main rotor hub just inboard of the pitch change housings on either main rotor blade.

The main rotor blades were detached from the aircraft -they had been cut for transportation. Main rotor blade serial number 3420D was bent upwards approximately 45 degrees at approximately 30 inches from the coning bolt. The spar had been cut at approximately 69 inches from the coning bolt. The blade was bent forward at approximately 28 inches from the tip, and there was scoring on the leading edge, and some transfer of a white substance. A large section of the skin and honeycomb was detached from the spar, and a portion of the skin and honeycomb structure, approximately 1.5 feet, was not present for the examination.

Main rotor blade serial number 2322D was basically straight, the blade was saw-cut at approximately 29 inches from the coning bolt. The skin and honeycomb portion of the blade was detached from the spar from this point out to 76 inches from the coning bolt. There was compression buckling visible on the upper and lower surfaces of the blade. There were dents in the lower surface of the blade within approximately 12 inches from the tip. There was a very slight upward bend on the blade.

The intermediate flex coupling was separated at the flex coupling arms that attach to the tail rotor driveshaft forward yoke. The flexplate arms and the clutch and tail rotor driveshaft yoke arms were severely bent, in a direction consistent with stretching of the tail rotor driveshaft. The forward approximately 3 feet of the tail rotor driveshaft was present for the examination, but the rest of the driveshaft was not present. The B288-8 support bracket, where the tail rotor driveshaft damper assembly attaches to the tailcone, was broken and distorted rearward.

The aft flex coupling was separated, the flexplate arms were separated at the tail rotor gearbox input yoke arms. The forward portion of the aft flex coupling was not present for the examination. The tail rotor gearbox was intact and free to rotate at least one full turn and contained blue oil. The tail rotor output shaft, hub, and one tail rotor blade (serial number 7679 E), appeared to be undamaged. The other tail rotor blade (serial number 7659 E) was damaged at the tip, and the tip portion was not present for the examination.

Fuel System

The fuel caps were in place on the fuel tanks. The auxiliary fuel tank had at least one puncture in its skin, otherwise the fuel system was intact. There was a substantial amount of water in the fuel system, mixed with fuel. The gascolator was intact and in place. The gascolator was removed and the bowl contained a mixture of water and blue liquid with the odor of aviation gas. There were no significant contaminants visible in the gascolator bowl. The screen was removed and photographed. Blue liquid with the odor of Avgas spilled from the airbox when it was opened, along with water.

The fuel tank vent system was disconnected in several places and did not appear to match a factory installed configuration. Investigators were able to blow air through both of the A731-3 aluminum vent lines in the mast fairing, both fittings on both of the fuel tanks, and all of the additional rubber and aluminum tubes that were present, though it was not clear which tubes had originally been connected to which location.