



Aviation Investigation Final Report

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|--------------------------------|--------------------------------------|-------------------------|-------------|
| Location: | Ketchum, Oklahoma | Accident Number: | CEN15LA379 |
| Date & Time: | August 25, 2015, 07:50 Local | Registration: | N444KD |
| Aircraft: | ROBINSON HELICOPTER COMPANY R44 II | Aircraft Damage: | Substantial |
| Defining Event: | Part(s) separation from AC | Injuries: | 1 Minor |
| Flight Conducted Under: | Part 91: General aviation - Personal | | |

Analysis

The private pilot stated that, before the flight, he had intended to refuel the helicopter but that the pumps were not operating. He added that he did not loosen the fuel cap before departure and that he did not remove the fuel cap when he performed his aircraft preflight. He stated that he checked the fuel level by observing the fuel quantity gauge during his preflight.

The private pilot reported that he was flying between about 300 and 400 ft above ground level (agl) at 80 to 90 kts when there was a sudden "boom," followed by a yaw. He immediately lowered the collective, rolled the throttle to idle, and entered an autorotation. The nose dropped and he pulled back on the cyclic to keep the helicopter level. He flared the helicopter around 40 kts and 40 ft agl and the nose yawed hard left. He pulled the collective and the skids hit about level. The helicopter rolled over on its right side in a flat, grass pasture.

The first parts of the tailboom (including the helicopter's left tank fuel cap) were located about 1,700 ft from the main wreckage. The tail rotor gearbox and tail rotor blades were found near the initial tailboom parts. The metallurgical examination of the tailboom attachment point (bulkhead), tail rotor gearbox, tail rotor hub, and tail rotor blades revealed that the fractures were consistent from overstress fractures with no evidence of preexisting damage.

The tail rotor separation from the helicopter was likely due to a severe blade imbalance associated with an impact to one of the blades. However, examination of the components could not determine what object was impacted. No evidence of impact with a foreign object such as a bird, vegetation, or drone was observed, although such an impact could not be entirely ruled out since one of the blade tips was missing and subsequent blade contact with the vertical stabilizer could have masked a prior impact. Although the fuel cap was found near the start of the debris trail, no evidence of impact damage or paint transfer corresponding to contact between a blade and the fuel cap was identified.

Although the pilot stated that he had not loosened the fuel cap before departing on the accident flight, the fuel cap was found 1,700 ft from the main wreckage. While the exact sequence of events could not be determined because there was no impact mark on the fuel cap, it is likely that the fuel cap was not properly secured at some point and subsequently departed the helicopter during the accident flight. Whether or not it was the fuel cap that impacted the tail rotor blade or some other unknown object could not be determined based on the available evidence.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The separation of the tail rotor gearbox from the tailboom aft bulkhead due to overstress loads imposed by a blade imbalance from an in-flight impact with an undetermined object.

Findings

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| Aircraft | Tail rotor blade - Damaged/degraded |
| Aircraft | Tail rotor gearbox - Damaged/degraded |
| Aircraft | (general) - Not specified |

Factual Information

History of Flight

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| Enroute-cruise | Part(s) separation from AC (Defining event) |
| Enroute-cruise | Collision with terr/obj (non-CFIT) |

On August 25, 2015, about 0750 central daylight time, a Robinson Helicopter R44 II, N444KD, sustained substantial damage when it impacted terrain about 0.8 nm northeast of the South Grand Lake Regional Airport (1K8), Ketchum, Oklahoma, after a loss of the tailrotor gearbox. The pilot received minor injuries. The helicopter was registered to the Marcotte Veterinary Clinic PC and operated by the pilot under the provisions of the 14 Code of Federal Regulations Part 91 as a personal flight. Visual meteorological conditions prevailed at the time of the accident, and no flight plan was filed. The flight departed from 1K8 about 1748 on a local flight.

The pilot reported that he conducted a preflight of the helicopter before departing from his home located about 8 miles from 1K8. He flew to 1K8 where he intended to refuel the helicopter. The pilot stated that he landed near the self-service fuel pumps and grounded the helicopter. He tried to swipe his credit card in the self-service fuel pumps but the fuel pumps were not operating. He ungrounded the helicopter, started the helicopter, and checked the magnetos and sprague clutch before departing to Grove, Oklahoma, located about 16 miles from 1K8. The pilot stated that he had not loosened the fuel cap prior to departing from 1K8, and additionally, he did not remove the fuel cap when he performed his aircraft preflight. He stated that he checked the fuel level by observing the fuel quantity gauge during his preflight.

The pilot reported that there was nothing abnormal about the takeoff from 1K8. The wind was calm and he was flying about 300-400 ft agl (his typical cruising altitude) with 80 – 90 kts airspeed. He had flown about 1/2 mile from the airport heading northeast when there was a sudden "boom." There were no abnormal vibrations or noises before the "boom." He stated that there was a sudden yaw; although, he was uncertain if it was to the left or right. He immediately lowered the collective, rolled the throttle to idle, and entered an autorotation. The nose dropped and he pulled back on the cyclic to keep the helicopter level. He estimated that he flared the helicopter around 40 kts and 40 ft agl and the nose yawed hard left. He pulled the collective – although he wasn't exactly sure if he did or not. The skids hit about level and the helicopter rolled over on its right side in a flat, grass pasture.

The pilot stated the he wasn't sure how long it was from the "bang" to landing with any certainty, but estimated 15 – 20 seconds, and not more than 30 seconds. He wasn't sure about how high he was when he flared, and he had never done a practice autorotation from 300 ft agl. He stated that he didn't hit a tree and he didn't see any birds close to the helicopter, although there were some buzzards a few hundred yards away. He wasn't sure if there was anything mechanically wrong with the tail rotor or gearbox that caused the problem.

The pilot held a private certificate with a helicopter rating. He had 144 total hours of flight time with 89 hours in the accident helicopter.

At 0735, the surface weather observation at the Grove Municipal Airport (GMJ) located about 23 nm east of 1K8, was: wind light and variable, 10 miles visibility, skies clear, temperature 12 degrees C, dew point 12 degrees C, altimeter 30.17 inches of mercury.

The examination of the accident site revealed that the first parts found in the wreckage path were located about 0.5 miles from 1K8, and were primarily tail boom sheet metal coverings of the boom structure just forward of the drive shaft flange. The debris path from the initial tail boom parts to the main wreckage was about 1,700 ft on a 063 degree heading. The helicopter's fuel cap was found about 125 ft from the initial tail boom parts. The tail rotor gearbox and tail rotor blades were found about 340 ft from the initial tail boom parts. The vertical stabilizer and horizontal stabilizer were found about 1,600 feet from the initial tail boom parts.

The helicopter was on its right side and the cabin remained intact. The left tank fuel cap was not attached to the filler neck and not located at the main wreckage site. The main rotor and blades remained attached the main transmission. One of the main rotor blades was bent opposite the direction of rotation and partially separated about 5 ft from the end of the blade tip. The other main rotor blade was bent but otherwise intact. A 6 ft section of the end of the tail boom was found near the main wreckage. The tail boom guard parts were located near the main wreckage. A prominent ground scar/slash was observed next to the end of the tail boom that remained attached to the fuselage.

The tail boom attach point (bulkhead), tail rotor gearbox, tail rotor hub and blades, and fuel cap were sent to the National Transportation Safety Board's Materials Laboratory for metallurgical examination. Examination revealed that the tail cone was fractured around its circumference just forward of the aft bulkhead. The tail rotor drive shaft was fractured at the aft flexible coupling, and the tail rotor gearbox was fractured from the aft bulkhead. The tail rotor blades were fractured into multiple pieces, and the tip was missing from one of the blades (blade labeled "B").

The examinations of the aft bulkhead fracture surfaces revealed that fractures were consistent with overstress failure or post-fracture damage, and there was no evidence of a preexisting crack. The tail rotor gearbox flange fracture surfaces were rough and matte gray consistent with overstress fractures and post-fracture damage. The tail rotor hub was intact, but showed evidence of substantial teetering.

The leading edges and fractures from blades A and B were examined closely for evidence of contact with a foreign object. Small areas consistent with insects fluoresced when examined under a black light, but no larger areas of fluorescing material were observed. No evidence of feathers or vegetation was found. Paint transfer observed on the blade surfaces was either red or white, consistent with contact with the blade guard or the empennage structure (the helicopter was painted white). Fractures of the skin on both blades formed on slant angles consistent with ductile overstress fractures.

A visual examination of the fuel cap was conducted. No evidence of heavy impact marks or paint transfer from the tail rotor blades were observed on the fuel cap. The fuel cap was placed on the exemplar R-44 left fuel tank filler's neck and twisted until it was tight. The fuel cap fit snugly and could not be loosened without exerting considerable pressure.

On May 30, 2012, the Robinson Helicopter Company issued Service Bulletin SB-84, which concerned fuel cap decals. The service bulletin stated the following:

"Fuel cap alignment stripes are required by regulation and necessary for the pilot to verify fuel caps are properly secured. An improperly secured cap may come off in flight. This bulletin requires inspection of fuel cap alignment stripes, refurbishing as required, and installation of decals to aid in use of the stripes."

The service bulletin had not been complied with and there were no alignment stripes or decals on the fuel cap.

Pilot Information

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| Certificate: | Private | Age: | 51, Male |
| Airplane Rating(s): | None | Seat Occupied: | Right |
| Other Aircraft Rating(s): | Helicopter | Restraint Used: | 3-point |
| Instrument Rating(s): | None | Second Pilot Present: | No |
| Instructor Rating(s): | None | Toxicology Performed: | No |
| Medical Certification: | Class 3 With waivers/limitations | Last FAA Medical Exam: | July 29, 2014 |
| Occupational Pilot: | No | Last Flight Review or Equivalent: | |
| Flight Time: | 144 hours (Total, all aircraft), 90 hours (Total, this make and model), 11 hours (Last 90 days, all aircraft), 2 hours (Last 30 days, all aircraft), 0.2 hours (Last 24 hours, all aircraft) | | |

Aircraft and Owner/Operator Information

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|--------------------------------------|--|---------------------------------------|-----------------|
| Aircraft Make: | ROBINSON HELICOPTER COMPANY | Registration: | N444KD |
| Model/Series: | R44 II | Aircraft Category: | Helicopter |
| Year of Manufacture: | 2003 | Amateur Built: | |
| Airworthiness Certificate: | Normal | Serial Number: | 10166 |
| Landing Gear Type: | N/A; Skid | Seats: | 4 |
| Date/Type of Last Inspection: | October 7, 2014 Annual | Certified Max Gross Wt.: | 2500 lbs |
| Time Since Last Inspection: | | Engines: | 1 Reciprocating |
| Airframe Total Time: | 2908 Hrs at time of accident | Engine Manufacturer: | LYCOMING |
| ELT: | Installed, activated, did not aid in locating accident | Engine Model/Series: | IO-540-AE1A5 |
| Registered Owner: | On file | Rated Power: | 205 Horsepower |
| Operator: | On file | Operating Certificate(s) Held: | None |

Meteorological Information and Flight Plan

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| Conditions at Accident Site: | Visual (VMC) | Condition of Light: | Day |
| Observation Facility, Elevation: | GMJ,831 ft msl | Distance from Accident Site: | 23 Nautical Miles |
| Observation Time: | 07:35 Local | Direction from Accident Site: | 93° |
| Lowest Cloud Condition: | Clear | Visibility | 10 miles |
| Lowest Ceiling: | None | Visibility (RVR): | |
| Wind Speed/Gusts: | / | Turbulence Type Forecast/Actual: | / |
| Wind Direction: | | Turbulence Severity Forecast/Actual: | / |
| Altimeter Setting: | 30.17 inches Hg | Temperature/Dew Point: | 12°C / 12°C |
| Precipitation and Obscuration: | No Obscuration; No Precipitation | | |
| Departure Point: | Ketchum, OK (1K8) | Type of Flight Plan Filed: | None |
| Destination: | Ketchum, OK (1K8) | Type of Clearance: | None |
| Departure Time: | 07:48 Local | Type of Airspace: | |

Airport Information

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|-----------------------------|-------------------------------|----------------------------------|----------------|
| Airport: | South Grand Lake Regional 1K8 | Runway Surface Type: | |
| Airport Elevation: | 782 ft msl | Runway Surface Condition: | Unknown |
| Runway Used: | | IFR Approach: | None |
| Runway Length/Width: | | VFR Approach/Landing: | Forced landing |

Wreckage and Impact Information

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|----------------------------|---------|-----------------------------|---------------------------|
| Crew Injuries: | 1 Minor | Aircraft Damage: | Substantial |
| Passenger Injuries: | | Aircraft Fire: | None |
| Ground Injuries: | N/A | Aircraft Explosion: | None |
| Total Injuries: | 1 Minor | Latitude, Longitude: | 36.549167,-95.000274(est) |

Administrative Information

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| Investigator In Charge (IIC): | Silliman, James |
| Additional Participating Persons: | Tim Wells; FAA Oklahoma City FSDO; Oklahoma City, OK Andy McMinn; Metalurgical Air Safety Investigations LLC; Norman, OK Thom Webster; Robinson Helicopters; Torrance, CA |
| Original Publish Date: | September 1, 2016 |
| Last Revision Date: | |
| Investigation Class: | Class |
| Note: | The NTSB did not travel to the scene of this accident. |
| Investigation Docket: | https://data.nts.gov/Docket?ProjectID=91856 |

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available [here](#).