Aviation Investigation Final Report

Location:	Las Vegas, Nevada	**Accident Number:**	WPR20FA013
Date & Time:	October 23, 2019, 15:53 Local	**Registration:**	N225JM
Aircraft:	Robinson R44	**Aircraft Damage:**	Substantial
Defining Event:	Unknown or undetermined	**Injuries:**	2 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot rented the helicopter to make a local personal flight. Radar data indicated that, after maneuvering around the area of a nearby national conservation, the helicopter flew along a road back toward the airport. The helicopter continued at an altitude between 500 to 700 ft above ground level (agl) for about 30 seconds then radar data ended 1 nautical mile from the accident site. A witness observed the helicopter impact the ravine adjacent to the road and break apart on impact. Ground scar analysis and wreckage fragmentation revealed that the helicopter collided with terrain in a tail-low attitude, consistent with the pilot performing an autorotation before impact.

Postaccident examination revealed evidence that the engine was running at the time of impact. The white exhaust signatures were consistent with lean operation. Examination of the engine compartment revealed that one magnet in the main rotor tachometer indicating system was separated from its housing from the yoke assembly; the other magnet assembly remained secured to the yoke assembly. The yoke assembly was not damaged, but there was evidence of slight damage to both senders, consistent with the magnet contacting the senders. With only one magnet installed, the main rotor tachometer rpm would indicate about 50% of the actual rotor rpm and the low rotor rpm horn would sound. It could not be determined if the magnet came free from the housing prior to impact. Examination of the magnet assembly revealed signatures consistent with compliance with a manufacturer service bulletin requiring the use of adhesive to secure the magnets.

The helicopter was refueled the morning of the accident, and the fuel was sumped by a pilot receiving instruction and a flight instructor. The fuel samples from the main fuel tank were dirty and they opted to cancel the flight and have a mechanic flush the tanks. The mechanic never flushed the tanks, but the flight instructor reportedly took more samples later in the day until they were clean. When the accident pilot arrived before the flight, he was told that the helicopter had completed maintenance and was informed that an earlier flight was canceled because a pilot had found sediment in the fuel tanks. The accident pilot's preflight actions could not be determined, but it is likely he would have sumped the tanks and found them to be clean, given that he was aware of an issue earlier in the day.

Investigators took samples of the liquid in the gascolator while at the accident site. The color was an orange-yellow and there was some debris in the bowl that displayed a gelatinous consistency; the screen was clear. The remainder of the fuel found in the system was free of contamination. An analysis of the fuel was consistent with that of normal aviation fuel with the presence of iron and brass consistent with that of corrosion. A further examination of the remaining fuel showed the presence of fillers in a polymeric material. The origin of the material found is unknown and the effect, if any, on the helicopter performance could not be determined.

The reason the pilot conducted an auto-rotation could not be determined. It is feasible that if the magnet from the rotor tachometer separated inflight, the pilot would hear the magnet contact the airframe, have the low-rotor warning horn sound, the main rotor tachometer rpm would display 50%, and in response he would perform an autorotation. This scenario could not be determined because of the damage incurred to the airframe during the accident sequence. Because there was evidence that the engine was running at the time of impact, it could also not be determined if the fuel contributed to an inflight event that resulted in the pilot's decision to make an autorotation.

Probable Cause and Findings

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

An undetermined inflight event that resulted in the pilot performing an autorotation to uneven terrain for reasons that could not be determined due to the extent of impact damage.

Findings

Not determined	(general) - Unknown/Not determined

Factual Information

History of Flight

Maneuvering-low-alt flying	Unknown or undetermined (Defining event)

On October 23, 2019, at 1553 mountain standard time, a Robinson R44 II Raven, N225JM, was substantially damaged when it was involved in an accident near Las Vegas, Nevada. The airline transport pilot and passenger were fatally injured. The helicopter was operated as a Title 14 *Code of Federal Regulations* (CFR) Part 91 personal flight.

The pilot contacted the fixed based operator (FBO) that rented the helicopter in the early afternoon on the day of the accident and asked office personnel if the helicopter was available to rent later that afternoon. One of the schedulers responded that the helicopter was undergoing maintenance, and the pilot stated that he would stop by the office anyway to check if the maintenance was done and put money on his account. The pilot and passenger arrived about 10 minutes later. The pilot asked why the helicopter was in maintenance and the office personnel told him that an earlier flight was canceled because that pilot had found sediment in the fuel tanks. The accident pilot stated that he was happy to wait, and about 20 minutes later, the flight instructor who had canceled the earlier flight called, stating that the maintenance was done, and the helicopter was ready to fly. The pilot and passenger planned to take a 1-hour flight. (see figure 1.)

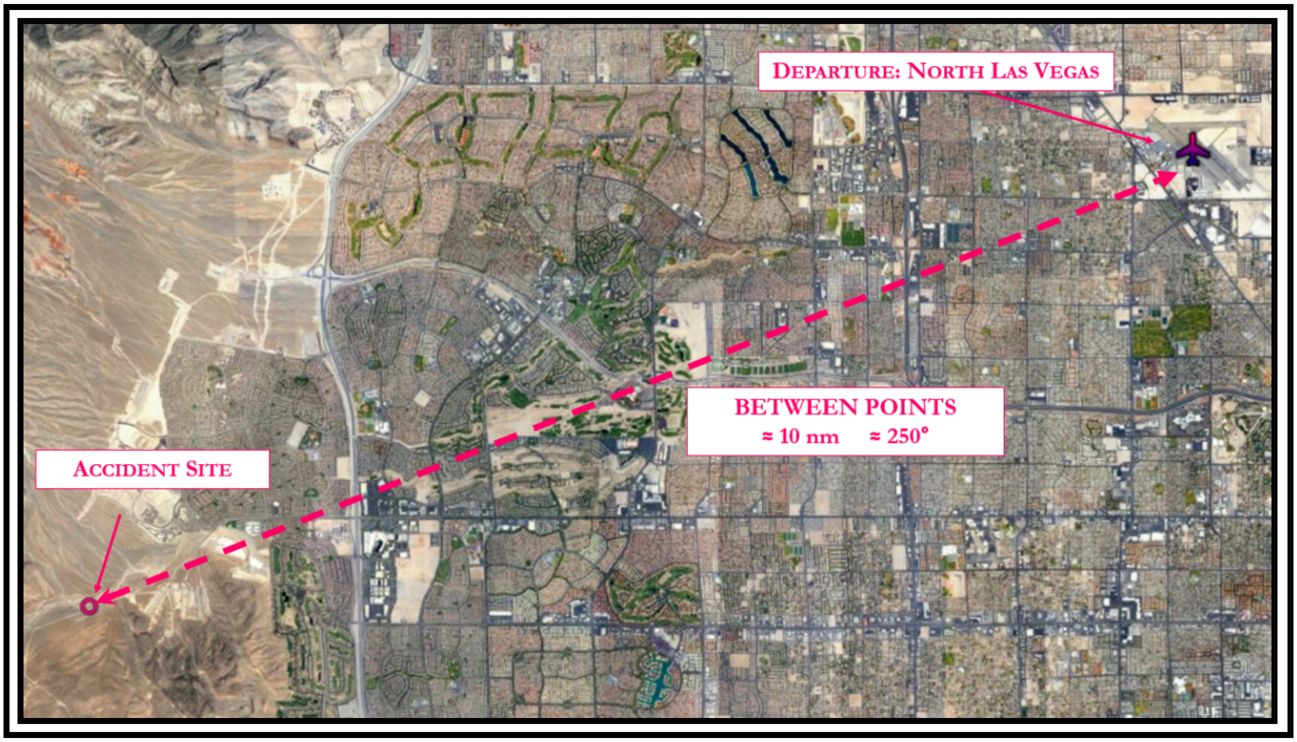


Figure 1: Airport to Accident Site

A witness, who was also a pilot, stated that while riding his motorcycle, he initially saw the helicopter in the upper right-corner of his vision at an estimated 100 to 200 feet above ground level (agl) in a nose-up attitude and in a very steep descent angle heading opposite his direction of travel. He estimated that the helicopter was moving about the same speed as the traffic (about 50 mph). He witnessed the helicopter impact the ravine adjacent to the road (about 200 ft ahead of him and 100 ft to the right) and break apart on impact.

A review of radar flight track data indicated that the helicopter departed and continued west-southwest toward the Red Rock Retention Basin checkpoint. After clearing the Class Bravo airspace, the returns showed a left 360° orbit over Blue Diamond Road, consistent with the pilot circling over a remote control (RC) airpark and the Desert Sportsman's Rifle Club. Thereafter, the track was consistent with the pilot loosely following the road around Calico Basin and climbing up to 4,700 ft mean sea level (msl), about 400 ft agl. The helicopter then made a left turn and serval maneuvers over the Red Rock National Conservation Area washes, including a possible touchdown, during which the forward airspeed speed was reduced to 0 kts. After performing serval low-level maneuvers, the track was consistent with the helicopter following Blue Diamond Road toward the north-northeast. The last radar return was at 1553:23 about 1 nautical mile (nm) west-southwest of the accident site. The last 30 seconds of the track data indicated an airspeed of about 100 to 120 kts at an altitude between 500 to 700 ft agl. (see figure 2 below.)

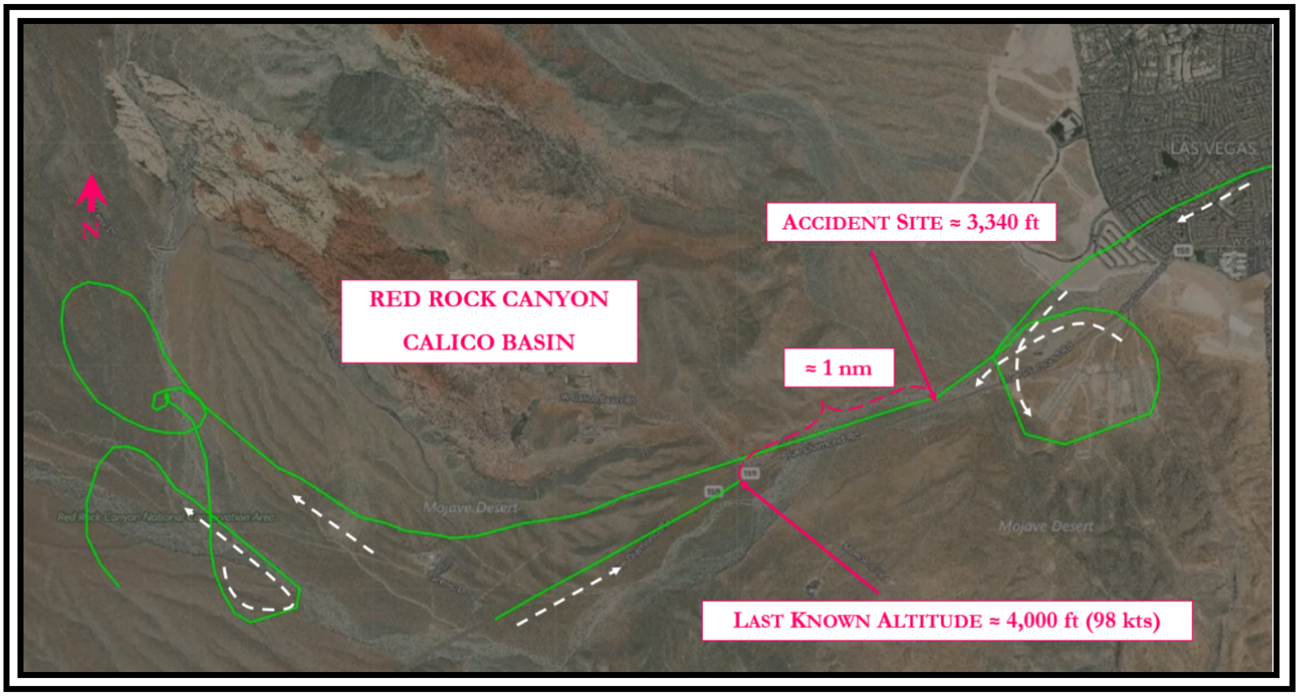


Figure 2: Radar Track Data

Pilot Information

Certificate:	Airline transport; Flight instructor	**Age:**	53,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	January 2, 2019
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 15000 hours (Total, all aircraft), 12 hours (Total, this make and model)		

The pilot held an airline transport pilot certificate with a rating for airplane multiengine land, and commercial privileges for airplane single-engine land and rotorcraft-helicopter. According to information compiled from Federal Aviation Administration (FAA) records, as of the date of the accident, he had approximately 15,000 total hours of flight experience.

The pilot’s rotorcraft logbook indicated that the pilot began flying helicopters in 2013 with a majority of his earlier experience acquired in a Schweizer helicopter. His last flight was recorded on March 3, 2019, during which he received a 0.9-hour checkout in an R44, including practice autorotations, low rotor rpm recovery, and settling with power. The flight included 6 daytime landings and occurred 234 days before the accident flight. The pilot’s total rotorcraft experience was 352.1 hours, of which 8 flights were in the R44 helicopter, totaling 12.3 hours. The logbook indicated that he had flown the accident helicopter once before on February 8, 2019, for 1.5 hours during which he flew from North Las Vegas to Henderson, Nevada, and back; there were no other recorded helicopter flights from North Las Vegas.

A logbook endorsement dated July 2016 stated that the pilot had completed the awareness training in accordance with paragraphs "(b)(2)(ii)(a-d) " of Section 2 of Special Federal Aviation Regulation (SFAR) No. 73. The currency requirements provided in the SFAR state that no person may act as pilot-in-command of an R44 helicopter carrying passengers unless the pilot in command has met the recency of flight experience requirements of §61.57 in an R44. In pertinent part, § 61.57 (a)(1) states that “Except as provided in paragraph (e) of this section, no person may act as a pilot in command of an aircraft carrying passengers … unless that person has made at least three takeoffs and three landings within the preceding 90 days and -(i) The person acted as the sole manipulator of the flight controls; and(ii) The required takeoffs and landings were performed in an aircraft of the same category, class, and type (if a type rating is required)…” The exceptions did not pertain to the accident flight because the pilot was not conducting the flight operation under a part 119 certificate holder.

Aircraft and Owner/Operator Information

Aircraft Make:	Robinson	**Registration:**	N225JM
Model/Series:	R44 II	**Aircraft Category:**	Helicopter
Year of Manufacture:	2005	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	10954
Landing Gear Type:	N/A; Skid	**Seats:**	
Date/Type of Last Inspection:	September 28, 2019 100 hour	**Certified Max Gross Wt.:**	2500 lbs
Time Since Last Inspection:	87 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	3231 Hrs at time of accident	**Engine Manufacturer:**	Lycoming
ELT:	Installed	**Engine Model/Series:**	IO-540-AE1A5
Registered Owner:	Binner Enterprises LLC	**Rated Power:**	235 Horsepower
Operator:	Airwork Las Vegas	**Operating Certificate(s) Held:**	None

The Robinson R44 Raven II helicopter was manufactured in 2005 and was equipped with its original Lycoming IO-540-AE1A5 engine. The tachometer time at the accident site was 3,231.3 hours. According to inspection and maintenance records, the last 50-hour engine inspection was completed on October 08, 2019, at a tachometer time of 3,195.4 hours, 35.9 hours before the accident; the last 100-hour airframe inspection was completed on September 28, 2019, at a total time of 3,144.5 hours.

Governor and Tachometer System

The collective control for the accident helicopter was conventional and included a twist grip throttle. When the collective control is moved upward, the engine throttle is opened automatically by an interconnecting linkage. The helicopter was equipped with an engine governor system, which sensed engine rpm and applied corrective input forces to the throttle to maintain engine rpm as needed.

The governor system comprised a solid-state electronic controller, which determined engine rpm from the tachometer points in the engine's right magneto. When the governor sensed the need to adjust engine rpm, it activated a motor which drove the throttle directly. The governor system was designed to assist the pilot in controlling the rpm in the normal operating range. It may not prevent over- or under-speed conditions generated by aggressive flight maneuvers.

The helicopter was equipped with one electronic dual (engine and rotor) tachometer. The sensor for the engine tachometer is the same set of magneto breaker points used by the governor. The sensor for the rotor tachometer is an electronic Hall effect device, which senses passage of two magnets attached to the main rotor gearbox input yoke assembly. (see figures 3 and 4 below.) Robinson personnel reported that, with only one magnet installed, the main rotor tachometer rpm would indicate about 50% of the actual rotor rpm and the low-rotor rpm horn would sound. The normal rotor/engine rpm is 102% on the tachometer and the lowest numeric marking is “50,” with two graduated lines beneath.

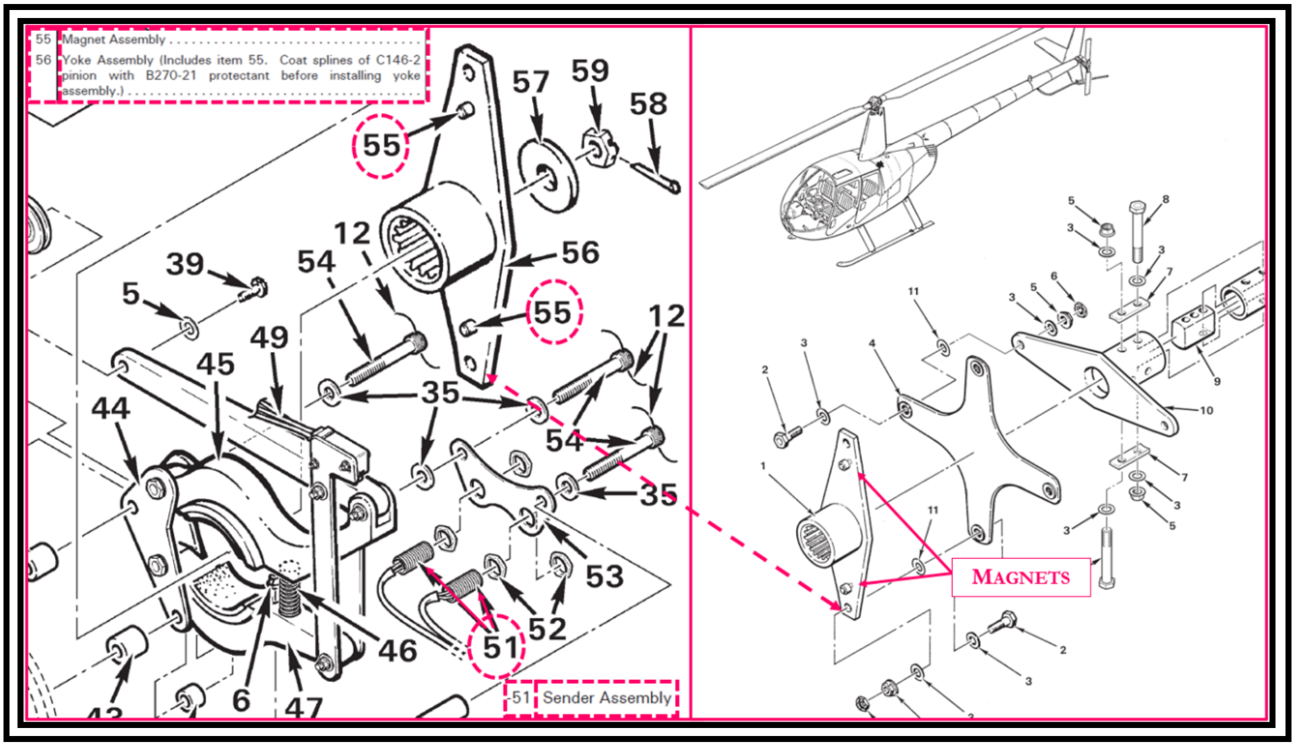
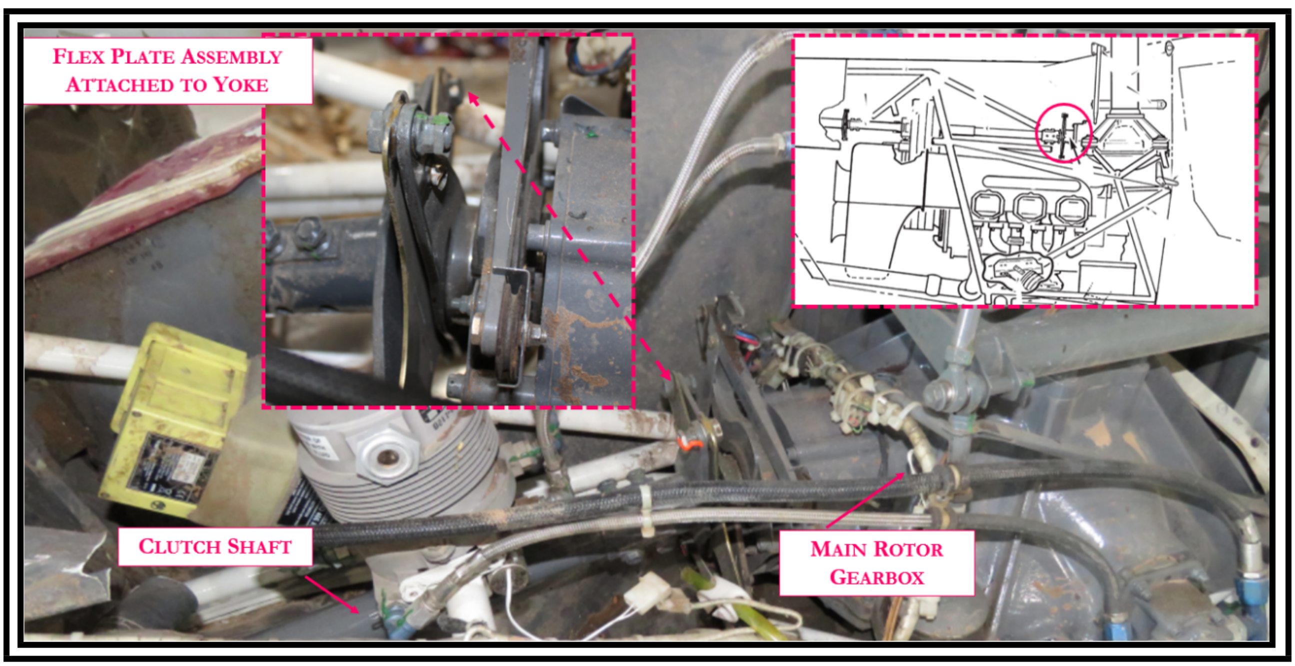


Figure 3: Rotor Tachometer Assembly



Picture 4: Location of Rotor Tachometer Assembly

Low Rotor RPM Recovery Procedure

According to the R44 Pilot's Operating Handbook (POH), the recommended procedure to recover from a low rotor rpm warning condition (warning horn and caution light) was as follows: To restore rpm, lower collective, roll throttle on and, in forward flight, apply aft cyclic. According to Robinson, lowering the collective lever will reduce the power required by the rotors to aid the recovery of rotor rpm; however, in the R44 helicopter, the correlator will decrease the throttle when the collective is lowered and reduce engine rpm (by a few percent) unless the pilot or rpm governor system rotates the twist grip to roll throttle on.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KVGT,2203 ft msl	**Distance from Accident Site:**	10 Nautical Miles
Observation Time:	22:53 Local	**Direction from Accident Site:**	66°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	11 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	80°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.97 inches Hg	**Temperature/Dew Point:**	28°C / -6°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Las Vegas, NV (VGT)	**Type of Flight Plan Filed:**	None
Destination:	Las Vegas, NV (VGT)	**Type of Clearance:**	None
Departure Time:	15:35 Local	**Type of Airspace:**	

Airport Information

Airport:	North Las Vegas VGT	**Runway Surface Type:**	
Airport Elevation:	2205 ft msl	**Runway Surface Condition:**	Dry;Rough;Soft
Runway Used:		**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Fatal	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	36.146945,-115.381668

The accident site was located in desert terrain about 10 nm from the departure airport on a bearing of 250°. The wreckage was found distributed in a ravine over a 200-ft distance on a median magnetic heading of about 070°. The ravine and debris field ran parallel to the road and was located about 4 to 5 ft below the pavement. The first identified area of impact was an approximate 5-inch line (oriented parallel to the road) of scraping and maroon-colored paint transfer across a rock and orange torque stripe buried in the dirt before the rock. Adjacent to that line was another parallel line of paint transfer that was red in color. The orientation and colors were consistent with the tail rotor guard and tailskid making contact first, indicative of a nose-high attitude at the time of impact.

Airframe and Engine

The mixture control was in the full-rich position. The collective was in a full-up position and the collective friction bolt center was at the top of the slider slot. The pilot’s throttle twist grip was in a position close to full off (idle). Examination of the control systems revealed no evidence of pre-impact mechanical malfunction or failure that would have precluded normal operation.

Rotational signatures on the aft surface of the engine cooling fan, starter ring gear and oil cooler, alternator, and the belt tension actuator vertical tube surfaces were consistent with the engine producing power at the time of impact.

An external visual examination of the engine revealed crush damage to the bottom of the crankcase, with the majority of damage to the oil pan. The spark plugs were removed. No mechanical damage was noted and the electrodes and posts exhibited a light, white ash coloration, which according to the Lycoming representative, was consistent with very lean operation(s).

The crankshaft was rotated by hand utilizing the ring gear. The crankshaft rotated freely and easily in both directions. "Thumb" compression was observed in proper order on all six cylinders. The valve train operated in proper order, and appeared free of any pre-mishap mechanical malfunction. Uniform lifting action was observed at each rocker assembly. Clean, uncontaminated oil was observed at all six rocker box areas. Mechanical continuity was established throughout the rotating group, valve train, and accessory section during hand rotation of the crankshaft.

The cylinder combustion chambers were examined through the spark plug holes using a lighted borescope. The combustion chambers remained mechanically undamaged, and there was no evidence of foreign object ingestion. The valves were intact and undamaged. There was no evidence of valve-to-piston-face contact. The piston faces all displayed a whitish coloration and the valve faces were white and orange, consistent with a lean operation. White residue/soot was seen throughout the remainder of the exhaust system. The sides of the piston heads were dark black in color and the rings displayed dark discoloration.

The ignition harnesses from both magnetos to their respective spark plugs remained intact. The magnetos were secured to their respective mounting pads. The right magneto was timed at 20°; the left magneto was at 18°. Removal of the right magneto revealed that the bearing cage had broken; the broken piece was found in the oil sump. The magnetos were put on a test bench; the left magneto operated normally and the right magneto vibrated, but operated normally with even spark at each post. Both magnetos were rotated by hand and moved freely. It could not be determined the amount of vibration the engine would have been subjected to as a result of the magneto bearing cage being broken.

Rotor Tachometer System

Examination of the engine compartment revealed that one magnet from the main rotor tachometer indicating system was separated from its housing on the yoke assembly; the magnet was located on the fuselage frame near the firewall. Both the housings showed a color consistent with a dark residue and a yellow/orange mark was on both housings and senders. (see figure 5 below.) The yoke assembly was not damaged.

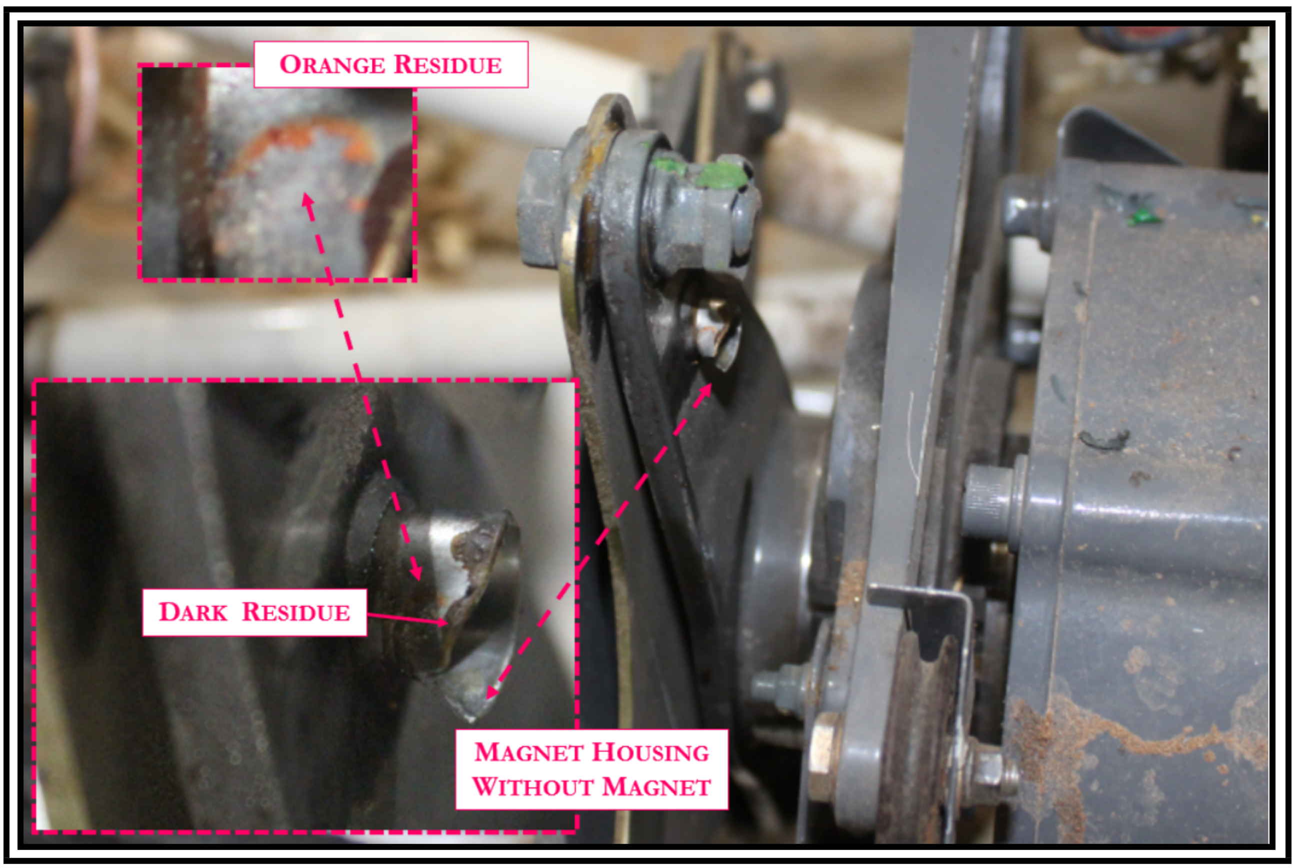


Figure 5: Magnet Housing on Yoke Assembly

The National Transportation Safety Board Materials Laboratory completed an examination of the yoke, magnet assembly, and senders. Examination of the damaged magnet housing revealed that the deformation and fracture to the magnet housing was not consistent with that of impact directly with the magnet housing body. The fractured side exhibited deformation consistent with an object pushing from the inside of the housing radially outwards through the cylindrical wall. The intact side of the magnet housing did not exhibit deformation or contain any witness marks consistent with a strike. Deformation was also observed in the magnet housing perpendicular to its direction of motion, consistent with an internal force pushing through the magnet housing side wall.

There was orange residue in a shape consistent with a circular outline on the exterior of the magnet housing's cylindrical wall. (see figures 6 and 7 below.) There were additional areas on the open end of the magnet housing's cylindrical wall and on the yoke body where a brownish/amber colored residue was present. The residue had a brittle response when scraped with a tool and was sent for analysis. There were areas of plastic deformation resembling a smearing-like movement of material further inside the interior of the cylindrical wall.

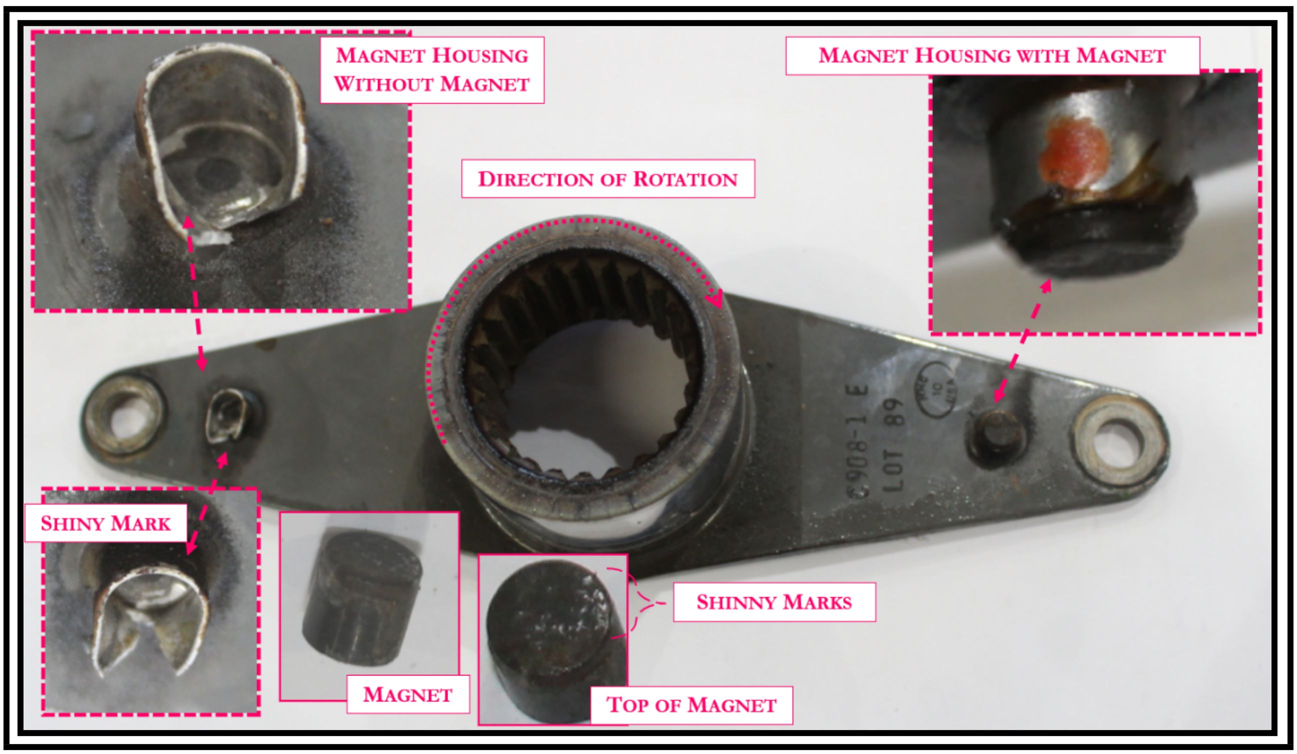


Figure 6: Magnet Assemblies on the Yoke

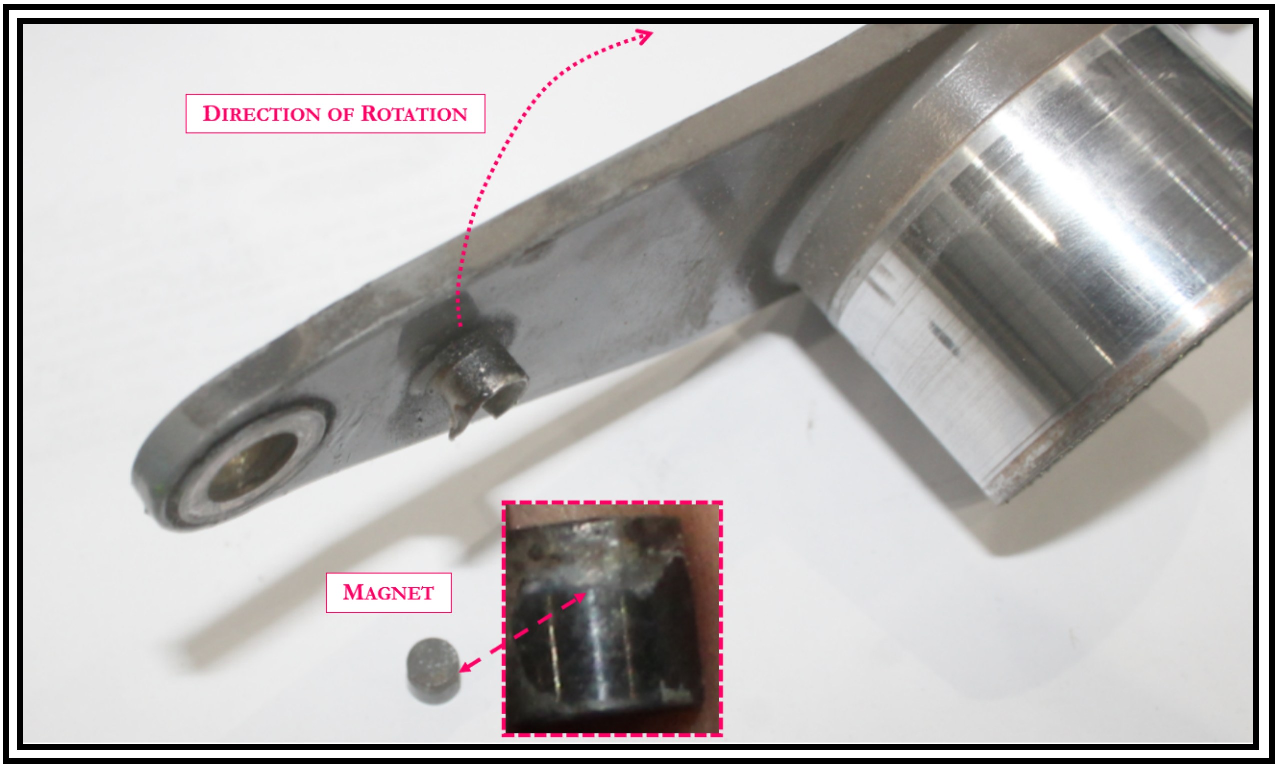


Figure 7: Magnet Housing

The Hall effect sensors exhibited some witness marks consistent with contact with a moving object. These contact marks exhibited plastic deformation in a direction consistent with the intended movement between the magnets and the faces of the Hall effect sensors. (see figure 8 below.) The contact damage extended 0.025 down from the face of the sensor.

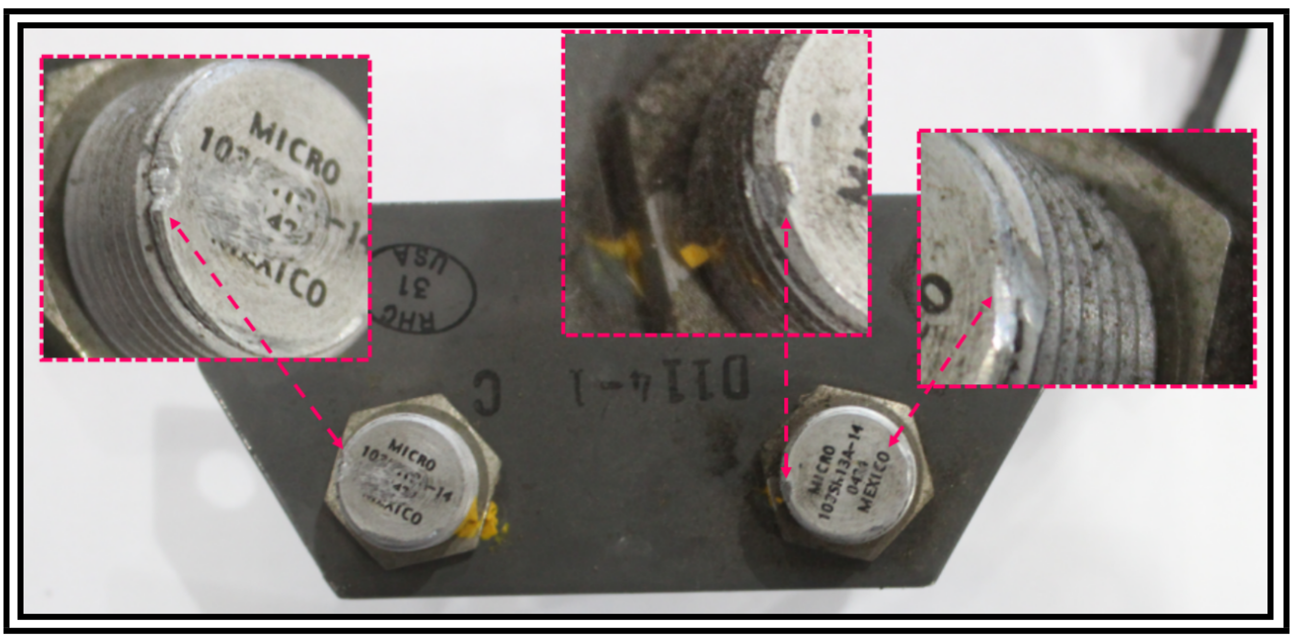


Figure 8: Sensor Damage

Robinson issued a Service Bulletin in 2013 (SB-86) for securing the magnets into the housing, requiring the use of Loctite® 271 adhesive. Samples of the brown residue was gathered by the NTSB Materials Laboratory for comparison to a sample of uncured Loctite® 271. Despite not being a match, the differences in spectrum of the unknown material were likely a result of curing and aging/degradation of the material, particularly the loss of spectral peak intensity. A sample was additionally compared to a Robinson-provided exemplar magnet housing with dried adhesive. This residue on the accident part was either a similar material or a degraded sample of the exemplar material. A spectral library search was done on the accident spectrum and no other strong match was found.

The material found on the outside of the exemplar fitting was a strong match for the uncured Loctite sample. The uncured sample recovered from the outside of the exemplar fitting differed from the cured exemplar sample consistent with the significant change the Loctite material underwent during curing.

The orange material on the surface appeared to be paint, consistent with the Service Bulletin requirement that a mechanic place a yellow marker displaying that the Service Bulletin to add the adhesive was completed.

Tests and Research

Fueling Information

The operator of the helicopter instructed pilots to receive fuel at North Las Vegas and owned a 750-gallon truck that served fuel to three businesses.

According to the records provided by the fuelers, the accident helicopter was fueled twice the day before the accident; once at 1138 with 11.6 gallons and once at 1540 with 16.8 gallons. The pilot receiving instruction on both of those flights stated that the fuel was clean of debris and the helicopter functioned normally after refueling. The records further indicated that, about 1830, the truck refueled with 479 gallons of 100LL aviation fuel. Almost immediately after the refueling, the fuel truck then refueled a Cessna 172 with 6.5 gallons. The student and pilot that flew the airplane after that fueling stated that the fuel was clean, and they had no problems on their cross-country flight.

The accident helicopter was the first aircraft to be fueled in the morning of the accident. According to the fueler, he arrived at the office around 0700 and performed the normal procedure of draining the truck, which included 0.5 gallons of fuel from the lower sump and 0.5

gallons from the filtered hose. He drained both into a white porcelain bucket and noted that both were clean of contaminants. An instructor from the accident operator called for fuel, and at 0825, the accident helicopter was fueled with 23.6 gallons, filling both the auxiliary and main fuel tanks to capacity. Shortly thereafter, another Cessna 172 received 13.3 gallons, and the pilots of that airplane reported no anomalies with the fuel or their flight.

The pilot receiving instruction scheduled with the instructor for the morning of the accident stated that, after getting fuel, he began performing the preflight with the instructor watching behind him. He retrieved the GATS jar fuel tester from under the right rear seat and proceeded to sump the auxiliary fuel tank. The sample looked clean and he sumped the main tank. The fuel appeared dirty with floating black and gray specks (similar in appearance to sand). He showed the instructor, who poured out the sample on the concrete and suggested that they take another sample. After taking two more samples with the same results, the instructor volunteered to clean the jar, thinking that perhaps it was dirty. He additionally found a 5-gallon bucket and dumped the fuel samples into it, which totaled about 6 to 7 samples. The pilot receiving instruction elected to cancel the flight due to the contaminated fuel samples. The instructor then informed the operator's mechanic of the samples, but the mechanic stated that he was working on several airplanes and would not be able to look at the fuel system until that afternoon.

The mechanic stated that that he did not have an opportunity to flush the fuel tanks in the accident helicopter. Later in the day, the instructor relayed to the pilot receiving instruction that the mechanic had not had the opportunity to work on the helicopter, and the pilot decided to cancel the scheduled afternoon flight. The accident pilot was then scheduled to fly the helicopter.

The instructor stated that, after they sumped the fuel in the morning, he returned to the helicopter several hours later to check on the mechanic's progress. He noted that the helicopter was on the list to be inspected, but had yet to undergo maintenance. He drained about one quart of fuel from the helicopter, with the first samples containing fine black, brown, and red grains. With each sample, the fuel became more and more clear, and the final three samples were clean.

Fuel Examination

Fuel samples were collected from the gascolator at the accident site. The bowl was full with a liquid consistent in odor and appearance with that of 100LL aviation fuel while at the site. The screen was clean of debris. The following day, the same samples were observed to be an orange-yellow color with some debris in the bowl that displayed a gelatinous consistency. (see figure 9 below.) During the post-accident examination, investigators reinstalled the gascolator bowl and removed engine baffling for examination purposes. The electric fuel pump was connected to an external power source and the line from the pressure relief valve was disconnected, routing it into a clean bucket. Upon the pump being energized, fuel flowed freely from the line; the fuel displayed a green hue and was free from contaminants.

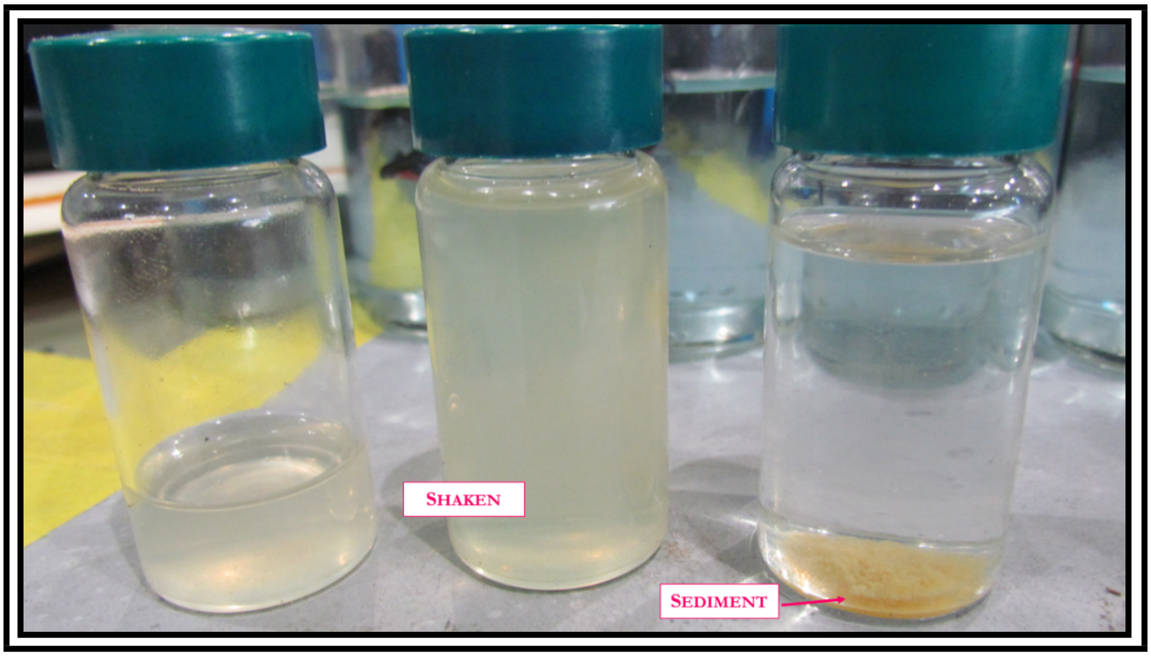


Figure 9: Fuel from Gascolator

Investigators removed the fuel injector lines from their respective cylinders and examined each injector; the injectors were free of particulates. The injectors were reinstalled and glass bottles were placed under each one. The pump was again activated and fuel flowed to each jar; the fuel was blue and clear of contaminants.

The auxiliary fuel tank was cut open and the bladder was pliable and in good condition. There were numerous small, non-ferrous flakes in the remaining fuel. The screen was clean and the restrictor in the interconnect line was free from debris. The examination of the remainder of the fuel system revealed no evidence of mechanical malfunction or failure.

The fuel was sent to a private laboratory for examination. The analysis produced a normal distillation curve and carbon numbers for aviation fuel. In pertinent part, the fuel and the dried residues showed the presence of similar amounts of lead (TEL), iron and zinc-copper (brass) and bromine. The iron and brass were consistent with that of corrosion. A further examination of the remaining fuel showed the presence of low concentrations of glass fibers, Titania particles, and a calcium compound, consistent with fillers in a polymeric material.

Additional Information

Previous Events

A Robinson Helicopter Company representative reported that instances of a magnet separating from a magnet assembly prompted issuance of Service Bulletin (SB) 86, which required an adhesive be applied between the magnet and the magnet housing and a yellow dot placed on the magnet housing. The accident helicopter’s records did not contain entries related to the SB, but yellow/orange dots were found on the magnet assemblies, suggesting compliance with the SB.

A review of the NTSB database revealed two accidents that cited the magnet separation in the probable cause.

ERA17LA163 - April 2017

The pilot stated that he was descending when he heard and felt a loud "pop" that was accompanied by a yaw to the right, shaking and vibration, with engine roughness. At that time the rotor tachometer had, "dropped to zero", while the engine tachometer was "at about 60-70%." He immediately entered an autorotative descent to a median between two roads and landed hard.

Postaccident examination of the engine compartment revealed one magnet in the main rotor tachometer indicating system was separated with its housing from the yoke assembly; the other magnet assembly remained secured to the yoke assembly. The yoke assembly was not damaged, but there was evidence of slight damage to one sender assembly, consistent with the magnet assembly separation.

The probable cause was cited as a partial failure of the helicopter's rotor tachometer due to the separation of one of the magnet assemblies and engine roughness, which precipitated the pilot's initiation of an off-airport autorotation, during which he applied improper aft cyclic flight control input, which was contrary to the Pilot's Operating Handbook. The reason for the reported engine roughness could not be determined during postaccident examination and engine test-runs.

CEN13LA194 - March 2013

The pilots were en route when they heard a loud “bang,” followed immediately by the low rotor rpm horn, a warning light illumination, and a rapid decrease in rotor rpm indication. In response, the instructor initiated an autorotation by lowering the collective, and the engine immediately lost power. The helicopter touched down and then rocked forward due to soft and downward-sloping terrain. A post accident examination revealed that one magnet in the main rotor tachometer indicating system was separated from its housing on the yoke assembly; the other magnet assembly remained secured to the yoke assembly. Deformation was found on one of the sensors opposite the magnet, indicating that the magnet had contacted the sensor see Figure 10 below). The separation of the magnet caused the rotor rpm indication to drop and the low rotor rpm warning horn and light to activate. Due to the control linkage between the collective and the throttle, when the instructor lowered the collective, the throttle closed rapidly.

According to Robinson Helicopters, the control linkage between the collective and the throttle (the correlator) will close the throttle when the collective is lowered, resulting in an engine rpm change of only a few percent. When a pilot rapidly rolls the throttle to idle, this can result in a fuel-air ratio becoming too rich or too lean to sustain engine operation and result in an engine failure. Robinson representatives further stated that the pilot would need to roll off the throttle with the twist grip to cause enough of a change to potentially cause the engine to quit, and this is only likely to happen at high altitudes.

The probable cause was cited as a total loss of engine power due to a rapid throttle change during autorotation, which the flight instructor initiated in response to a low rotor rpm warning, which resulted from the separation of one of the magnets used to provide rotor rpm indications from the rotating transmission yoke. Contributing to the accident was the flight instructor's aft cyclic input upon landing. As a result of the event, Robinson issued Service Bulletin 86.

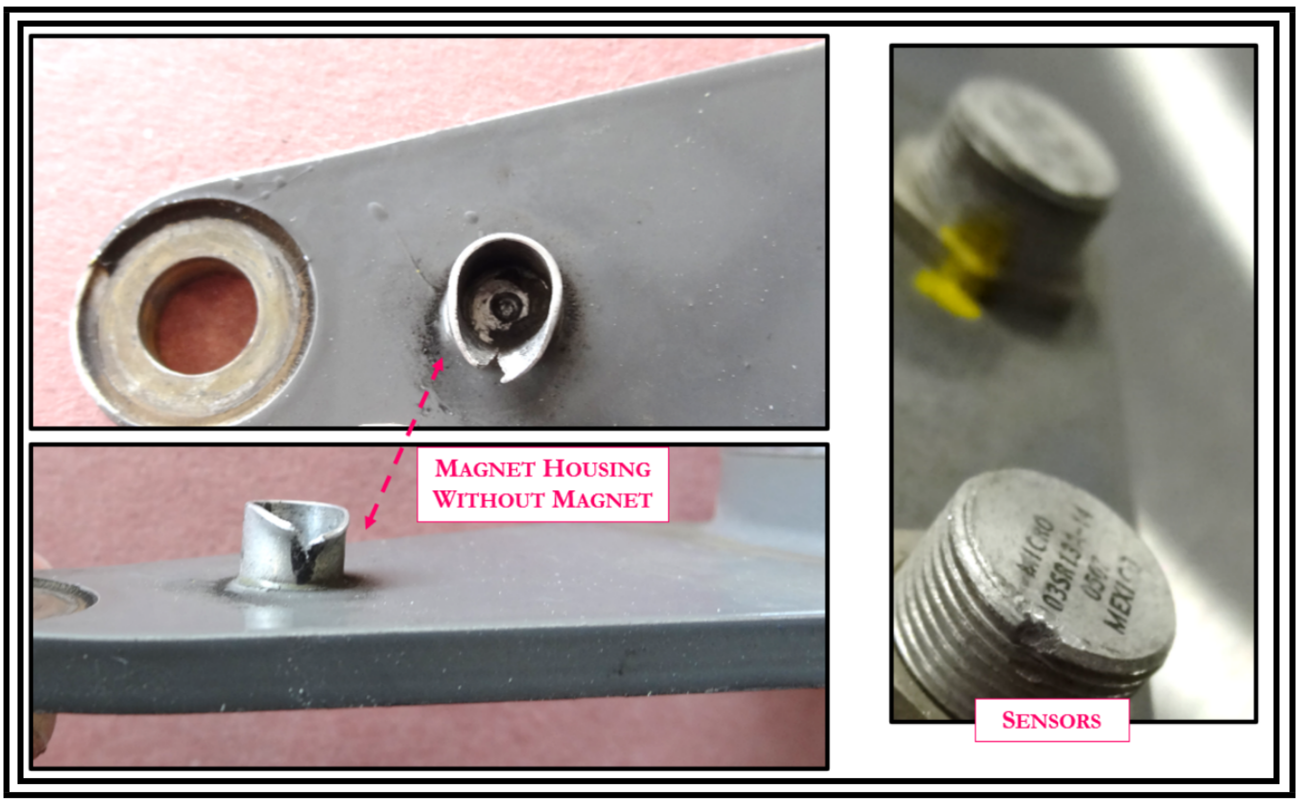


Figure 10: Magnet Housing and Sensor from Accident CEN13LA194

Administrative Information

Investigator In Charge (IIC):	Keliher, Zoe
Additional Participating Persons:	Rich Ramirez; Federal Aviation Administration; Las Vegas, NV Troy Helgeson; Lycoming Engines; Williamsport, PA Ken Martin; Robinson Helicopter Company; Torrance, CA
Original Publish Date:	January 24, 2023
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=100481