

INVESTIGATION SUPPORT MATERIAL SUPPLEMENT

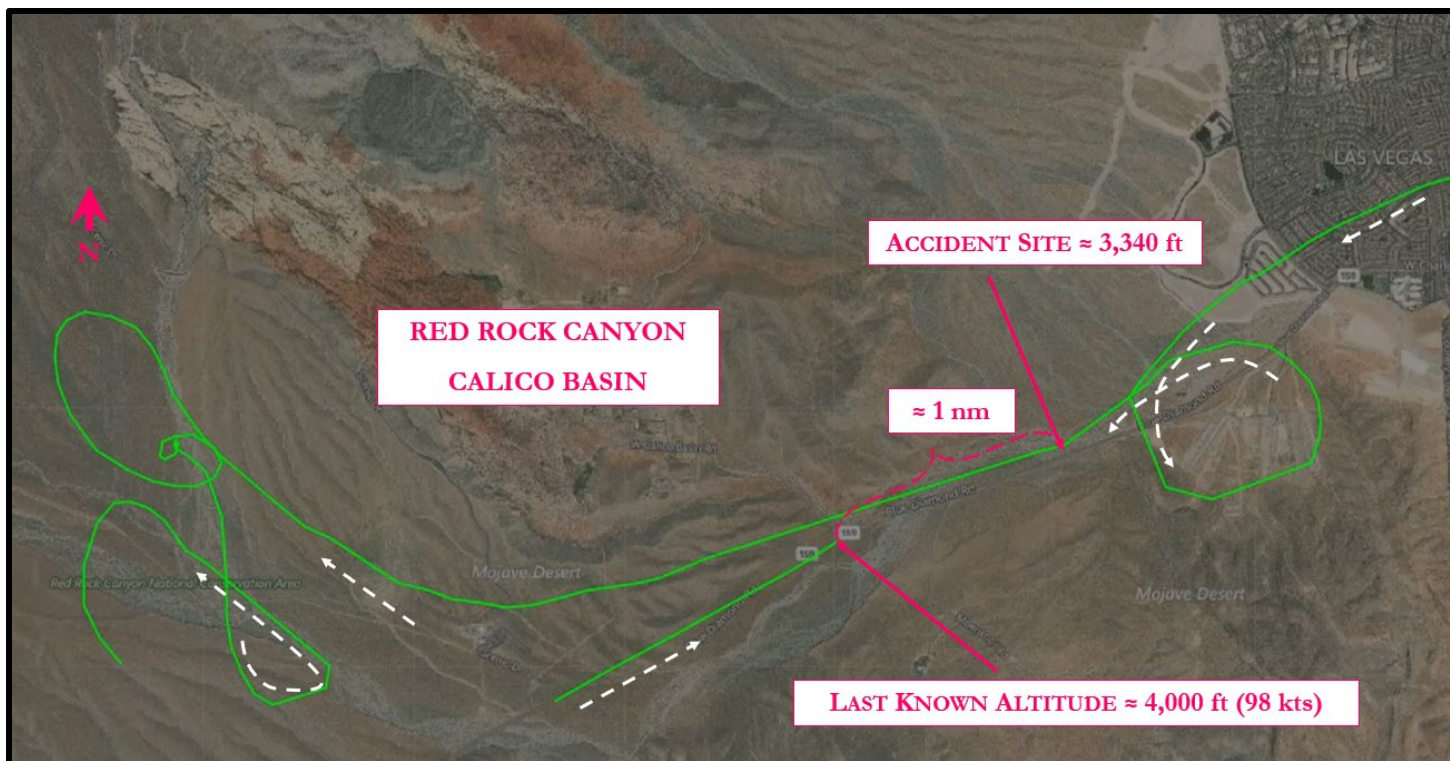
HISTORY OF FLIGHT

On October 23, 2019, at 1553 mountain standard time, a Robinson R44 II Raven, N225JM, sustained substantial damage after impacting terrain following an auto-rotation in Las Vegas, Nevada. Binner Enterprises LLC, owned the helicopter and Airwork Las Vegas was operating the helicopter under the provisions of 14 *Code of Federal Regulations* (CFR) Part 91. The airline transport pilot and passenger survived the impact, but later succumbed to their injuries. The personal local flight departed from North Las Vegas Airport, Las Vegas, Nevada, about 1535. Visual meteorological conditions prevailed and no flight plan had been filed.

The pilot had called Airworks, the fixed based operator (FBO) that rented the helicopter, in the early afternoon on the day of the accident. During the call he asked the office personnel if the R-44 was available to rent 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 certified flight instructor (CFI) that had canceled that earlier flight called stating that the maintenance was done and the helicopter was ready to fly. The pilot and passenger planned to take an hour flight since they needed to return the helicopter back to the FBO for a tour scheduled at 1900.

A witness, who was additionally a pilot, stated that he observed the helicopter while riding a motorcycle southbound on Blue Diamond rd. He witnessed the helicopter about 1 to 2 seconds before impact and the accident sequence. He initially saw the helicopter in the upper right-corner of his vision at an estimated 100 to 200 feet agl in a nose-up attitude and in a very steep descent angle heading opposite in his direction of travel. He estimated the helicopter was moving about the same speed as the traffic (about 50 mph), because the closure rate seemed similar to the northbound automobiles. He witnessed the helicopter impact the ravine adjacent to the road (about 200 feet ahead of him and 100 feet to the right) and break apart on impact.

A review of the preliminary radar track data indicated that after departure, the helicopter departed and continued west-southwest toward the Red Rock Retention Basin checkpoint. After the track cleared the Class Bravo airspace the returns showed a left 360° orbit over Blue Diamond rd., consistent with the pilot circling over a remote control (RC) airpark and the Desert Sportsman's Rifle Club. Thereafter the radar showed a track consistent with the helicopter loosely following the road around Calico Basin and climbing up to 4,700 feet mean seal level (msl), equivalent to about 400 feet above ground level (agl). The helicopter then made a left turn and several maneuvers over the Red Rock National Conservation Area washes including a possible touchdown where the forward airspeed speed was reduced to 0 kts. After making several low-level maneuvers, the track was consistent with the helicopter adjoining Blue Diamond rd. and following the road heading north-northeast. The last radar hit was at 1553:23 and located on the road about 1 nautical mile (nm) west-southwest from the accident site. The last 30 seconds of the track revealed the helicopter was following the road with an airspeed of about 120 to 100 kts at an altitude between 500 to 700 feet agl.



Picture 01: Radar Track Data

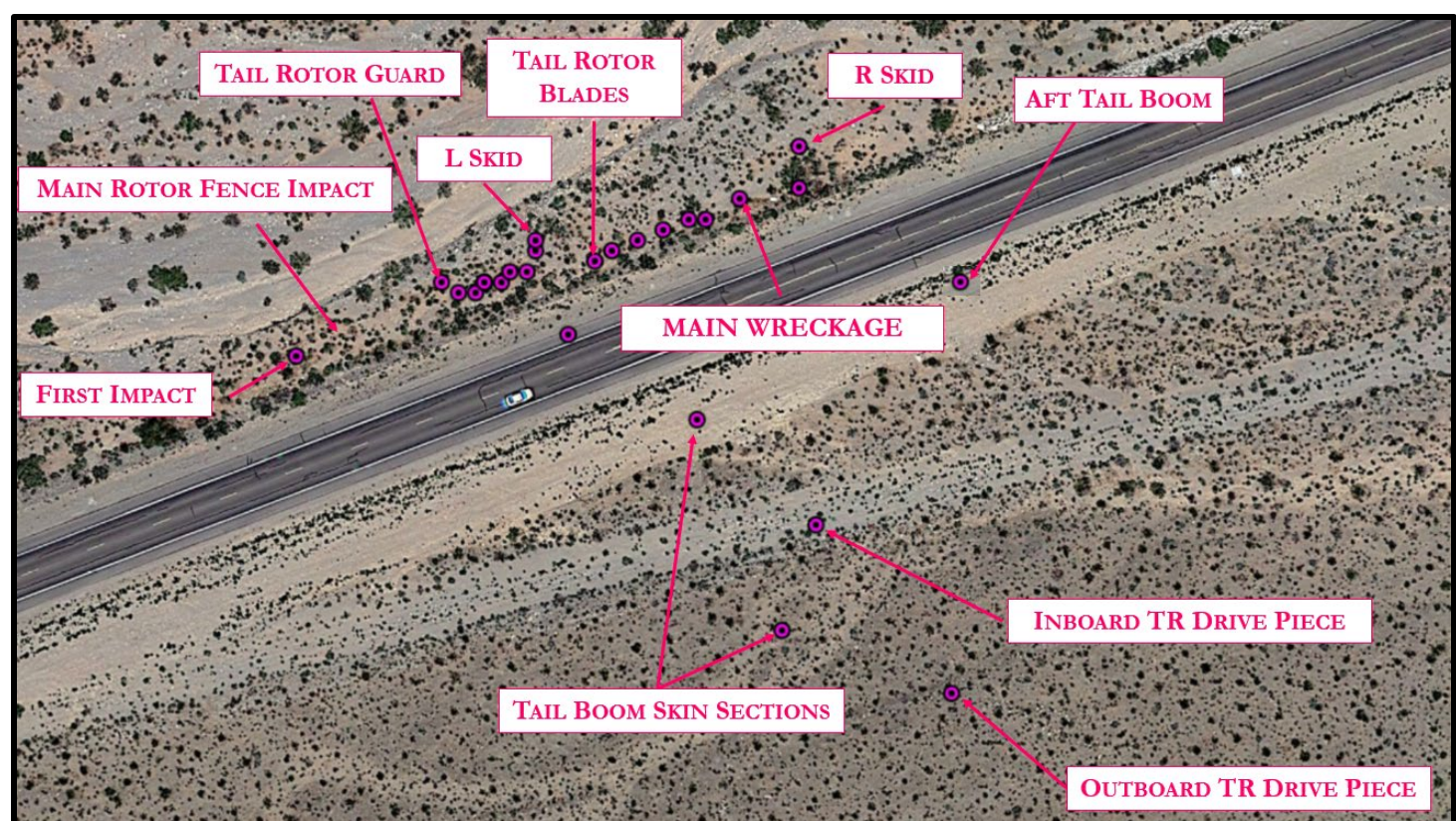


Picture 02: Wreckage in Relation to Surrounding Landmarks

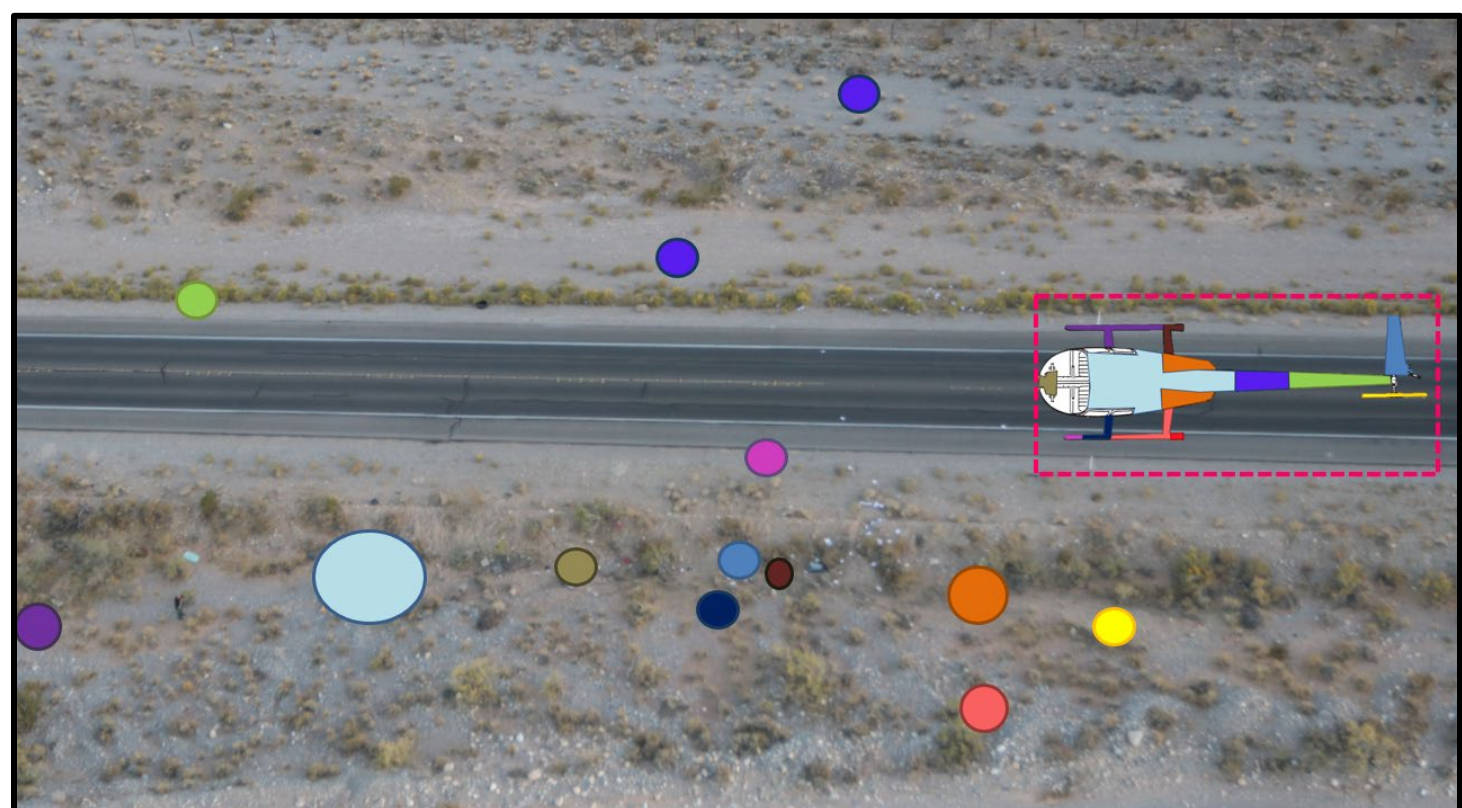
WRECKAGE AND IMPACT

The accident site was located in the 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 foot distance on a median magnetic bearing of about 070° . The ravine and debris field ran parallel to the road and was located about 4-5 feet below the pavement. The first identified area of impact was a

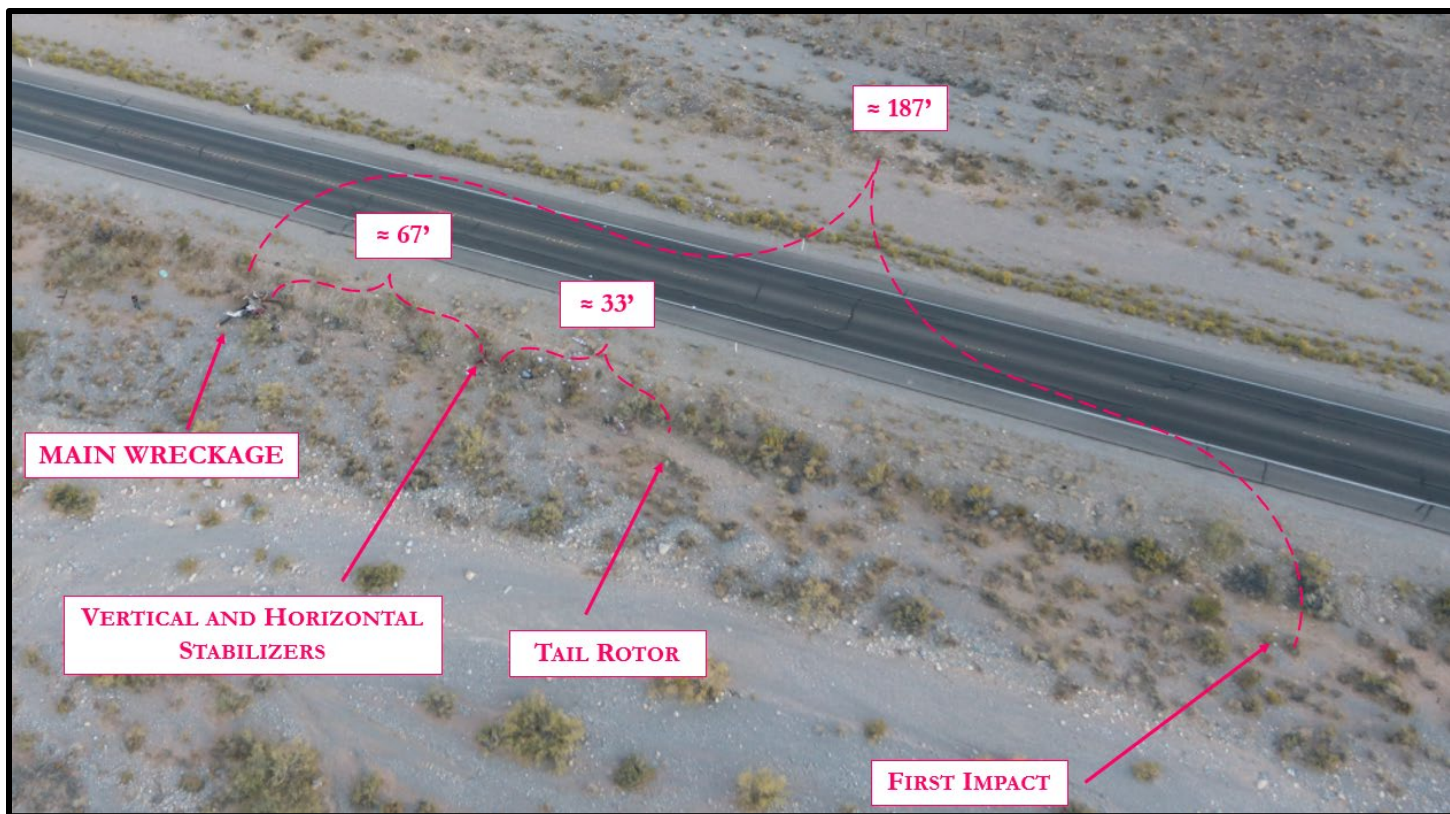
approximate 5 inch line (oriented parallel to the road) of scraping and maroon-colored paint transfer across a rock. Adjacent to that line was another parallel line of paint transfer that was red in color. The orientation and colors were consistent with the tail rotor guard (candy-cane: white and red) and tailskid (maroon) making contact first indicative of a nose-up attitude.



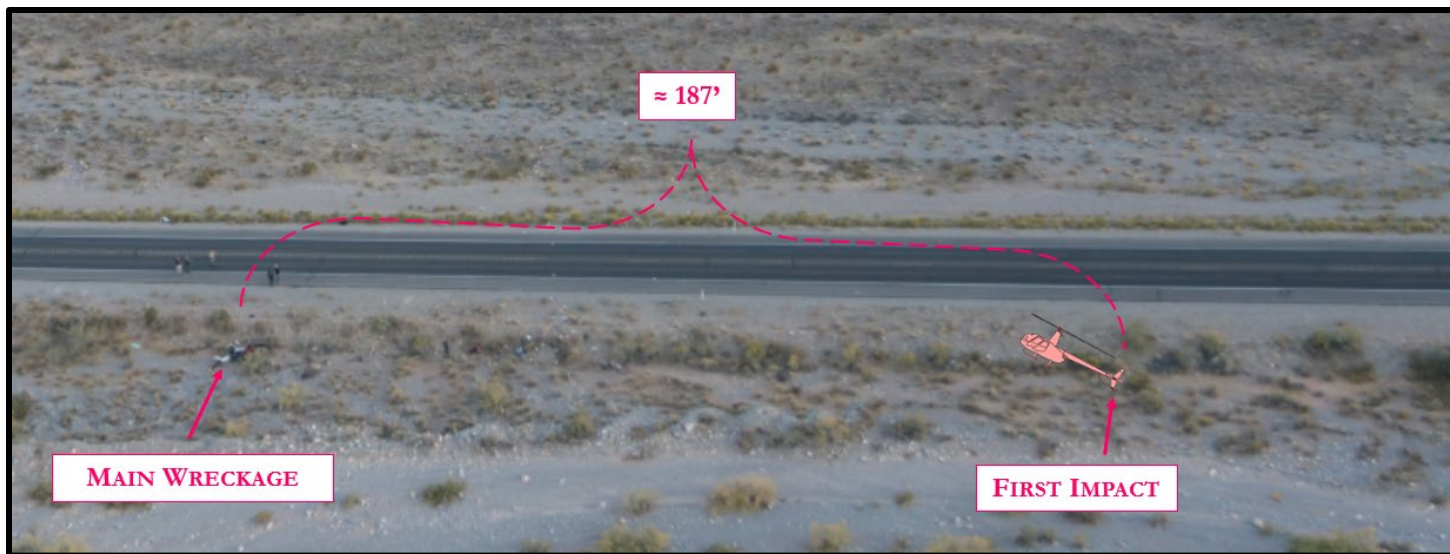
Picture 03: Wreckage GPS Points



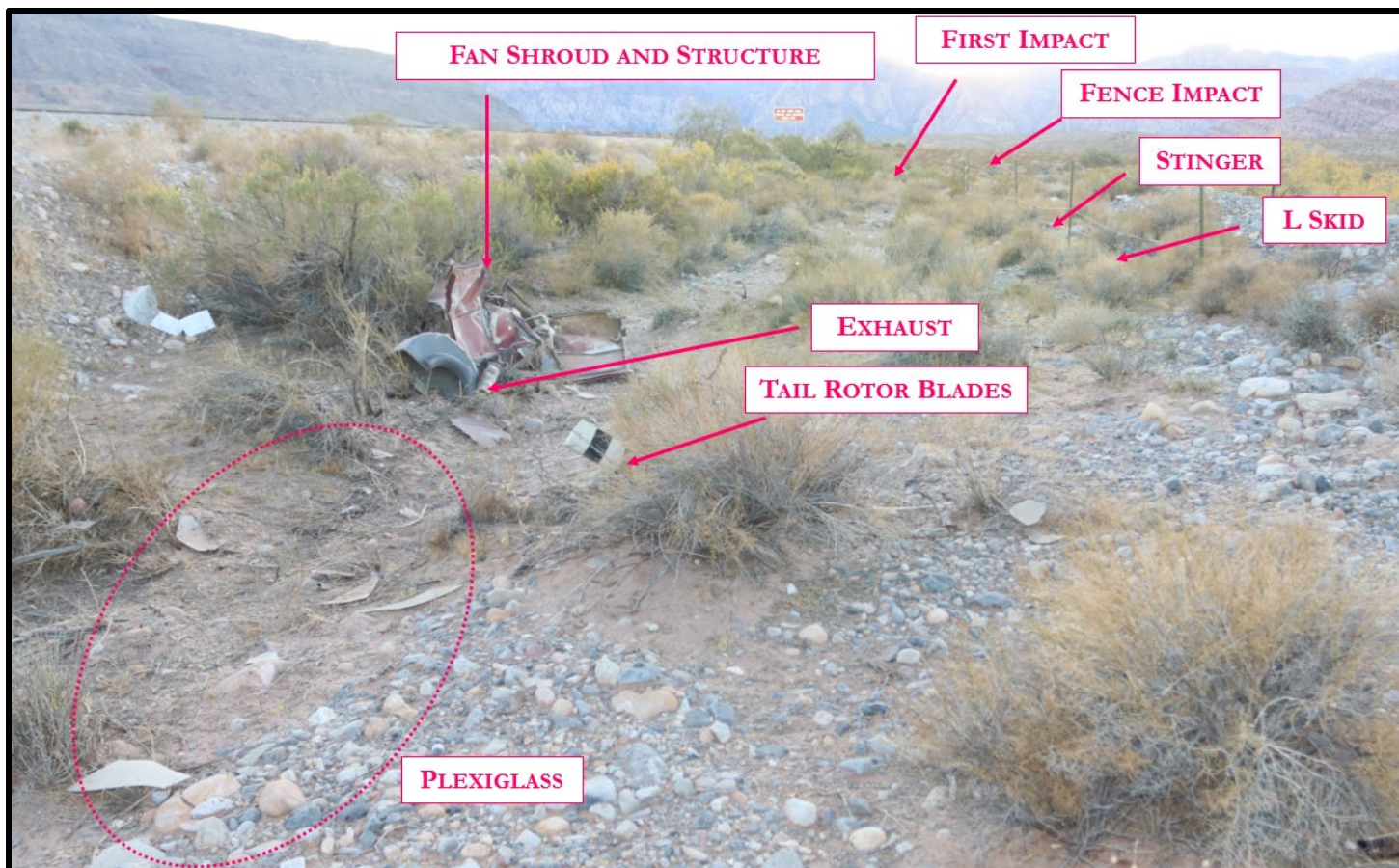
Picture 04: Wreckage Scatter Diagram



Picture 05: Wreckage Distance from main Wreckage to First Identified Point of Impact



Picture 06: Estimated Impact Angle



Picture 07: Wreckage from First Identified Point of Impact

AIRFRAME

The helicopter, serial number 10954, was originally manufactured in 2005.

FUSELAGE

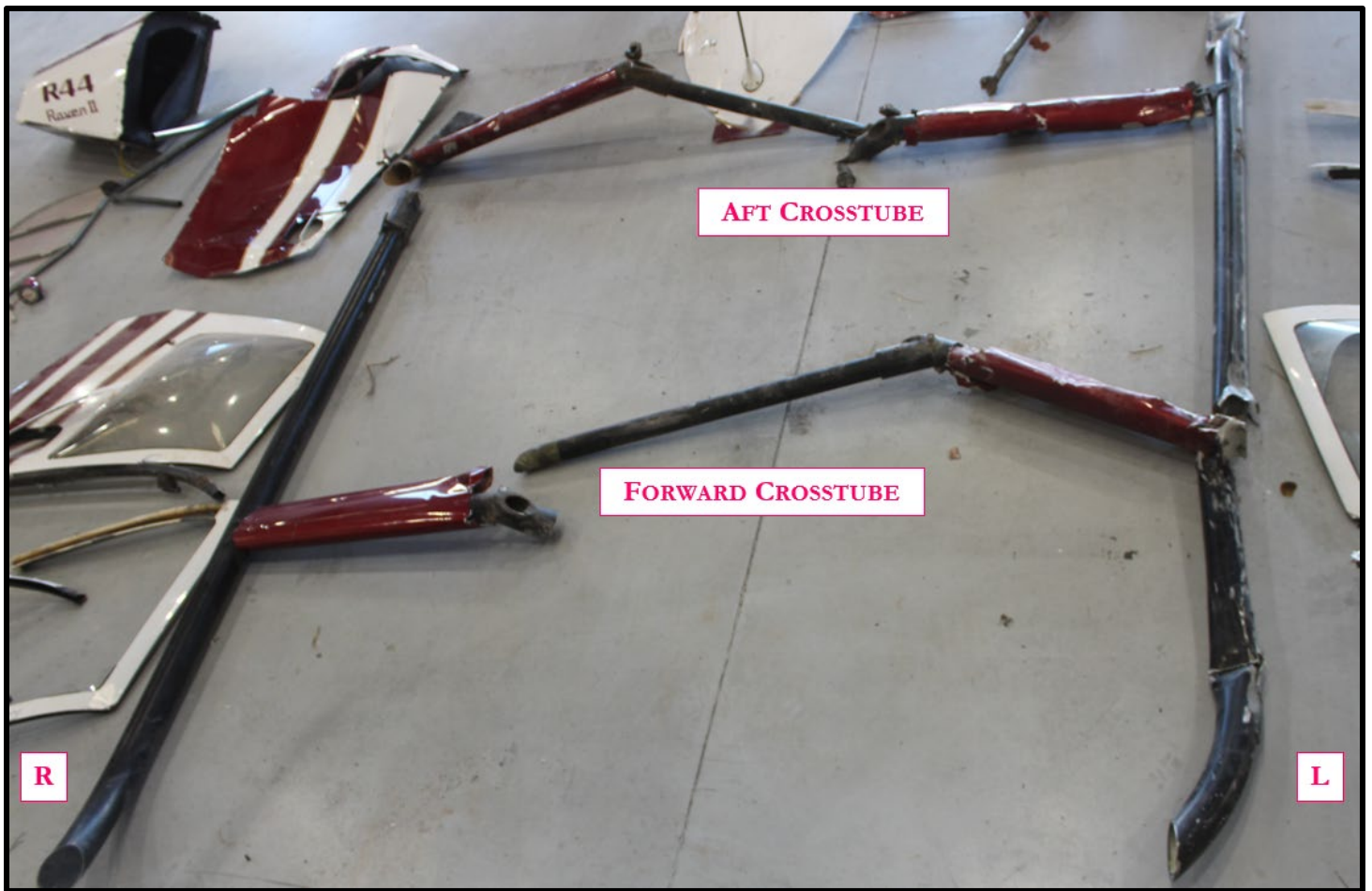
The fuselage had sustained major crush deformation. The tail-boom remained attached at the frame and continued aft about 40 inches where the skin was folded to the left.

The panel had become detached from the fuselage frame and was located adjacent to the main wreckage in the debris field. A majority of the gauges and radios did not display any meaningful readings. The altimeter was set at 29.78 inHg. The manifold pressure needle was frozen at 33 inches. The tachometer displayed 3,213.3 hours and the Hobbs displayed 2,657.84 hours. The air conditioner switch was positioned to "off." The map light was selected to "low" in the cabin light was selected to "on." The key remained inserted into the ignition and was found on the "left" position.

The Clutch, MR Temp, MR Chip, Carbon Dioxide, Starter On, TR Chip, Low Fuel, Low rpm, Fuel Filter, Aux Fuel Pump, and ALT lamps were removed, and their filaments were examined. No obvious deformation or stretching could be confirmed.

There were rotational signatures on the following surfaces all of which were consistent with the engine producing power at the time of impact: aft surface of the forward fan shroud housing; starter ring gear and oil cooler; alternator (circumferential scoring); belt tension actuator vertical tube (scoring).

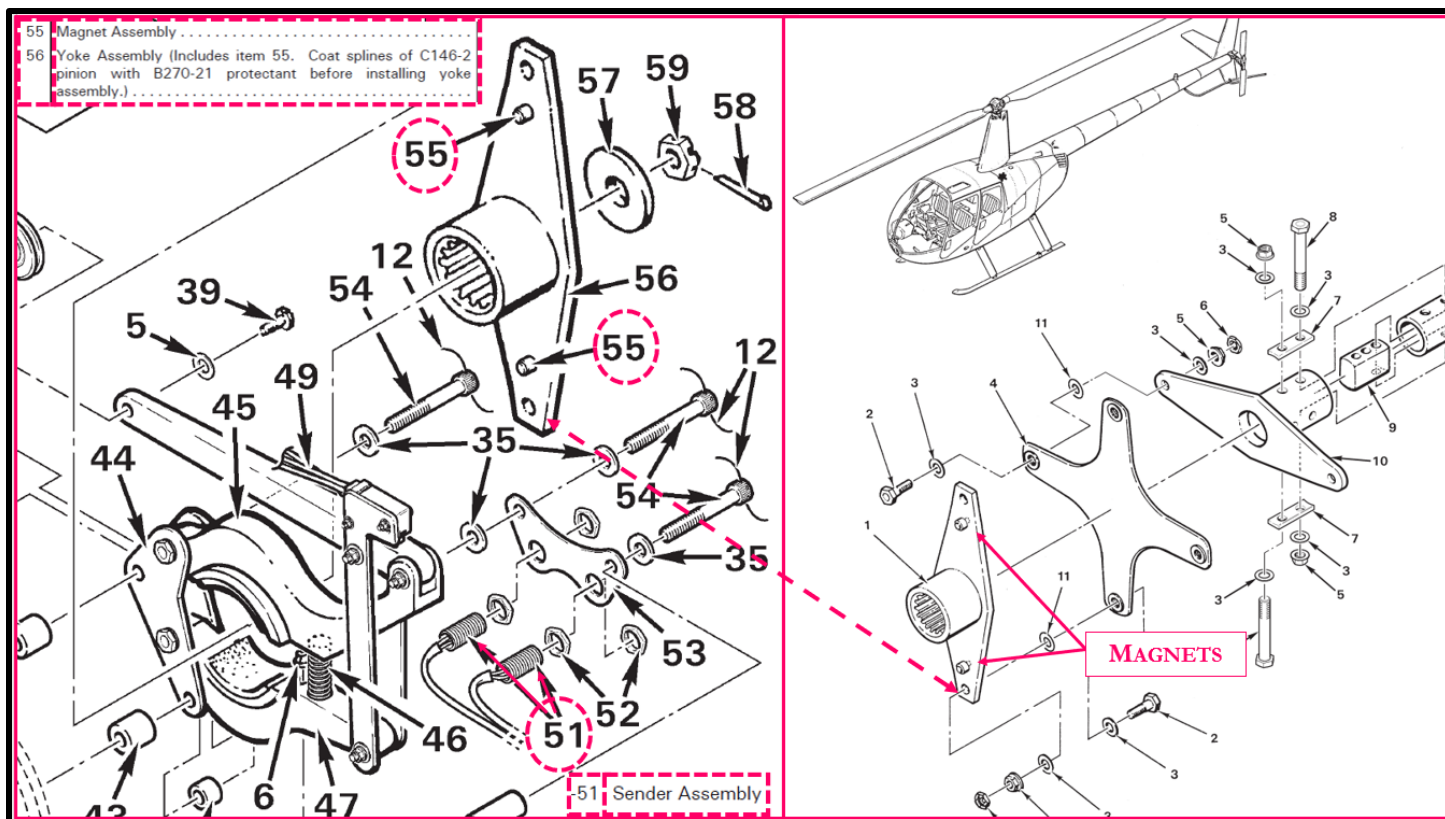
The left landing gear sustained more damage than the right. The left forward crossbar sustained crush damage consistent with the left skid impacting the ground and tearing aft. The right skid sustained less damage and was found furthest from the wreckage.



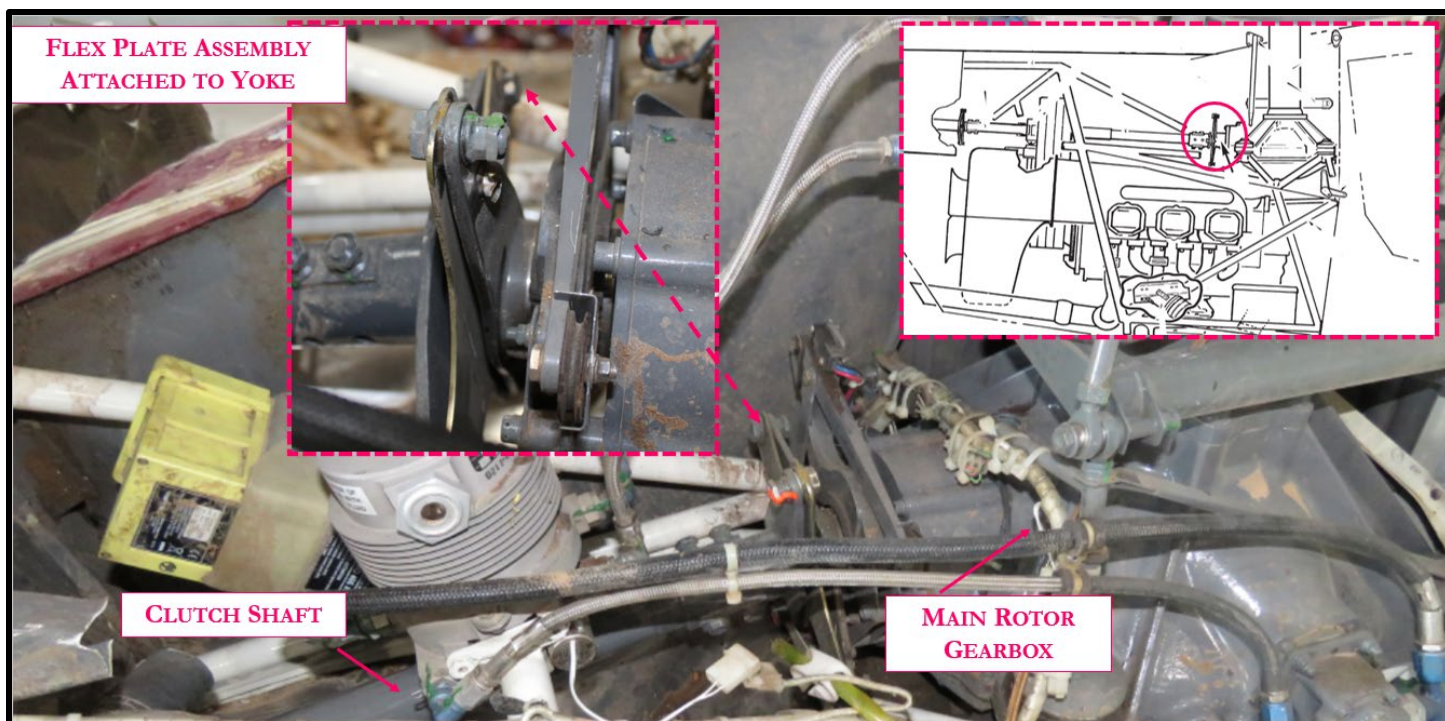
Picture 08: Landing Skids

MAIN ROTOR DRIVE SHAFT SENSORS

An electronic engine and rotor dual tachometer was equipped on the helicopter. The rotor tachometer signal is provided by two magnets at the main gearbox drive yoke that pass by an electronic Hall Effect devices. Robinson representative reported that with only 1 magnet installed, the main rotor tachometer rpm would indicate about 50% of the actual rotor rpm.

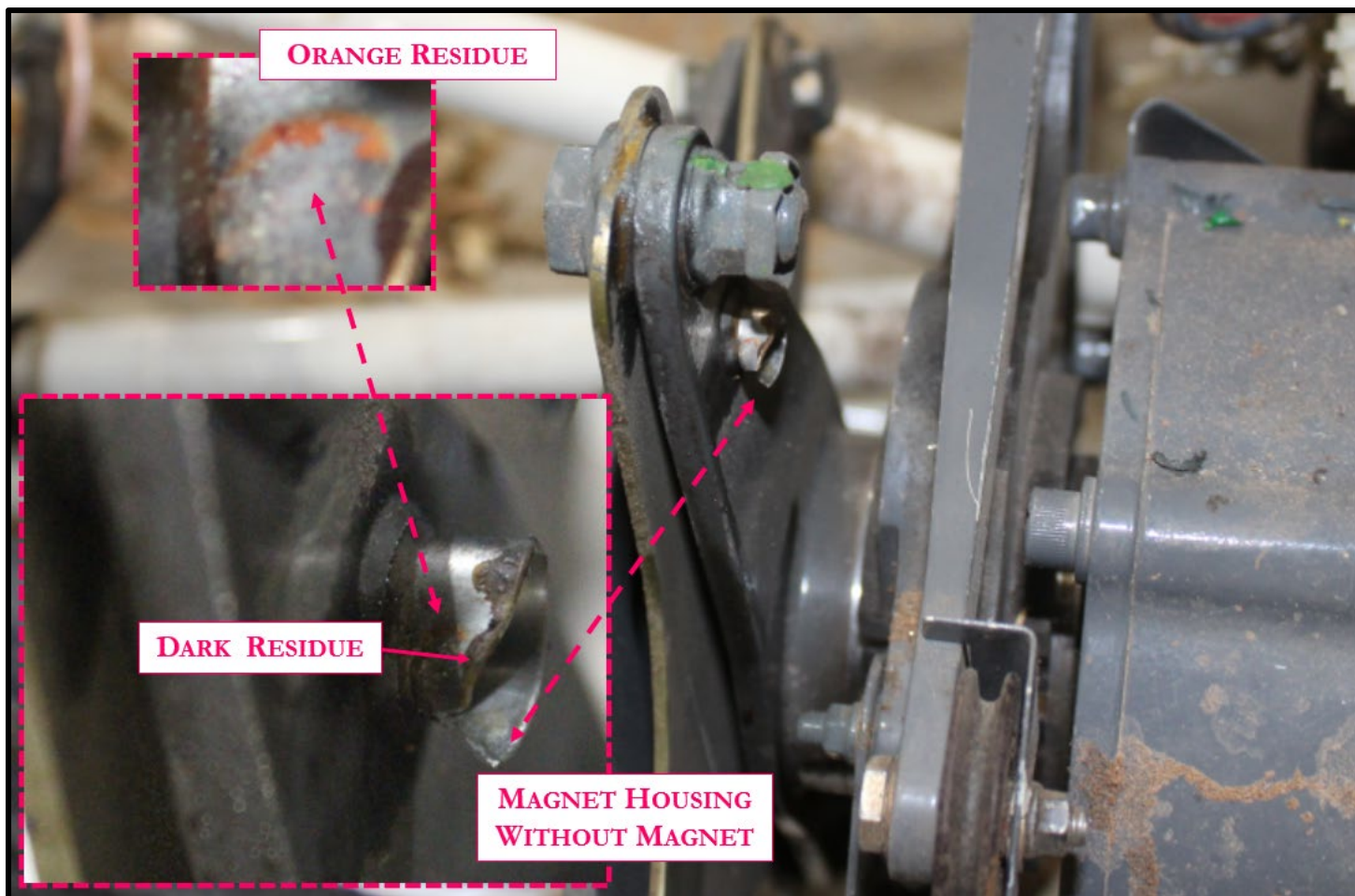


Picture 09: Rotor Tachometer Assembly

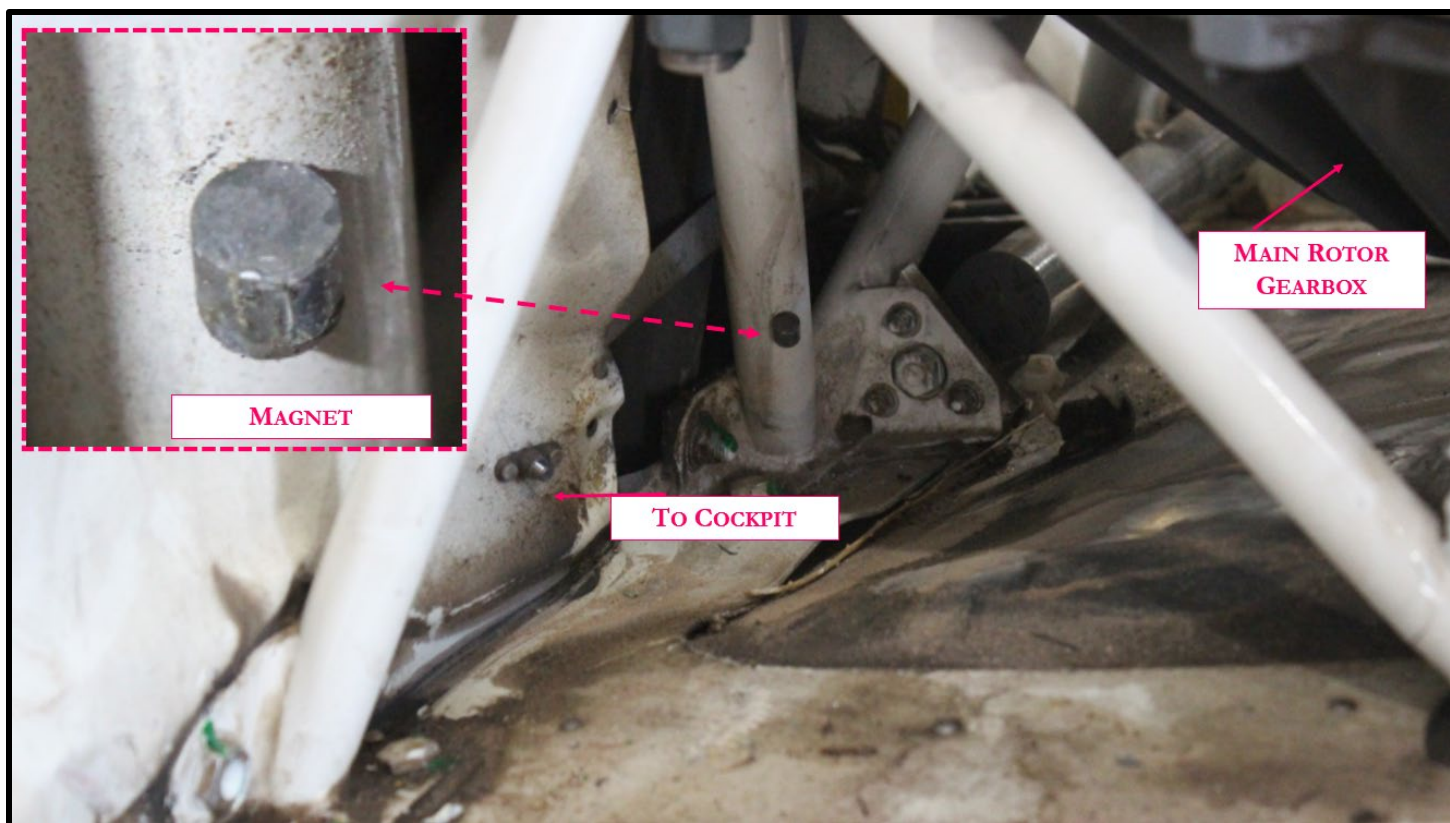


Picture 10: Location of Rotor Tachometer Assembly

Examination of the engine compartment revealed one magnet assembly part number (p/n) B570-1 associated with the main rotor tachometer indicating system was separated from the Yoke Assembly, p/n C908-1; the magnet was located on the fuselage frame near the firewall.

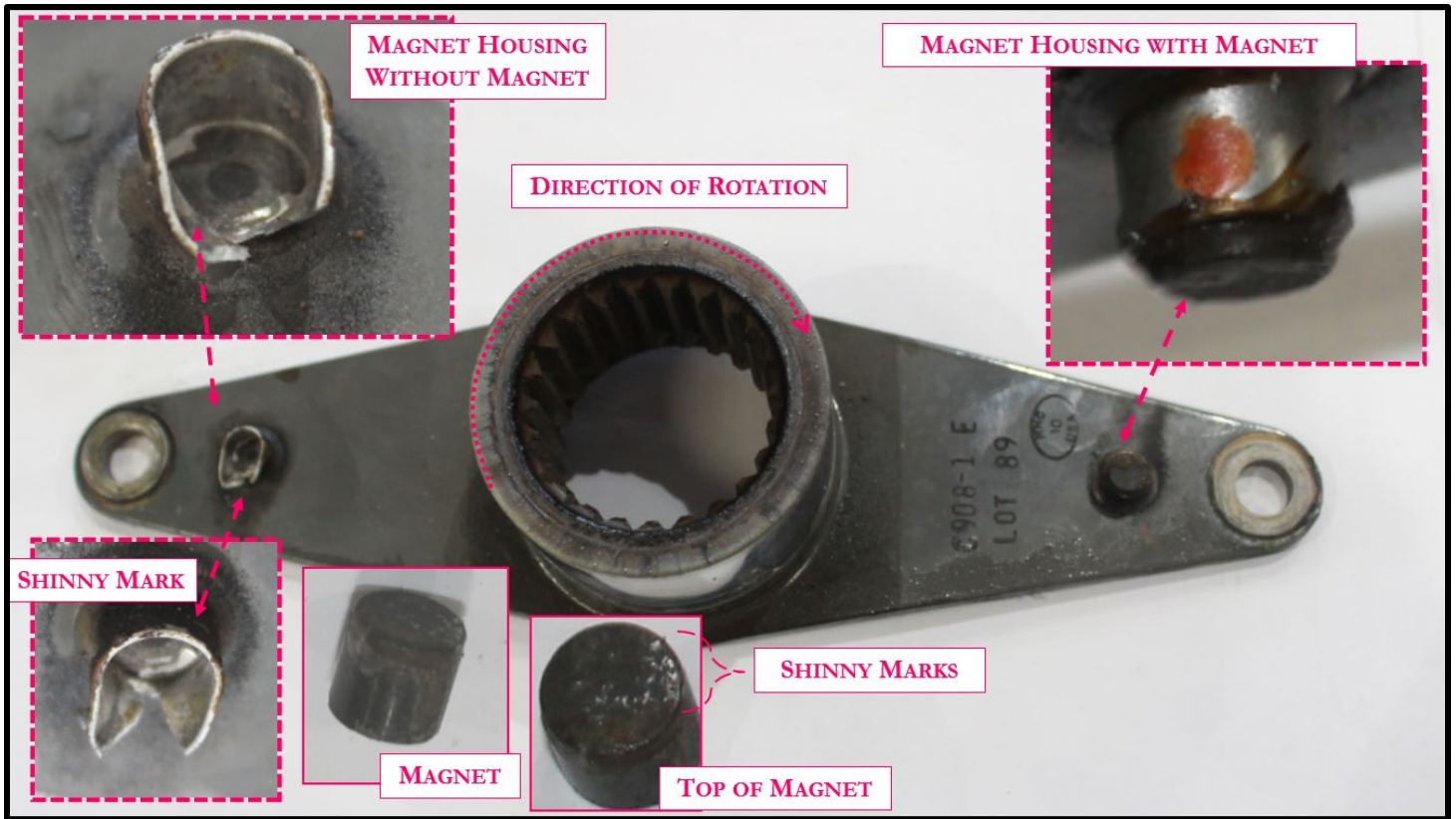


Picture 11: Magnet Housing on Yoke Assembly

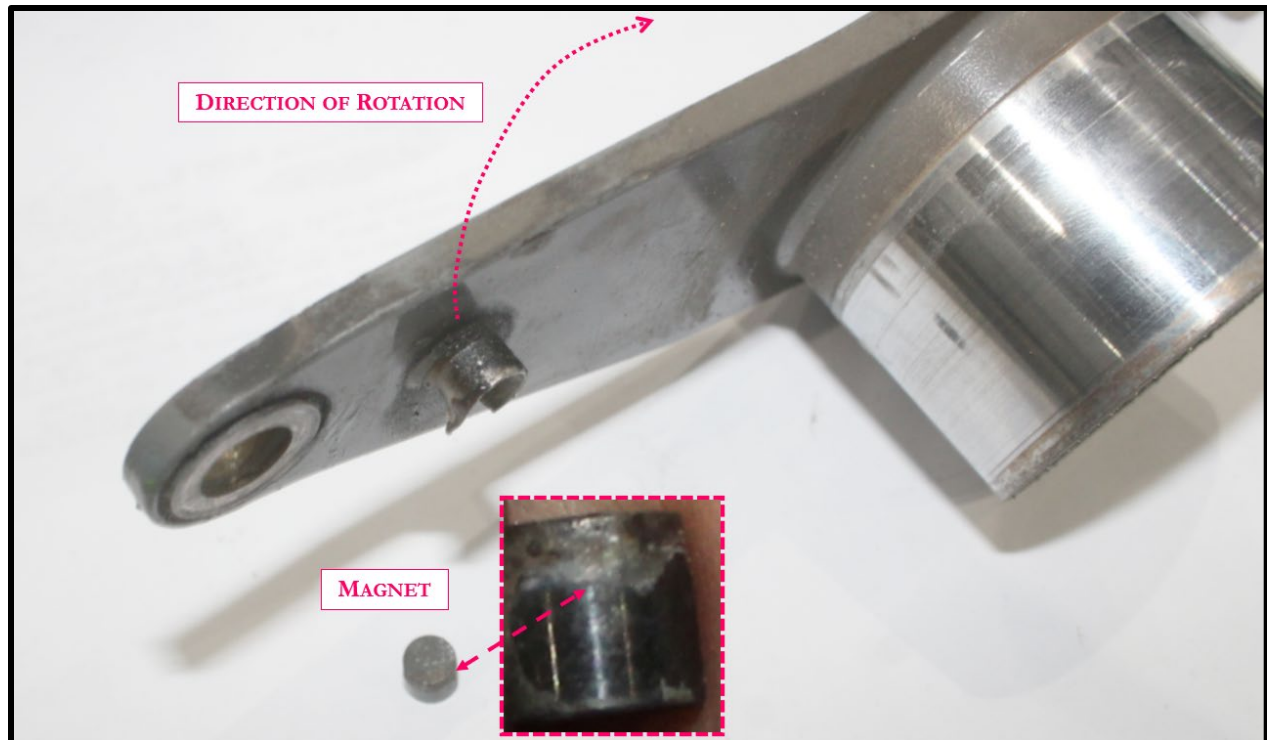


Picture 12: Magnet on Fuselage Frame

The magnet housing was shiny at the top of one side (the direction of rotation) consistent with contact of the magnet against a sender. The other magnet assembly remained secured to the yoke assembly. Both the housings showed a color consistent with a dark residue and a yellow/orange mark was on both housings and senders. The yoke assembly was not damaged.

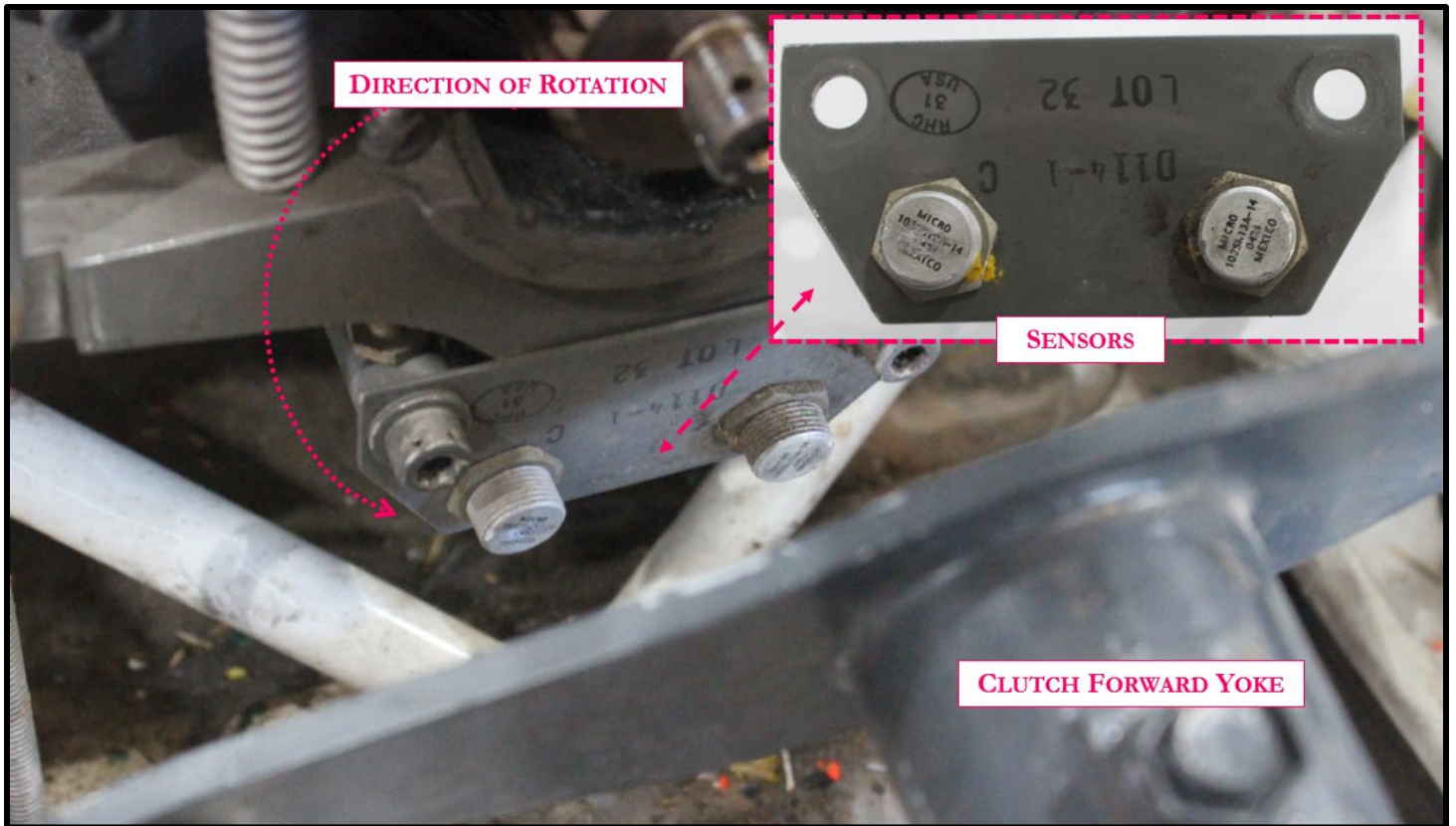


Picture 13: Magnet Assemblies on the Yoke

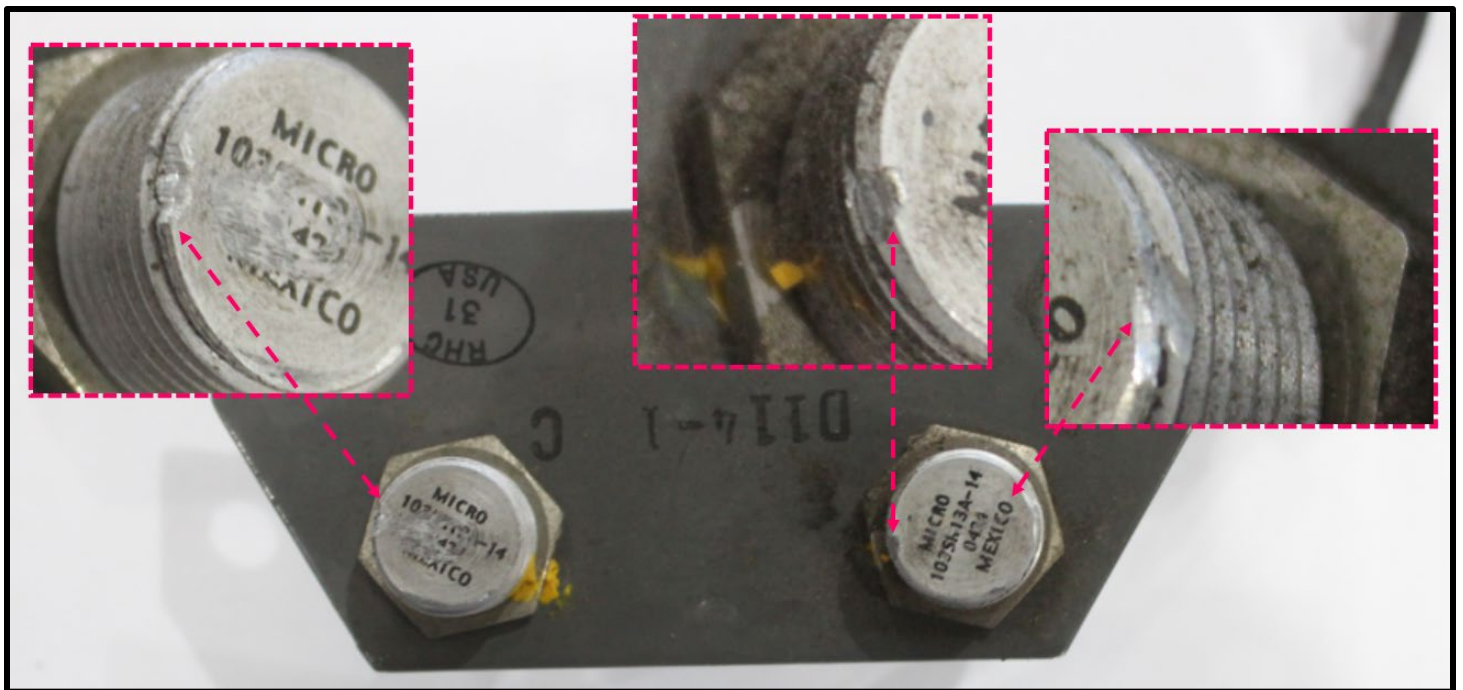


Picture 14: Magnet Housing

There was evidence of slight damage to both sensors, consistent with the magnet assembly separation. The lowest numeric marking on the dual tachometer associated with the main rotor is 50, with 2 graduated lines beneath.



Picture 15: Sensor Location



Picture 16: Sensor Damage

A Robinson Helicopter Company representative reported there have been instances of a magnet separating from a magnet assembly which prompted issuance of Service Bulletin (SB) 86¹, which required an adhesive be applied between the magnet and the magnet housing and a yellow dot placed on the magnet housing.

1. A partial failure of the helicopter's engine 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.²

2. 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.³

FUEL SYSTEM

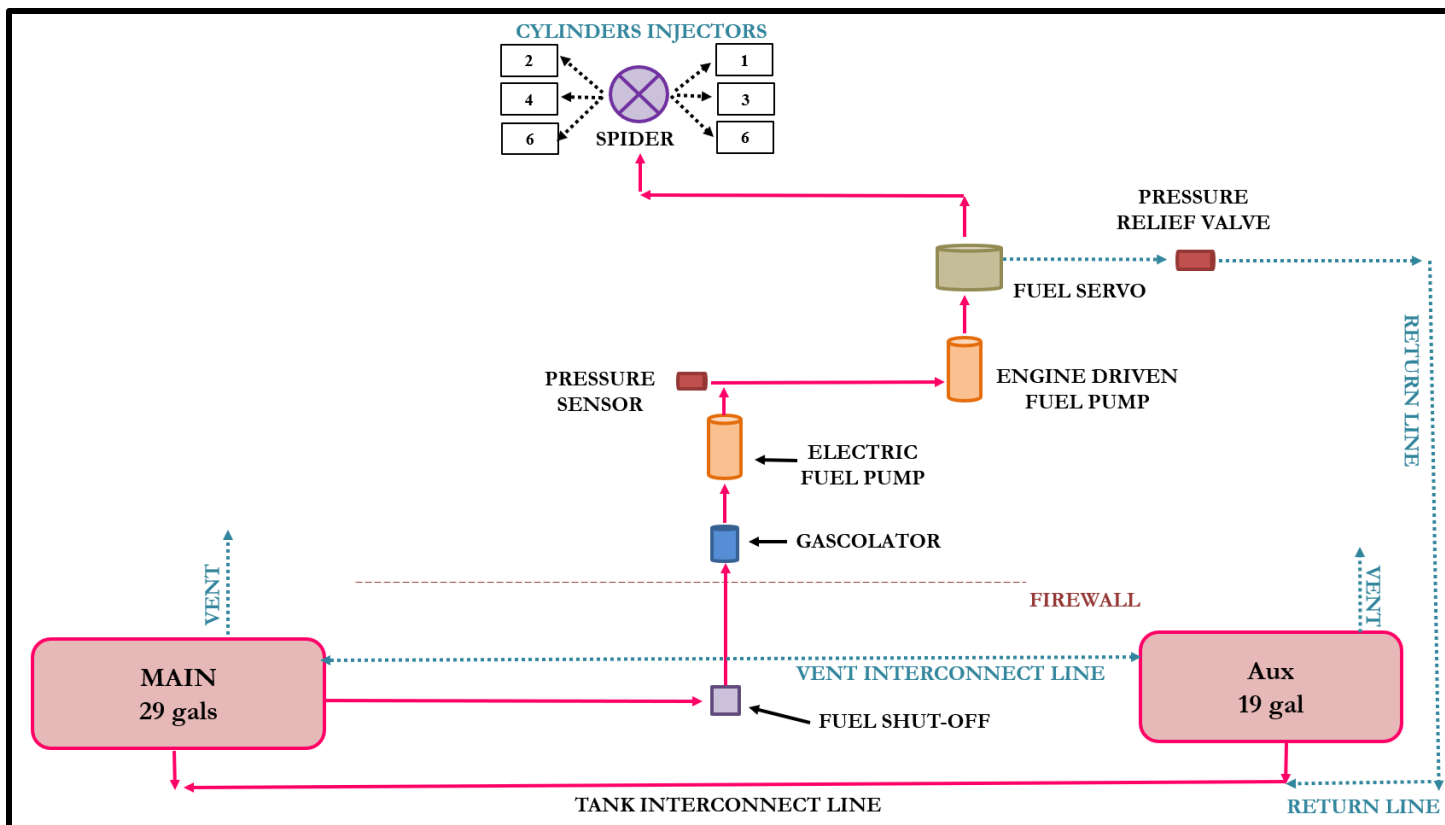
The fuel system includes main and auxiliary tanks, a shutoff valve control located between the front seats, and a strainer (gascolator). The fuel tanks have flexible bladders in aluminum enclosures. Fuel tank air vents are located inside the mast fairing. The R44 II fuel system is a pressurized fuel system that includes an engine-driven pump, an auxiliary (electric) fuel pump, and a fuel return line which allows pump supply in excess of engine demand to return to the fuel tanks. The engine will function normally with either the engine-driven or auxiliary (electric) pump operating. After start, the pump runs continuously as long as the engine has oil pressure and the clutch switch is in the engage position. The R44 II has a pressure switch on the gascolator which illuminates the fuel filter caution light if the strainer becomes contaminated. Continued operation with an illuminated filter caution light may result in fuel starvation. A pressure switch downstream of the auxiliary fuel pump illuminates the aux fuel pump caution light if auxiliary pump output pressure is low. When the clutch switch is disengaged, the auxiliary pump is off and the aux fuel pump caution light should be illuminated. Proper mechanical fuel pump function is indicated by normal engine operation after engine start prior to clutch switch engagement and before shutdown while clutch switch is disengaged.

The R44 II has plunger-style drain valves at the gascolator and at each fuel tank sump. The gascolator is located on the lower right side of the firewall and is drained by pushing up on the plastic tube which extends below the belly. Valves for both tanks are located inside the right cowl door below the auxiliary tank. Fuel samples are taken by extending the plastic tubes clear of the aircraft and pushing on the plungers.

¹ https://robinsonheli.com/wp-content/uploads/2015/12/r44_sb86.pdf

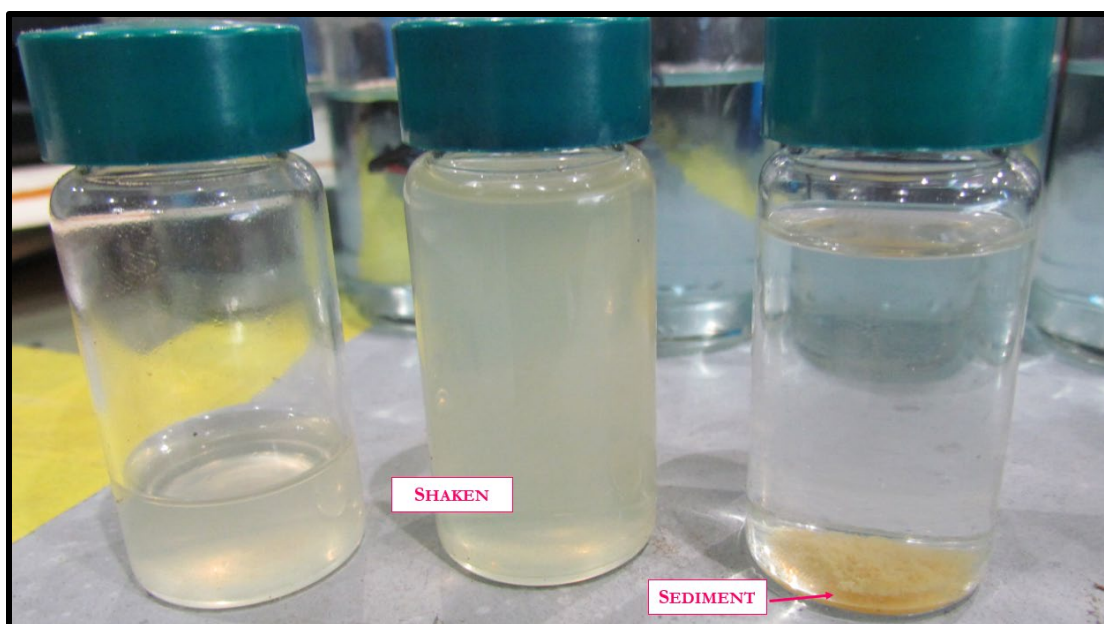
² <https://app.nts.gov/pdfgenerator/ReportGeneratorFile.ashx?EventID=20170421X02231&AKey=1&RType=HTML&IType=LA>

³ <https://app.nts.gov/pdfgenerator/ReportGeneratorFile.ashx?EventID=20130315X55013&AKey=1&RType=HTML&IType=LA/>



Picture 17: Fuel System

Investigator removed the gascolator at the accident site. The bowl was full with a liquid consistent in odor with that of 100LL AVGAS, but the color was an orange-yellow; there was some debris in the bowl that was akin to a gelatinous consistency (the liquid was captured in glass bottles for possible future testing). During recovery fuel began to pour from the system where the T had broken at the return line to the aux tank. Investigators cut the interconnect line and clamped it for recovery purposes.



Picture 18: Fuel from Gascolator

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 investigators

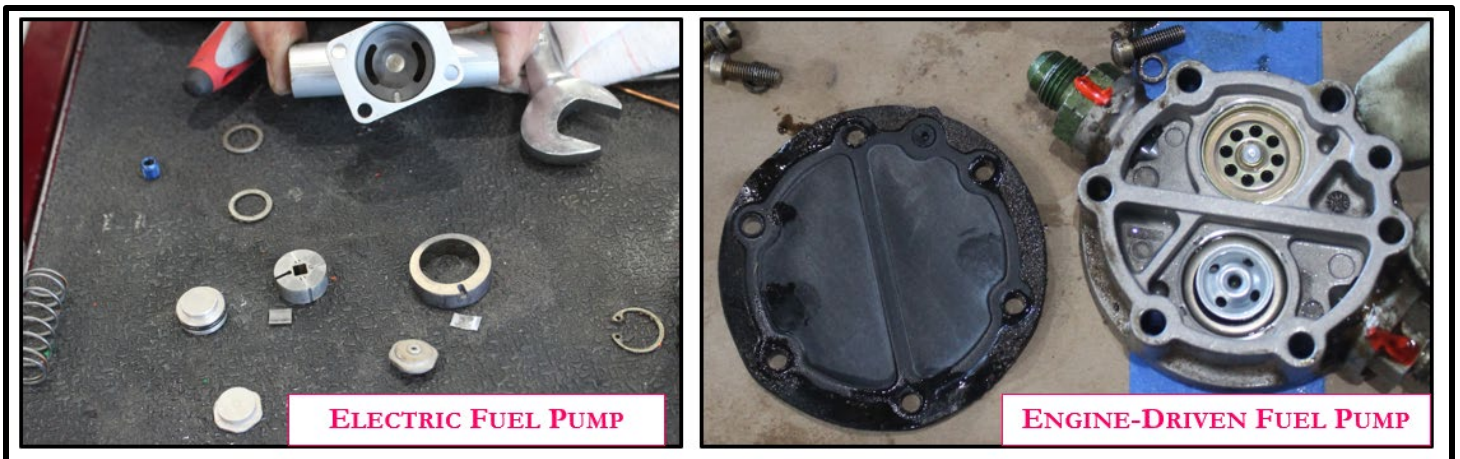
disconnected the line from the pressure relief valve routing it into a bucket. The fuel flowed from the line into a clean bucket. Upon the pump being energized, fuel flowed freely from the line; the fuel had a green hue and was free from contaminants.

Investigators removed the fuel injector lines from their respective cylinders and examined each injector; they were clean from 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.



Picture 19: Fuel Collected from Injectors

The engine-driven fuel pump remained attached to the engine. Movement of the lever resulted in suction and expulsion of air from the fuel lines. Disassembly of the fuel pump revealed that it was free of internal mechanical malfunction and obstruction to flow; the diaphragm was intact. The electric-driven fuel pump vanes were intact and no contaminants were found.



Picture 20: Fuel Pumps

The auxiliary tank was cut open and the bladder was observed to be in pliable and in good condition. There was numerous small non-ferrous flakes in the remaining fuel. The screen was clean and the restrictor in the interconnect line was free from debris.

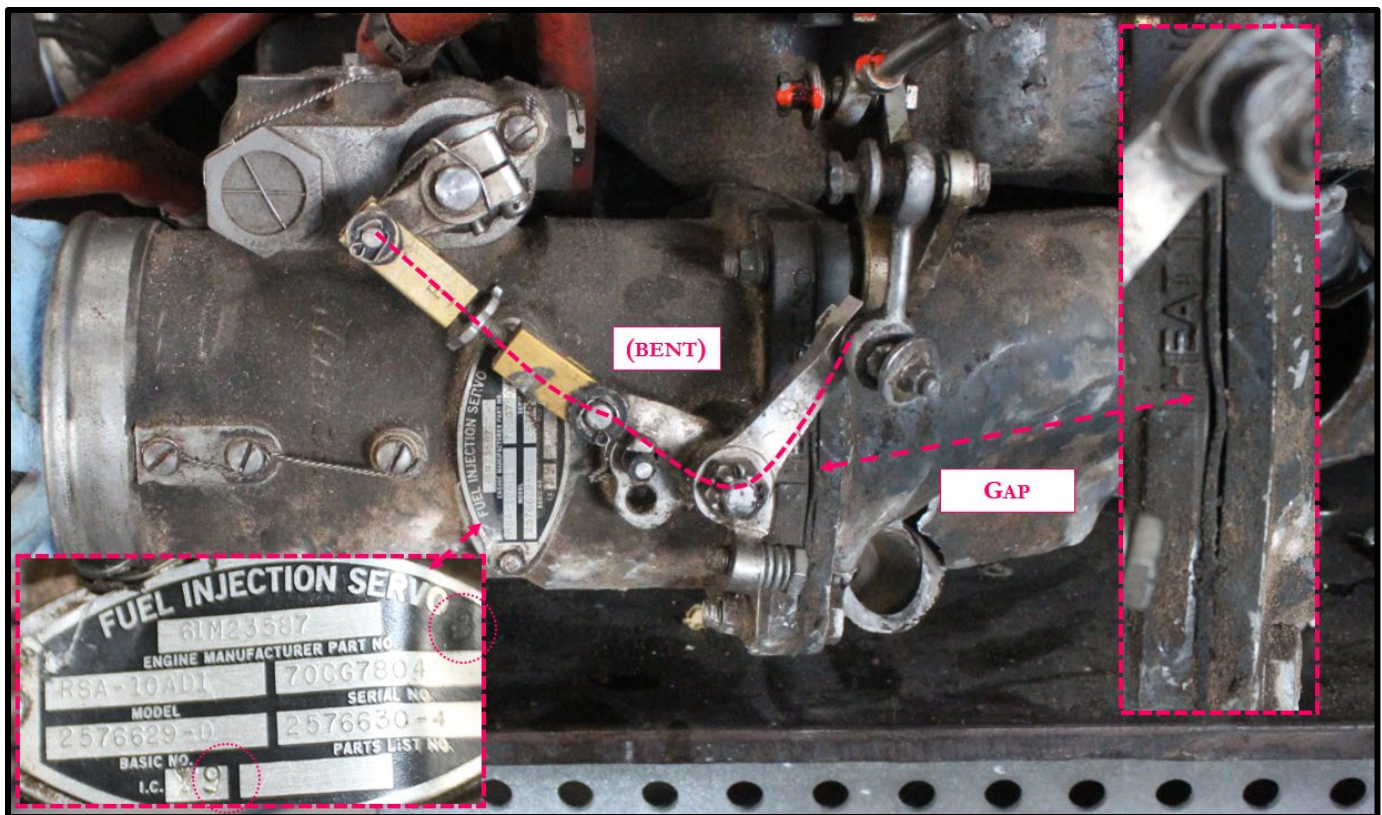
FUEL SERVO AND FLOW DIVIDER

The fuel servo was a Bendix RSA-10AD1, (part number 61M23587, serial number 70CG7804). The servo was last overhauled by D & G Supply in Niles Michigan and signed as being completed on May 10, 2017.

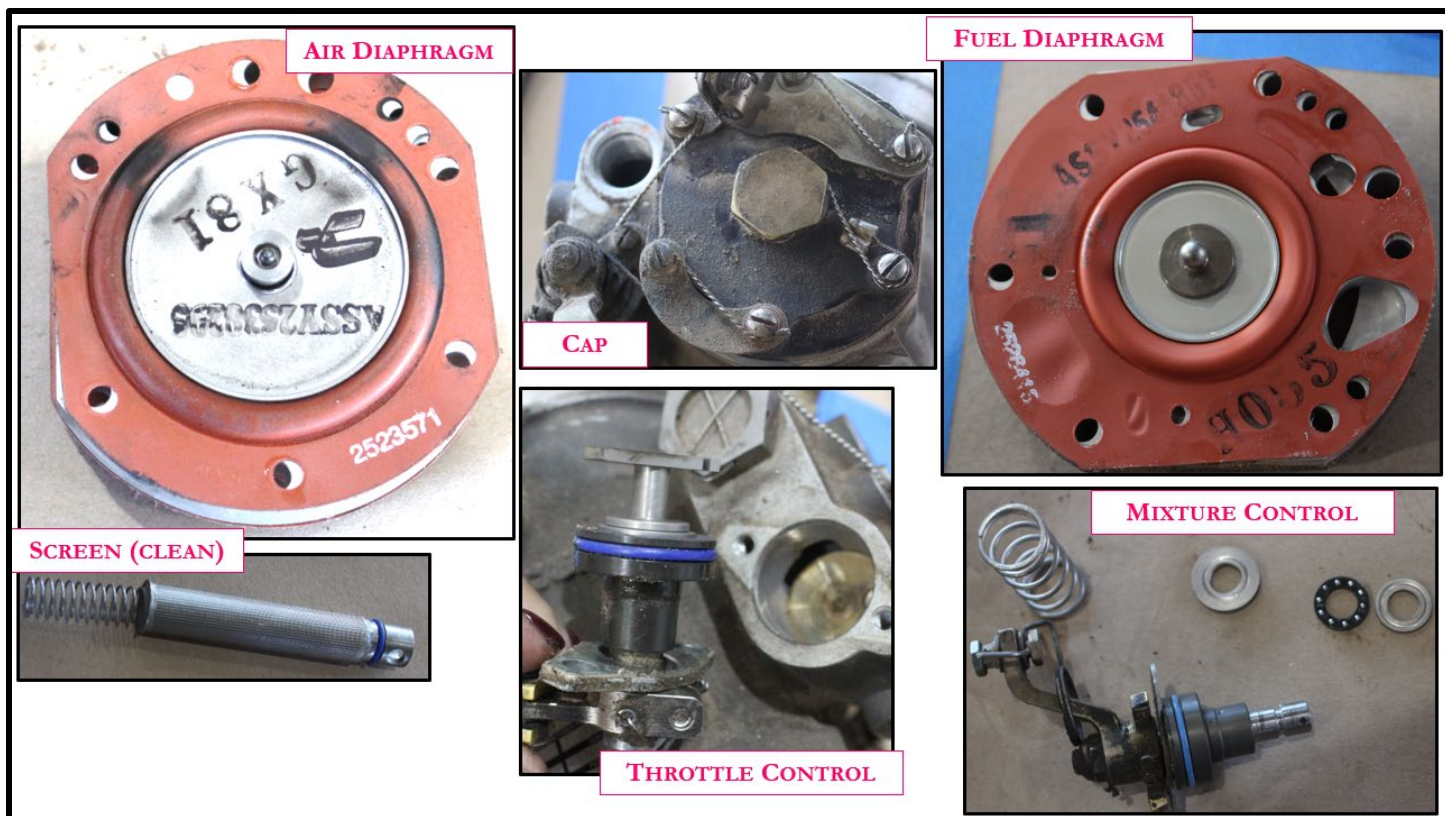
The major components of the servo include the airflow section, the flow metering section, and the fuel regulator section. Together, these sections are designed to meter fuel in direct ratio to the volume of air being consumed by the engine.

The regulator assembly contains an air diaphragm, a fuel diaphragm, and regulator stem that has a regulator ball affixed at the end. The air diaphragm senses impact air and compares it to venturi suction. The fuel diaphragm compares metered and unmetered fuel pressure. The diaphragms are connected by the regulator stem, which passes through the center body section of the regulator. The four chambers in the regulator section of the servo act in unison to cause the diaphragms to equalize and regulate the appropriate amount of fuel to the engine when the airflow is altered. When the engine is operating at a constant throttle setting, opposing forces of the fuel and air diaphragms cause the regulator valve stem to unseat to a specific position and an appropriate quantity of fuel is provided to the engine. As the throttle setting is increased, velocity of air through the venturi increases and pressure decreases within the suction side of the air chamber relative to the impact side. This creates a pressure differential across the air diaphragm and causes the regulator valve (ball at the end of the regulator stem) to move towards a more open position. As the regulator valve opens (ball moves off the seat), more fuel is provided to the engine. Once the pressure differential across the fuel diaphragm stabilizes and reaches a force in equilibrium with the air diaphragm, fuel flow is again stabilized.

The servo still contained the black data plate, which according to the manufacturer was to be changed to a yellow data plate at overhaul. There was a gap between the servo body and the intake adapter flange, consistent with impact. The throttle spring was intact and the linkages contained bends consistent with impact damage. Upon disassembly, investigators noted a black residue on the top of the air diaphragm, which according to the manufacture was normal for a unit that had been in service. The diaphragms were intact and pliable. The fuel screen was clean from debris. The mixture and throttle arms moved from stop to stop. There was no evidence of mechanical malfunctions or failures.

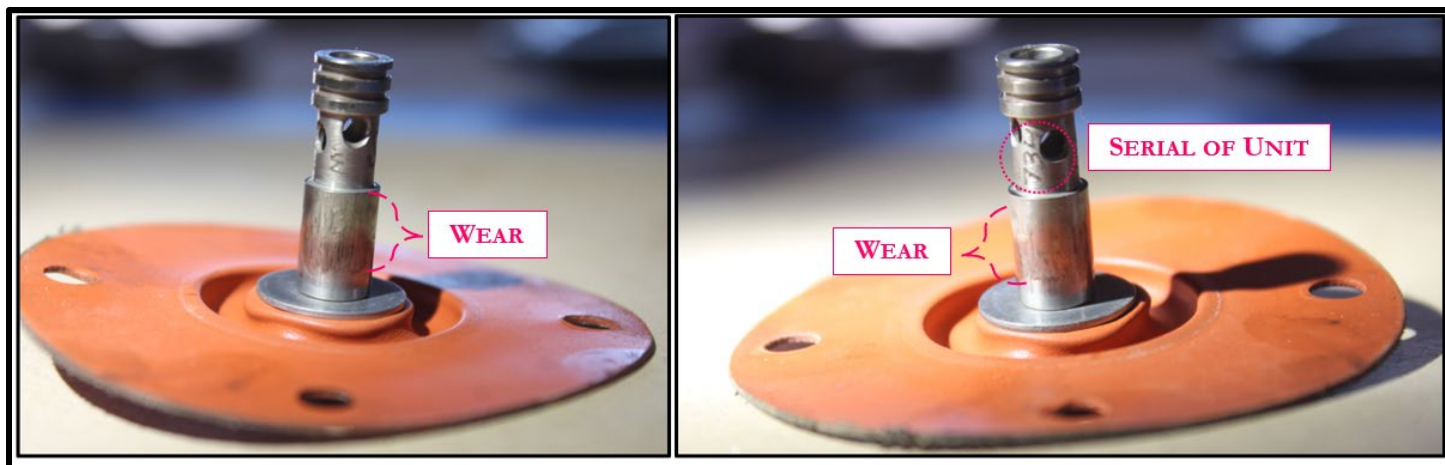


Picture 21: Fuel Servo (mounted on engine)



Picture 22: Fuel Servo (components)

The flow divider/spider was disassembled. The diaphragm was pliable and contained not rips. The piston had the serial number of the unit vibropeened on the body. The piston had wear marks on the upper body.



Picture 23: Flow Divider Diaphragm

ENGINE

The powerplant contained a data tag labeling it as a Lycoming IO-540-AE1A5, serial number indicated it was L – 30575-48A.

FAA Type Certificate	1E4
Rated horsepower.....	235
Rated speed RPM.....	2800
Bore, inches.....	5.125
Stroke, inches.....	4.375
Displacement, cubic inches.....	541.5
Compression ratio	8.5:1
Firing order	1-4-5-2-3-6
Spark occurs, degrees BTC.....	20
Valve rocker clearance (hydraulic tappets collapsed)	.028-.080
Prop. drive ratio	1:1
Prop. driven rotation	Clockwise

Fuel

Inlet to fuel pump min-2/max 35 psi

Inlet to fuel injector min 18/max 45 psi

Performance Cruise

(75% Rated) 2800rpm 175hp 15.0gal/hr fuel consumption 500F max CHT

An external visual examination of the engine revealed that it had sustained 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 ash white coloration, which according to the Lycoming representative was consistent with a very lean operation(s).

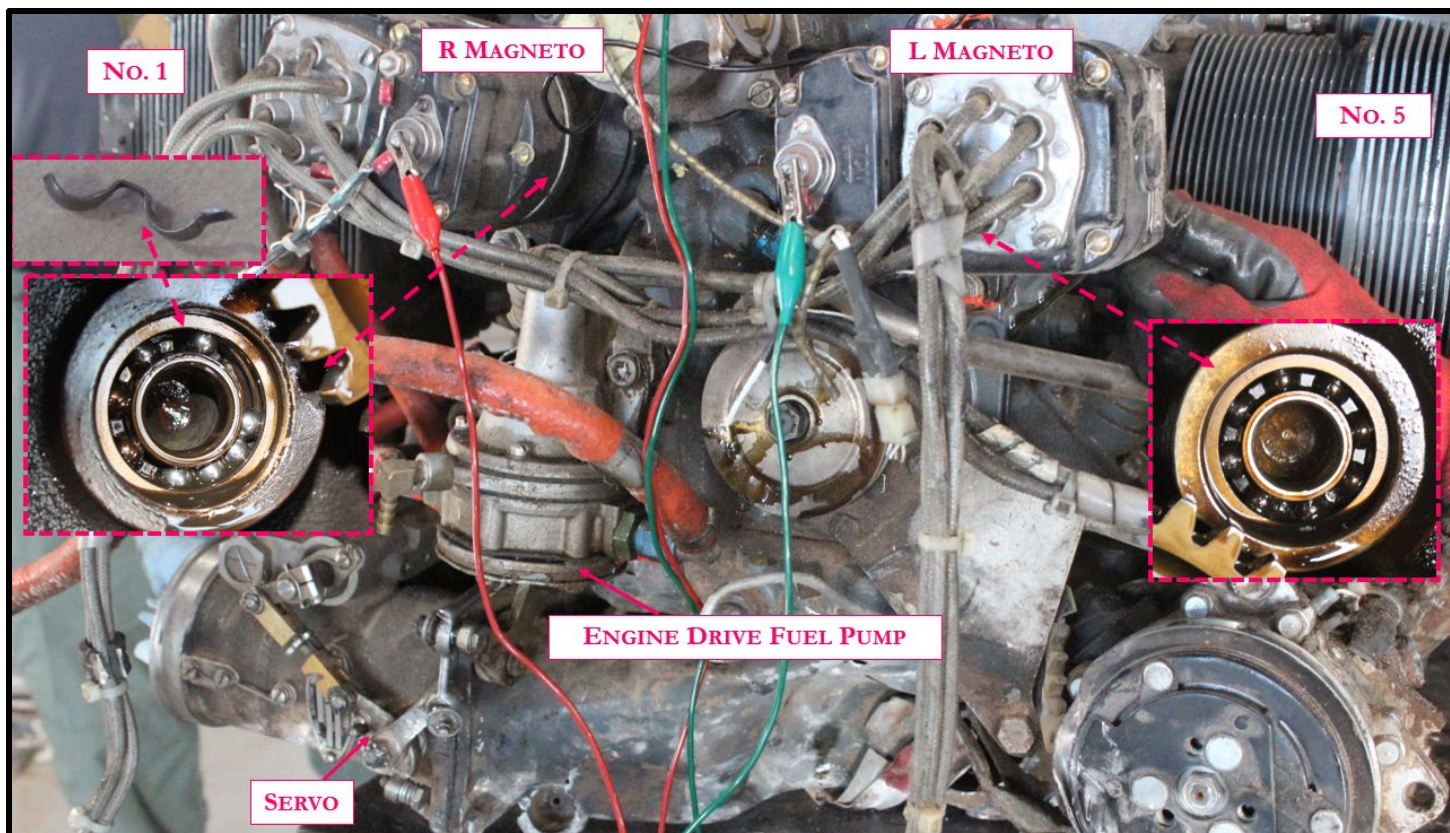
The crankshaft was rotated by hand utilizing the ring gear. The crankshaft was free and easy to rotate in both directions. "Thumb" compression was observed in proper order on all six cylinders. The complete valve train was observed to operate in proper order, and appeared to be free of any pre-mishap mechanical malfunction. Normal in uniform "lift action" was observed at each rocker assembly. Clean, uncontaminated oil was observed at all six rockerbox areas. Mechanical continuity was established throughout the rotating group, valve train and accessory section during hand rotation of the crankshaft.

The cylinders' combustion chambers were examined through the spark plug holes utilizing 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 additionally seen throughout the remainder of the exhaust system.



Picture 24: Combustion Signatures

The ignition harnesses were attached from both magnetos to their respective spark plugs. The magnetos were secured to its respective mounting pads. The right magneto (on the side of the even cylinders) 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.



Picture 25: Magnetos

RECORDS

The tachometer at the accident site was 3,231.3. The last 50-hour engine inspection was recorded as being completed on October 08, 2019 at a tachometer of 3,195.4 hours, equating to 35.9 hours prior to the accident; the last 100-hour airframe inspection was recorded as being completed on September 28, 2019 at a total time of 3,144.5 hours.

The engine was overhauled and recorded as being installed on the helicopter in May 2015 at an engine total time of 2197.8, equating to 1,033.5 hours amassed since overhaul.

FUEL

Desert Aviation Center was the primary place that Air Work pilots were instructed to receive fuel. The owned a 750-gallon truck that served AVGAS to three businesses at North Las Vegas, both allowed to buy fuel from them because of a lease agreement.

According to the records provided by Desert Aviation the accident helicopter was fueled twice on October 22 (the day prior to the accident). Once at 1138 with 11.6 gallons and once at 1540 with 16.8 gallons. The pilot-undergoing instruction (PUI)⁴ on both those flights stated that the fuel was clean of debris and the helicopter functioned normally. The records further indicated that about 1830 the truck refueled with 479 gallons of 100LL AVGAS. 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 long cross-country flight.

The accident helicopter was the first aircraft to be fueled in the morning. According to the fueler, he arrived at the office around 0700 and did the normal procedure of drain the truck ½ gallon of fuel from the lower sump and ½ gallon from the filtered hose. He drained both into a white porcelain bucket and noted that both were clean of

⁴ See Records of Conversation: Thomas Bencin

debris (he pours clean fuel back into the truck). A CFI from Airwork called for fuel and at 0825 he fueled the accident helicopter with 23.6 gallons topping off both the auxiliary and main fuel tanks. About 0847 another Cessna 172 received 13.3 gallons and the pilots reported no anomalies with the fuel or their flight.

The PUI stated that after getting fuel, he began performing the preflight with the CFI 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 black and gray specs floating (similar in appearance to sand). He showed the CFI who poured out the sample in the concrete and suggested they take another sample. After taking 2 more samples with the same results the CFI 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 CFI then informed the Airwork mechanic of the samples who explained that he was working on several airplanes and would not be able to look at the fuel system until that afternoon.

The mechanic stated the he did not have an opportunity to flush the fuel tanks in the helicopter. The CFI relayed to the PUI that the mechanic had not had the opportunity to work on the helicopter and asked him if he wanted to cancel his scheduled afternoon flight, to which he replied that he did based on what occurred in the morning. The accident pilot arrived at Airwork aware that he may not be able to rent the accident helicopter because it was in maintenance for having contaminated fuel earlier in the day. After waiting for about 20 minutes, at which time the CFI was presumably sumping the fuel tanks, he relayed to the front desk area that the helicopter was “good to go.” Despite numerous attempts, the CFI did not make a statement to the NTSB.

PERSONNEL INFORMATION

PILOT (RIGHT-SEAT)

Scott Socquet

Airline Transport Pilot Certificate (Airplane Multiengine Land, Airplane Single Engine Land, Rotorcraft-Helicopter) and Flight Instructor (Airplane Single and Multiengine, Instrument Airplane), was a 53-year-old male. This pilot reported civil flight experience that included 15,000 total and 220 hours in last six months as of exam dated 01/02/2019. This pilot was 73 inches tall and weighed 227 lbs at the time of the last exam. The last exam was conducted by Aviation Medical Examiner (AME) 16759. This pilot was issued a First Class Medical Certificate with the following limitation(s): Must have available glasses for near vision. Address is in Milford, CT.

The pilot’s personal rotorcraft flight logbook was found in the wreckage. A review of the logbook disclosed that the pilot began flying helicopters in 2013 with a majority of his earlier experience acquired in the Schweizer. His last flight was March 03, 2019 during which time he received a 0.9 hour checkout in an R-44 where he practiced autorotations, low rotor recovery, and settling with power⁵.

The following were the last entries in the pilot’s rotorcraft logbook:

⁵ See Record of Conversation: Albert Azouz for the CFI’s checkout comments.

Date	Type	Time
10/14/2018	AS355	7
11/13/2018	R-44	1.7
12/21/2018	R-44	1.6
12/30/2018	R-44	1.5
12/31/2018	R-44	1.5
1/2/2019	R-44	1.4
2/8/2019	R-44	1.5
2/16/2019	R-44	2.2
3/3/2019	R-44	0.9
Hours from 2014-Current		332.8
Total		352.1

Picture 26: From Pilot's Logbooks

PASSENGER (LEFT-SEAT)

Howard Jameson

Male, age 27 – no DIWS or SPAS records.⁶

WEATHER INFORMATION

Winds from east to northeast around 5 to 10 knots with gusts to 15 knots; high clouds and no precipitation. The official closest METAR site was KLAS (accident time of 2253 UTC):

METAR KLAS 232256Z 08008KT 10SM FEW250 28/M05 A2997 RMK AO2 SLP131 T02831050=

METAR KLAS 232156Z 04006KT 10SM FEW250 29/M04 A2998 RMK AO2 SLP134 T02891039=

KVGT did have a wind shift from 320 degrees to 080 degrees within the timeframe of the accident:

METAR KVGT 232253Z 08011KT 10SM CLR 28/M06 A2998 RMK AO2 WSHFT 2225 SLP151 T02831056=

SPECI KVGT 232239Z 08016G21KT 10SM CLR 28/M05 A2998 RMK AO2 WSHFT 2225 T02831050=

METAR KVGT 232153Z 32015G20KT 10SM CLR 29/M07 A2999 RMK AO2 SLP153 T02891072=

A “non-official” weather site right there near entrance of the park and it showed east wind (the whole time no wind shift in direction) 4 mph with gusts to 10 mph.

ADDITIONAL INFORMATION

CONTACT INFORMATION

Lycoming: Troy Helgeson

Robinson: Ken Martin:

FAA: Rich Ramirez and Carey Atnip

Jesse Jameson (father of pilot and passenger)

⁶ https://m.facebook.com/hjamesonii?pn_ref=friends_search

