

National Transportation Safety Board - Aircraft Accident/Incident Database

Accident Rpt# GAA16CA462	09/05/2016 1120 CDT	Regis# N31627	Hondo, TX	Apt: N/a
Acft Mk/Mdl AIR TRACTOR INC AT-400		Acft SN 400-0506	Acft Dmg: SUBSTANTIAL	Rpt Status: Factual Prob Caus: Pending
Eng Mk/Mdl PRATT & WHITNEY PP6-27		Acft TT 19575	Fatal 0 Ser Inj 0	Flt Conducted Under: FAR 137
Opr Name: RUSTYS FLYING SERVICE		Opr dba:		Aircraft Fire: NONE
				AW Cert: SPR

Summary

The pilot reported that, while maneuvering at low altitude over a field during an agricultural application flight, the airplane struck an antenna atop a tower adjacent to the field, and the antenna wrapped around the right wing and landing gear. The pilot added that he attempted an off-airport landing, but the airplane impacted terrain. The airplane sustained substantial damage to the fuselage, empennage, and both wings.

The pilot reported that there were no preimpact mechanical failures or malfunctions with the airframe or engine that would have precluded normal operation. In an e-mail, the tower owner's lawyer reported that the tower was used for internet and two-way communications. He added that the tower was under 200 ft above ground level and "with the antenna attached, the tower was in the mid to upper 100 [foot] range." The lawyer reported that the tower was marked and lit appropriately and was not registered due its height.

Cause Narrative

THE NATIONAL TRANSPORTATION SAFETY BOARD DETERMINED THAT THE CAUSE OF THIS OCCURRENCE WAS: The pilot's failure to maintain clearance from an antenna atop a tower while maneuvering at a low altitude and the airplane's subsequent impact with terrain during an attempted off-airport landing.

Events

1. Maneuvering-low-alt flying - Collision with terr/obj (non-CFIT)
2. Maneuvering-low-alt flying - Loss of control in flight
3. Emergency descent - Off-field or emergency landing

Findings - Cause/Factor

1. Personnel issues-Psychological-Attention/monitoring-Monitoring environment-Pilot - C
2. Environmental issues-Physical environment-Object/animal/substance-Tower/antenna (incl guy wires)-Awareness of condition - C
3. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-Altitude-Not attained/maintained - C

Narrative

The pilot reported that while maneuvering at low altitude over a field during an aerial application flight, the airplane struck an antenna atop a tower adjacent to the field, and the antenna wrapped around the right wing and landing gear. The pilot further reported that he attempted an off-airport landing, but the airplane impacted terrain. The airplane sustained substantial damage to the fuselage, empennage, and both wings.

The pilot reported that there were no preimpact mechanical failures or malfunctions with the airframe or engine that would have precluded normal operation.

In an email with the tower owner's lawyer, he reported that the tower was used for internet and two way communications. He further reported that the tower was under 200 feet above ground level and "with the antenna attached, the tower was in the mid to upper 100 [foot] range." The lawyer reported that the tower was marked and lit appropriately and was not registered, due to the tower height.

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Accident Rpt# GAA17CA114	01/13/2017 1600 PST	Regis# N795DE	Coalinga, CA	Apt: Agro-west 5CA7
Acft Mk/Mdl BEECH B200-UNDESIGNAT		Acft SN BB-1510	Acft Dmg: SUBSTANTIAL	Rpt Status: Factual Prob Caus: Pending
Eng Mk/Mdl P&W PT6A			Fatal 0 Ser Inj 0	Flt Conducted Under: FAR 091
Opr Name: OPTIMAL AVIATION SERVICES		Opr dba:		Aircraft Fire: NONE
				AW Cert: STN

Summary

The pilot reported that, during the takeoff roll on a narrow runway about 70 to 80 knots, he noticed that the engines were not at full power. He advanced the throttles "a little further," but when he did so, the left main landing gear dropped off the left side of the runway into soft mud. Subsequently, the airplane veered off the runway to the left, the nose gear collapsed, and the airplane stopped in the mud.

The fuselage and engine firewalls sustained substantial damage.

The pilot reported that there were no preaccident mechanical malfunctions or failures with the airplane that would have precluded normal operation.

Cause Narrative

THE NATIONAL TRANSPORTATION SAFETY BOARD DETERMINED THAT THE CAUSE OF THIS OCCURRENCE WAS: The pilot's failure to maintain directional control during takeoff.

Events

1. Takeoff - Loss of control on ground
2. Takeoff - Runway excursion
3. Takeoff - Collision with terr/obj (non-CFIT)

Findings - Cause/Factor

1. Personnel issues-Task performance-Use of equip/info-Aircraft control-Pilot - C
2. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-Directional control-Not attained/maintained - C
3. Environmental issues-Physical environment-Terrain-Wet/muddy terrain-Contributed to outcome

Narrative

The pilot reported that during the takeoff roll on a narrow runway about 70 to 80 knots, he noticed that the engines were not at full power. The pilot further reported that he advanced the throttles "a little further," but when he did so, the left main landing gear dropped off the left side of the runway into soft mud. Subsequently, the airplane veered off the runway to the left, the nose gear collapsed, and the airplane stopped in the mud.

The fuselage and engine firewalls sustained substantial damage.

The pilot did not report any preaccident mechanical malfunctions or failures with the airplane that would have precluded normal operation.

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Accident Rpt# WPR16LA125 06/14/2016 1550 PDT Regis# N1076Y Bishop, CA Apt: Bishop BIH
Acft Mk/Mdl BELL 206-L1 Acft SN 45380 Acft Dmg: SUBSTANTIAL Rpt Status: Factual Prob Caus: Pending
Eng Mk/Mdl ALLISON 250 C30P Acft TT 34947 Fatal 0 Ser Inj 0 Flt Conducted Under: FAR 091
Opr Name: GLOBAL EQUITY INVESTMENTS, LLC Opr dba: Aircraft Fire: NONE

Events

1. Enroute-cruise - Fuel related

Narrative

On June 14, 2016, about 1550 Pacific daylight time, a Bell 206L-1 helicopter, N1076Y, was substantially damaged during an autorotative landing attempt near Bishop, California, following a loss of engine power during cruise flight. The private pilot and two passengers were not injured. The helicopter was owned by a private company and operated by the pilot under the provisions of Title 14 Code of Federal Regulations Part 91. Visual meteorological conditions prevailed, and no flight plan was filed for the cross-country flight that departed Corona Municipal Airport (AJO), Corona, California, about 1320. The personal flight was destined for Mammoth Yosemite Airport (MMH), Mammoth, California.

According to the pilot, the flight departed AJO with 110 gallons of fuel on board and flew direct to General Wm. J. Fox (WJF), Lancaster, California to avoid restricted airspace. He planned the flight around a forecasted headwind of approximately 15 knots. Once he reached WJF, the pilot then flew a direct course to MMH, but after more than 2 hours of flight in 30 knot headwinds and turbulence the pilot decided to land at Bishop Airport to service the helicopter, which only had 110 lbs (about 16 gallons) of fuel remaining. He began a descent from his cruising altitude, 12,000 feet mean sea level (msl), but as he passed below 10,000 feet msl, the pilot heard a "violent explosion in the engine compartment" and immediately felt the helicopter vibrate. He then observed an engine out light indication and quickly initiated an autorotation. During the helicopter's descent to land, the pilot made two attempts to restart the engine, but was unsuccessful. The pilot reported that he observed that he was "too high" in the last 2,000 feet of his descent. He subsequently pulled the collective early to avoid landing in a crater; however, the helicopter impacted the ground hard, which resulted in substantial damage to the tail boom.

A review of photographs supplied by the Federal Aviation Administration (FAA) showed the accident was surrounded by flat terrain and terrain suitable for landing. Further, images from an online mapping tool showed flat topography near the accident site.

According to FAA records, the helicopter was manufactured in 1980, and registered to Premiere Rotors, LLC on February 19, 2008. The helicopter was powered by a Rolls Royce M250 C30P, 650 shaft horsepower turboshaft engine, which was installed in 1992 in accordance with supplemental type certificate SH5695SW. A review of the aircraft logbooks revealed that the helicopter's most recent 100 hour inspection was completed on July 1, 2015 at which time the airframe had accumulated 34,947 total flight hours and the engine had accumulated 17,261 total flight hours. According to the registered owner, the accident pilot had entered into a lease-to-buy contract a few months prior to the accident with the intent of purchasing the helicopter.

According to a National Transportation Safety Board (NTSB) weather study, multiple weather forecasts that had been issued prior to the time of the pilot's departure, showed a probability of high winds throughout his route of flight. A National Weather Service Surface Analysis Chart depicted a thermal low pressure system over southern Nevada with a trough of low pressure extending northward. The chart showed a 12-hectopascal pressure gradient across southern California and supported strong wind gusts over the mountainous regions of eastern California. The winds aloft forecast for the area that had been issued about 6 hours prior to the pilot's time of departure and was valid beginning at 1400 indicated winds from the west-southwest at approximately 17 to 30 knots. An area forecast issued at 1245 forecasted southwesterly winds at 20 knots gusting to 30 knots. Further, multiple Terminal Aerodrome Forecasts that were issued on the morning of the accident flight indicated up to 30 knot wind gusts along the pilot's route of flight.

The weather at Bishop Airport (BIH), Bishop, California near the time of the accident indicated winds from 280 degrees at 7 knots, clear skies, temperature 32 degrees C, dewpoint -2 degrees C, and a barometric altitude of 29.76 inches of Hg.

The helicopter came to rest in a slight nose up attitude approximately 4 nautical miles from Bishop Airport, Bishop, California. The helicopter was subsequently transported to a secure facility in Rancho Cordova, California where an airframe examination was completed by representatives of the airframe and engine manufacturers under the supervision of the NTSB and FAA.

An initial inspection of the airframe revealed that the empennage had separated from the aft tailboom. The aft section of the tail rotor drive shaft at the tailboom displayed rotational scoring consistent with rotation at impact. The top half of the left end plate on the horizontal stabilizer was separated. One tail rotor blade

was bent, but remained attached to the tail rotor hub and its opposing blade was separated at the blade root. Both tail rotor blades displayed paint transfer markings at the leading edges and the separated blade exhibited a gouge mark near the outboard tip of the blade. Paint transfer markings similar in color to the color scheme of the accident helicopter were found on the outboard leading edges of one of the main rotor blades, which displayed bending opposite the direction of rotation.

According to the Bell 206L-1 flight manual, the helicopter's total fuel system capacity was 99.4 gallons. According to the owner, the helicopter was equipped with a fuel range extender that expanded the fuel tank size to accommodate a total of 110 gallons of usable fuel. The helicopter fuel system included two interconnected forward fuel tanks with a capacity of 11 gallons each. The remaining fuel quantity was contained within the main fuel tank, located below the aft cabin.

A fuel system diagram furnished by the helicopter manufacturer shows that fuel is transferred from the forward tanks to the main fuel tank using right and left boost pumps located in the main tank and an ejector pump located between the two forward tanks. Fuel is then pumped from the aft tank to the engine through an airframe mounted fuel filter. After the helicopter is started, the fuel boost pumps engage to begin directing fuel from the forward tanks to the aft tank. The fuel boost pumps can only be deactivated through two circuit breakers that control each pump.

Fuel line continuity was observed from the forward fuel tank to the inlet port of the engine driven fuel pump. Both the right and left fuel boost pumps operated normally and continuously when tested using the cockpit circuit breakers; the left fuel boost pump measured 8 psi and the right boost pump measured 5 psi. A representative of the FAA stated that he noted the fuel boost pump circuit breakers were extended, indicating that the pumps were OFF when he arrived at the accident site. The pilot reported that he flew with the fuel boost pumps ON, but subsequently pulled the fuel boost pump circuit breakers after the accident when the helicopter came to rest. An inspection of fuel recovered from the fuel pump inlet line appeared free of contaminants.

The fuel gauge, which monitors the fuel quantity from the left forward tank and the main fuel tank, indicated approximately 40-50 lbs. of fuel (5.88 - 7.35 gallons) during the postaccident examination. Subsequently, a representative of the FAA drained approximately 20 gallons of fuel from the helicopter's fuel sump. A sample submitted to a laboratory for analysis revealed that it displayed the same specifications as JET A fuel.

A fuel consumption of approximately 35 gallons per hour, furnished by the helicopter manufacturer, was used to compute the approximate fuel burn during the accident flight. Based on the pilot's reported fuel quantity of 110 gallons at the time of his departure, the helicopter would have burned about 88 total gallons of fuel during the 2 hour and 30 minute long flight.

Approximately 1 teaspoon of fuel was drained from the fuel feed line that was connected to the fuel spray nozzle and considered normal by the engine manufacturer. The fuel was clear in appearance and free of contamination. The fuel spray nozzle tip displayed a black soot pattern with no indications of carbon deposits, blockage or streaking.

Collective and cyclic control continuity was verified from the cockpit to the main rotor assembly. Tail rotor pedal continuity was traced from the tail rotor pedals to the tailboom.

A subsequent engine examination/test run was performed at the engine manufacturer's facility with oversight from the NTSB.

An initial engine examination revealed that the N1 and N2 tach-generator drive gears rotated freely by hand using a speed handle.

Both the upper and lower magnetic chip detectors were free of ferrous debris.

The compressor inlet was free of debris, but exhibited a build-up of black residue around the back edge of the compressor front support.

A leak test was performed after a soap solution was applied to all fittings, connections and air lines. Approximately 50 PSI of pressurized air was directed through the Pc pneumatic line, which revealed no presence of leaks as the soap solution was not excreted.

During the three test runs, the engine functioned normally at ground-idle, flight-idle, max-continuous power and take-off power. Additionally, during subsequent transient tests, when the power was reduced to flight-idle and rapidly advanced to take-off power, the engine responded normally and produced maximum power without hesitation. Further, the vibration measurements were within the prescribed limitations of the manufacturer.

According to the manufacturer, the engine performance was 4.8% below new engine production standards at maximum take-off power, which was attributed to a faulty anti-ice solenoid valve that had failed in the open position, as designed.

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Accident Rpt# WPR16LA142	07/17/2016 1409 PDT	Regis# N790RJ	Mt. Adams, WA	Apt: N/a
Acft Mk/Mdl BELL UH 1H-NO SERIES		Acft SN 70-16371	Acft Dmg: SUBSTANTIAL	Rpt Status: Factual Prob Caus: Pending
Eng Mk/Mdl LYCOMING T53-L-703		Acft TT 8885	Fatal 0 Ser Inj 0	Flt Conducted Under: FAR PUBU
Opr Name: KING COUNTY SHERIFFS OFFICE		Opr dba:		Aircraft Fire: NONE

Events

1. Landing - Loss of tail rotor effectiveness
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On July 17, 2016, about 1409 Pacific daylight time, a Bell UH-1H helicopter, N790RJ, impacted mountainous terrain while maneuvering near a landing zone located at an elevation of about 7,800 feet in Mount Adams, Washington. Two pilots, four crewmembers and two passengers were not injured; however, the helicopter sustained substantial damage. The helicopter was registered to and operated by the King County Sherriff's Department and was supporting a Search and Rescue (SAR) mission at the time of the accident. Visual meteorological conditions prevailed at the time of the accident, and no flight plan had been filed for the public flight that originated from Yakima Air Terminal/McAllister Field (YKM), Yakima, Washington about 1330.

The pilot reported that after refueling at YKM, he departed to transport two SAR personnel onto Mt. Adams to retrieve an injured hiker. While en route, a sensor unit on the helicopter indicated 5 knots of wind. As they approached the hiker from the north, the pilot used too much left pedal and decided to abort the approach. He attempted a second approach from the south, but the helicopter yawed to the right, which the pilot attributed to a loss of tail rotor effectiveness (LTE). In an attempt to recover, the pilot reduced the collective and applied forward cyclic. The helicopter spun about 540 degrees, impacted the ground, and then departed the mountain. The pilot did not observe any indications of a malfunction with the rotor or the drive system on the helicopter. In his subsequent report, he reported that there were no mechanical malfunctions or anomalies that could have precluded normal operation. The helicopter then returned to YKM.

The FAA issued Advisory Circular (AC) 90-95, Unanticipated Right Yaw in Helicopters, in February 1995. The AC states that LTE is a critical, low-speed aerodynamic flight characteristic that could result in an uncommanded rapid yaw rate, which does not subside of its own accord and, if not corrected, LTE could result in the loss of aircraft control. It also stated, "LTE is not related to a maintenance malfunction and may occur in varying degrees in all single main rotor helicopters at airspeeds less than 30 knots."

Paragraph 6 of the AC covered conditions under which LTE may occur. It stated: "Any maneuver which requires the pilot to operate in a high-power, low-air-speed environment with a left crosswind or tailwind creates an environment where unanticipated right yaw may occur."

Paragraph 8 of the AC stated: "OTHER FACTORS...Low Indicated Airspeed. At airspeeds below translational lift, the tail rotor is required to produce nearly 100 percent of the directional control. If the required amount of tail rotor thrust is not available for any reason, the aircraft will yaw to the right."

Paragraph 9 of the AC stated: "When maneuvering between hover and 30 knots: (1) Avoid tailwinds. If loss of translational lift occurs, it will result in an increased high power demand and an additional anti-torque requirement. (2) Avoid out of ground effect (OGE) hover and high power demand situations, such as low-speed downwind turns. (3) Be especially aware of wind direction and velocity when hovering in winds of about 8-12 knots (especially OGE). There are no strong indicators to the pilot of a reduction of translation lift... (6) Stay vigilant to power and wind conditions."

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Accident Rpt# ERA15LA135	02/24/2015 612 EST	Regis# N989FX	Baltimore, MD	Apt: Baltimore/washington Intl BWI
Acft Mk/Mdl CESSNA 208-B		Acft SN 208B2403	Acft Dmg: SUBSTANTIAL	Rpt Status: Factual Prob Caus: Pending
Eng Mk/Mdl P&W CANADA PT6A-114A		Acft TT 1103	Fatal 0 Ser Inj 0	Flt Conducted Under: FAR 135
Opr Name: MOUNTAIN AIR CARGO INC		Opr dba:		Aircraft Fire: NONE
				AW Cert: STN

Events

1. Taxi-from runway - Abrupt maneuver

Narrative

On February 24, 2015, at 0612 eastern standard time, a Cessna 208B, N989FX, was substantially damaged when its empennage struck the ground while taxiing at Baltimore Washington International Airport (BWI), Baltimore, Maryland. The airline transport pilot was not injured. Night visual meteorological conditions prevailed, and an instrument flight rules flight plan was filed for the flight, which originated from Newark Liberty International (EWR), Newark, New Jersey and was destined for BWI. The on-demand cargo flight was conducted under the provisions of 14 Code of Federal Regulations Part 135.

Following an uneventful flight, the pilot landed the airplane on runway 33R, before exiting to the left onto taxiway J. He then continued to taxi to the southwest and transitioned onto taxiway AA. As the airplane approached the intersection of the taxiway and a service road, a ground service vehicle approached from the airplane's right. The pilot applied the airplane's brakes and full reverse thrust, and the airplane came to a stop. The ground service vehicle passed in front of the airplane at an estimated distance of between 2 and 3 feet, and the vehicle and the airplane did not collide.

The pilot stated that the "hard" braking and reverse thrust application caused the nose landing gear strut to compress, resulting in a "spring effect that was multiplied by removing reverse thrust rapidly." The airplane then pitched up and the empennage struck the ground, resulting in substantial damage to the airframe. The pilot reported that there were no pre-accident mechanical malfunctions or failures of the airplane's systems.

The operator of the ground service vehicle stated that he was proceeding to the security gate and was reaching down to grab an airport badge. The operator noticed the airplane when he looked up and immediately "slammed" on the brakes. The vehicle eventually came to a stop after crossing the taxiway.

Review of security camera video showed a sequence of events consistent with the statements provided by the pilot and the ground vehicle operator. Additionally, the airplane was taxiing with its landing lights, taxi lights, strobe lights, and rotating beacon lights on. The ground service vehicle's headlights, taillights, running lights, and a roof-mounted beacon were also on.

The 0554 weather conditions reported at BWI included 10 statute miles visibility and scattered clouds at 22,000 feet. The beginning of civil twilight occurred at 0620 and sunrise occurred at 0647. Moonrise occurred at 1024.

Code of Maryland Regulations 11.03.01.04 K(1) titled "Yielding the Right-of-Way" states "Any person operating a motor vehicle on the air operations area shall yield the right-of-way to aircraft in motion or aircraft with engines running, ready to be put in motion."

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Accident Rpt# ERA16LA265	04/26/2016 1500 EDT	Regis# N145HN	Pittsburgh, PA	Apt: West Penn Hospital Heliport PN80
Acft Mk/Mdl EUROCOPTER DEUTSCHLAND GMBH	Acft SN 9302	Acft Dmg: SUBSTANTIAL	Rpt Status: Factual Prob Caus: Pending	
Eng Mk/Mdl TURBOMECA ARRIEL 1E2	Acft TT 3362	Fatal 0 Ser Inj 0	Flt Conducted Under: FAR 135	
Opr Name: AIR METHODS CORP	Opr dba:	Aircraft Fire: NONE		AW Cert: STT

Events

1. Enroute-cruise - Miscellaneous/other

Narrative

On April 26, 2016, about 1500 eastern daylight time, a Eurocopter Deutschland GMBH MBB-BK-117 C-2, N145HN, operated by Air Methods Corp, was substantially damaged during cruise flight to West Penn Hospital Heliport (PN80), Pittsburgh, Pennsylvania. The commercial pilot, three crewmembers and one patient were not injured. The on-demand air medical flight was conducted under the provisions of 14 Code of Federal Regulations Part 135. Visual meteorological conditions prevailed and a company flight plan was filed for the flight that originated from Grafton City Hospital Heliport (22WV), Grafton, West Virginia, about 1430.

The pilot reported that the patient transfer flight was the second flight of the day, following maintenance work that was performed on the helicopter earlier that morning. The patient transfer flight was uneventful; however, after landing the pilot noticed that the left vertical fin cowling had partially separated and came in contact with a tailrotor blade. The pilot added that 8 of the 11 fasteners on the left vertical fin cowling were unlocked.

Examination of the tailrotor blade by representatives from the helicopter manufacturer revealed that the tailrotor blade had sustained substantial damage.

Examination of the helicopter by a Federal Aviation Administration inspector revealed that the Dzus fasteners on the right vertical fin cowling remained secured while the Dzus fasteners on the left vertical fin cowling were unlocked, consistent with them not being properly secured by maintenance personnel following the maintenance work that was performed.

Additionally, the operator reported that there were no mechanical failures or malfunctions with the helicopter.

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Accident Rpt# WPR15GA030	10/29/2014 1711 PDT	Regis# N332AX	Oxnard, CA	Apt: Point Mugu Nas NTD
Acft Mk/Mdl HAWKER AIRCRAFT LTD HAWKER	Acft SN 41H-697448	Acft Dmg: DESTROYED	Rpt Status: Factual	Prob Caus: Pending
Eng Mk/Mdl AVON 203/7	Acft TT 3691	Fatal 1 Ser Inj 0	Flt Conducted Under: FAR PUBU	
Opr Name: ATAC	Opr dba:	Aircraft Fire: NONE	AW Cert: SPE	

Summary

The airline transport pilot was flying the single-seat turbojet airplane, which was owned and operated by a private company under contract to the United States Navy. The accident airplane was one of a flight of two airplanes that were returning to the airport to land at the conclusion of a training exercise. The accident airplane was to follow the lead airplane in an "overhead break" maneuver, which included overflying the runway, entering a descending, 270-degree turn to enter the downwind leg of the traffic pattern, then subsequently entering a descending, 180-degree turn to final approach. The recommended final approach airspeed was 150 knots (kts).

Witnesses observed both airplanes during the approach, and noted that the accident airplane's approach appeared lower and slower than that of the lead airplane. They stated that they observed the accident airplane in a left-wing-low bank, the wings rocked from side to side, then the airplane entered a rapid roll to the right and pitched down until it impacted the ground.

Recorded data recovered from the airplane's primary flight display unit revealed that the airplane crossed the runway's extended centerline about 5,900 ft from the runway threshold in a 30-degree bank at an airspeed about 126 kts. At this time, the airplane was on a magnetic heading about 25 degrees from runway alignment, at an altitude of about 328 ft; field elevation was 13 ft. Although the airspeed was well below the target airspeed, the airplane was on a heading, and in a geographic location, that permitted capture of the final approach path with bank corrections. Stall onset occurred several seconds later when the airplane was at a bank angle of 45 degrees, an airspeed of 114 kts, and an altitude of 276 ft. Data indicated that the pilot did not increase thrust significantly in the approach until at, or possibly about 1 second before, stall onset.

The stall was the result of the combination of an airspeed that was 46 knots below the minimum target value, and a bank angle that was significantly more than that required to capture the final approach path. Examination of the engine and flight controls did not reveal any mechanical deficiencies that would have adversely affected the performance or controllability of the airplane before impact.

The on-scene investigation revealed that the pilot did not attempt to eject from the airplane. Naval Air Systems Command simulations determined that a successful ejection could have been accomplished as late as 2 seconds before the end of the data (the data ended several seconds before impact).

Cause Narrative

THE NATIONAL TRANSPORTATION SAFETY BOARD DETERMINED THAT THE CAUSE OF THIS OCCURRENCE WAS: The pilot's failure to maintain adequate airspeed during the approach for landing, which resulted in the airplane exceeding its critical angle of attack and experiencing an aerodynamic stall/spin at an altitude too low for recovery.

Events

1. Approach-VFR pattern final - Aerodynamic stall/spin
2. Approach-VFR pattern final - Loss of control in flight
3. Uncontrolled descent - Collision with terr/obj (non-CFIT)

Findings - Cause/Factor

1. Personnel issues-Task performance-Use of equip/info-Aircraft control-Pilot - C
2. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-Airspeed-Not attained/maintained - C
3. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-Angle of attack-Not attained/maintained - C

Narrative

HISTORY OF FLIGHT

On October 29, 2014, at 1711 Pacific daylight time, a Hawker Hunter Mk 58, single-seat turbojet fighter aircraft, N332AX, crashed while on approach to Naval Air Station (NAS) Point Mugu, California (NTD). The airline transport pilot was killed, and the airplane was destroyed by impact forces and postimpact fire. The airplane was registered to Airborne Tactical Advantage Company (ATAC) and the non-military public flight was operated under contract to Naval Air Systems Command (NAVAIR) in accordance with the provisions of 49 United States Code (USC) Sections 40102 and 40125. Visual meteorological conditions existed at the accident site and the flight was operated on a visual flight rules flight plan.

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The purpose of the flight was to support adversary and electronic warfare training with Carrier Strike Group 15 (CSG15). The accident airplane departed NTD at 1500 as the wingman in a flight of two Hunters, intending to participate in an adversarial support air defense training exercise offshore in warning area W291. The flight's radio call sign was "ATAC 11," and the accident airplane was "ATAC 12."

The accident occurred during the "overhead break" arrival to land on runway 21. The procedures were to fly as a flight of two with ATAC 12 making a left break 4 seconds after the lead airplane, ATAC 11. ATAC 12 was to follow the lead in a descending, 270-degree turn to enter the downwind leg for runway 21. At the initiation of the base leg, the pilot was to make a continuous, descending, 180-degree turn, and roll out on final approach to land on runway 21. The normal final approach is flown at a recommended airspeed at or above 150 knots.

Witnesses reported watching both airplanes make the approach and noted that ATAC 12's approach appeared lower and slower than the lead airplane. ATAC 12 was observed in a left-wing-low bank, followed by the wings rocking from side to side, then a quick roll to the right, after which the airplane nosed down and impacted the ground.

A video recording of the accident sequence was recovered from a fixed location near the accident sight. The recording was consistent with witness observations.

PERSONNEL INFORMATION

The operator reported that the 45-year-old pilot held an airline transport pilot certificate with ratings for airplane multiengine land and commercial pilot privileges for airplane single-engine land and instrument airplane. The operator reported that the pilot had a total flight time of 3,727.1 hours, with an estimated 15.1 hours in the accident airplane make and model. The pilot was recently retired from the United States Air Force after serving 21 years. He had most recently been assigned as a pilot in the Air Force, and was current in the F-16. The pilot was hired by ATAC on September 22, 2014, started his initial training on September 23, 2014, and completed it on October 7, 2014. The pilot then reported to ATAC at Point Mugu to begin his operational training.

The accident flight was the pilot's 5th flight with ATAC since reporting from his initial training. The pilot flew one mission on October 28 totaling 1.8 hours. On October 26, the pilot flew two missions totaling 3.7 hours. On October 23, the pilot flew one mission totaling 1.8 hours. The pilot had previously flown one overhead break approach prior to the accident flight.

The pilot held a Federal Aviation Administration (FAA) first-class medical certificate, issued on May 21, 2014, with a limitation that the pilot must wear corrective lenses.

AIRCRAFT INFORMATION

The Hawker Hunter Mk-58 is a single-seat, single-engine, multi-role combat airplane, first introduced into service in 1956; it was originally manufactured by Hawker-Siddeley Corporation of the United Kingdom. The airplane has tricycle, retractable landing gear and a hydraulically-boostered flight control system. The airplane was powered by an Avon 203/7 turbojet engine rated at 10,150 lbs of thrust. The airplane was maintained in accordance with an approved aircraft inspection program. Its most recent inspection was completed on September 5, 2014, at a total aircraft time of 3,690.9 hours.

WRECKAGE AND IMPACT INFORMATION

The accident site was located in a strawberry field east of Highway 1 and north of the final approach path to runway 21.

Investigators examined the wreckage at the accident scene. The first identified point of contact (FIPC) was a ground scar with components of the right wing located in the ground scar. The debris path extended about 325 feet on a magnetic heading of 290 degrees. The FIPC was 0.7 NM from the approach end of runway 21, on a heading of 035 degrees.

Examination of the engine, which was still contained in the fuselage, exhibited signatures consistent with the engine operating at a high power setting at impact. The airframe flight control components were examined on scene with no abnormalities noted.

MEDICAL AND PATHOLOGICAL INFORMATION

The Ventura County Coroner completed an autopsy on October 31, 2014. The cause of death was blunt force injuries. The FAA Civil Aerospace Medical Institute (CAMI), Oklahoma City, Oklahoma, performed toxicological testing on specimens of the pilot. Analysis of the specimens contained no findings for carbon monoxide, cyanide, volatiles, and tested drugs.

TESTS AND RESEARCH

NAVAIR Flight Animation

The airplane was equipped with a single Garmin G3X panel-mounted display, which had a primary flight display with attitude/directional guidance, electronic engine monitoring, and moving map capabilities. The installed configuration recorded 57 parameters at 1 second intervals. The data card for the Garmin G3X was recovered at the accident site. Recovered data from the unit captured the accident flight, as well as the previous flights made by the accident pilot.

The NAVAIR Aeromechanics Safety Investigation Support Team (ASIST) used the G3X data to analyze the flight, and published its "Engineering Analysis and Supporting Data Quick Report" that concluded that the data was "of good quality and ... valid for the purposes of this investigation." Angle of attack (AOA or alpha) was not directly sensed on the airplane, and was not derived or recorded by the G3X, but the ASIST analysis used two different methods to calculate AOA. The accident flight data ended a few seconds short of impact, which the ASIST report attributed to G3X internal buffering activity. The ASIST report concluded that the airplane experienced an aerodynamic stall near the end of its turn from the downwind leg of the traffic pattern to final approach for landing.

The data from the Garmin G3X was submitted to the US Navy Safety Center, and a visual representation was produced of both the accident flight and the previous flight completed by the accident pilot. The visual representations are included in the public docket for this accident.

NTSB Airplane Performance Report

An NTSB review of the ASIST report did not reveal any data or conclusions that warranted re-evaluation or independent verification. However, in an effort to gain additional insight into the accident, the NTSB analyzed data from the accident flight and two other flights, ATAC 11, and the pilot's previous flight on October 26, 2014.

The recorded data did not include any direct measures of throttle position or engine thrust but did include engine exhaust gas temperature (EGT). That parameter was used as an approximation of thrust setting. During the approach maneuver, the EGT remained at a level consistent with a relatively low thrust level, possibly flight idle. The EGT began an increase to near-takeoff value concurrent with the aerodynamic stall.

Depending on flap setting in the approach, the 180-degree turn should have been flown between 160 and 180 kts; recorded data showed that the airplane slowed through 160 kts shortly after the 180-degree turn began.

The target minimum speed until the wings-level rollout from the 180-degree turn onto final was 160 kts; however, the recorded speed was 126 kts when the airplane reached the extended runway centerline.

In both the 270- and 180-degree turns, the pilot lost significantly more speed than ATAC 11 did. In the 270-degree turn on both his previous flight and the accident flight, the pilot decreased his speed by about 110 knots, which was 35 knots more than the speed decrease by ATAC 11. In the 180-degree turn during the accident flight, the pilot decreased his speed by about 55 knots, compared to 38 knots by ATAC 11.

Airplane separation/spacing distances between ATAC 11 and ATAC 12 met the applicable criteria, and did not substantiate any need for the observed speed decreases of ATAC 12.

Following the aerodynamic stall, the airplane rolled from 45 degrees left-wing-low to 71 degrees right-wing-low in about 7 seconds, while descending to 92 feet, at which time the data ended.

Ejection Seat

The on-scene investigation revealed that the pilot did not attempt to eject from the airplane; the ejection seat was activated upon impact. Navair-conducted simulations determined that a successful ejection could have been accomplished as late as 2 seconds before the end of the recorded data.

National Transportation Safety Board - Aircraft Accident/Incident Database

Accident Rpt# WPR16LA032	11/24/2015 945 PST	Regis# N50713	Carlisle, WA	Apt: N/a
Acft Mk/Mdl HUGHES 369D-D		Acft SN 710982D	Acft Dmg: SUBSTANTIAL	Rpt Status: Factual Prob Caus: Pending
Eng Mk/Mdl ROLLS ROYCE 250-C20B		Acft TT 17942	Fatal 0 Ser Inj 0	Flt Conducted Under: FAR 091
Opr Name: OLYMPIC AIR INC		Opr dba:		Aircraft Fire: NONE
				AW Cert: STN

Events

1. Enroute-cruise - Loss of engine power (total)

Narrative

On November 24, 2015, about 0945 Pacific standard time a Hughes 369D, N50713, sustained substantial damage during a forced landing following a loss of engine power near Carlisle, Washington. The helicopter was registered to and operated by Olympic Air, Shelton, Washington, under the provisions of Title 14 Code of Federal Regulations Part 91. The commercial pilot, sole occupant of the helicopter, was not injured. Visual meteorological conditions prevailed and no flight plan was filed for the repositioning flight. The flight originated from Hoquiam, Washington, about 5 minutes prior to the accident, with an intended destination of a staging area near Carlisle.

The pilot reported that he originally departed a staging area near Francis, Washington, where he was parked on a hillside, waiting for improving weather. Prior to departing, he added about 50 pounds of fuel, noting he had 250 pounds of fuel total on board. The pilot departed and decided to land at Hoquiam, after noticing that the fuel gauge quantity indication was not decreasing as he would have expected for the flight. The pilot landed uneventfully at Hoquiam, noted he had about 140 pounds of fuel on board according to the fuel gauge, which was consistent with his estimations of how much fuel should have been on board. The pilot decided to depart and relocate the helicopter 12 nautical miles to a staging area where he was planning to refuel the helicopter prior to conducting external load operations in the area. The pilot stated that during the flight, the engine lost total power. He initiated an auto rotation to a partially open wooded area. Subsequently, the helicopter landed and rolled onto its right side.

Postaccident examination of the helicopter by the pilot revealed that the tailrotor and tailrotor gearbox were separated from the tail boom. The helicopter was recovered to a secure location for further examination.

Examination of the recovered wreckage revealed that the main rotor blades were removed to facilitate wreckage transport. The tailboom had contact damage from main rotor blade strike(s) and was fractured into multiple segments. The tail rotor system was still attached to the tailboom's aft frame. The tail rotor blades were damaged but exhibited little rotational damage. All main rotor blades exhibited various areas of bends, leading edge and trailing edge damage.

Control continuity was established for the collective and cyclic controls. Except for breaks in the area of the tailboom damage, tail rotor control continuity was verified. The drive system was functional from the engine through the main transmission to the main rotor hub. The tail rotor driveshaft had multiple fractures aft of FS 150 due to impact damage. The tail rotor transmission and tail rotor controls functioned normally. The upper flight controls and main rotor hub sustained minimal damage.

Electrical power was applied to the airframe and the N2 warning horn was found functional. The caution light panel was tested and all normal lights illuminated, including the low level fuel light. At this time, the fuel gauge indicated zero pounds of fuel. The fuel cell access covers were removed and the cells inspected. Only a small amount of fuel was found in the sump area below the start pump.

The engine and related systems sustained little visible damage. A fuel system vacuum check was successfully completed. The airframe fuel filter was removed from the housing. The filter and housing exhibited a slight amount of foam-like debris. Similar debris was observed in the fuel boost pump and in both the left and right fuel tanks.

In order to examine the fuel gauge quantity accuracy, 20 gallons of fuel was added in intervals utilizing 5-gallon fuel cans. With electrical power applied to the helicopter, the fuel quantity indicated on the fuel gauge were measured. When 4, 5, 7.5, 10, 12.5, 15, and 20 gallons of Jet A, which weighs about 6.8 pounds per gallon, was added to tank, the fuel quantity gauge indicated about 40-45, 80, 100, 150, 155-160, 175, and 245 pounds of fuel respectively.

While removing the fuel which was previously added, the low level fuel light illuminated at which time the fuel gauge displayed about 70 pounds of fuel. After the low level fuel light illuminated, the remaining fuel within the tank was removed and measured at about 5 gallons.

National Transportation Safety Board - Aircraft Accident/Incident Database

Accident Rpt# GAA17CA135	02/08/2017 1130 MST	Regis# N6640Z	Price, UT	Apt: N/a
Acft Mk/Mdl HUGHES OH 6A-NO SERIES		Acft SN 66-16076	Acft Dmg: SUBSTANTIAL	Rpt Status: Factual Prob Caus: Pending
Eng Mk/Mdl ROLLS ROYCE 250-C20B		Acft TT 12701	Fatal 0 Ser Inj 0	Fit Conducted Under: FAR PUBU
Opr Name: USDA APHIS WS ATOC		Opr dba:		Aircraft Fire: NONE
				AW Cert: STN

Summary

The helicopter pilot reported that, after landing to refuel, he reduced power to flight idle and initiated a 2-minute cooldown before shutting off the engine. One minute into the cooldown, the fuel truck approached the helicopter from the rear and struck the main rotor blades.

The helicopter sustained substantial damage to the main rotor blades.

Cause Narrative

THE NATIONAL TRANSPORTATION SAFETY BOARD DETERMINED THAT THE CAUSE OF THIS OCCURRENCE WAS: The fuel truck driver's failure to stop before impacting the helicopter's main rotor blades.

Events

1. After landing - Ground handling event

Findings - Cause/Factor

1. Personnel issues-Experience/knowledge-Knowledge-Knowledge of procedures-Flight service personnel
2. Personnel issues-Psychological-Attention/monitoring-Monitoring environment-Flight service personnel - C
3. Environmental issues-Physical environment-Object/animal/substance-Ground vehicle-Effect on operation - C

Narrative

The helicopter pilot reported that after landing to refuel, he reduced power to flight idle and initiated a 2-minute cool down prior to shutting off the engine. He further reported that one minute into the cool down, the fuel truck approached the helicopter from the rear and struck the main rotor blades.

The helicopter sustained substantial damage to the main rotor blades.

The pilot reported that there were no preaccident mechanical failures or malfunctions with the airframe or engine that would have precluded normal operation.

National Transportation Safety Board - Aircraft Accident/Incident Database

Incident Rpt# WPR15IA244	08/17/2015 830 MST	Regis# N771RT	Page, AZ	Apt: N/a
Acft Mk/Mdl QUEST KODIAC 100-NO SERIES		Acft SN 100-0059	Acft Dmg: MINOR	Rpt Status: Factual Prob Caus: Pending
Eng Mk/Mdl PRATT AND WHITNEY PT6A-34		Acft TT 953	Fatal 0 Ser Inj 0	Flt Conducted Under: FAR 135
Opr Name: ARROW WEST AVIATION		Opr dba: REDTAIL AVIATION		Aircraft Fire: NONE
				AW Cert: STN

Events

1. Takeoff - Sys/Comp malf/fail (non-power)

Narrative

HISTORY OF FLIGHT

On August 17, 2015, about 0830 mountain standard time, a Quest Kodiak 100, N771RT, sustained minor damage when the pilot's seat slid aft and the airplane veered from the landing strip during the takeoff roll near Page, Arizona. The commercial pilot and five passengers were not injured. Redtail Partners, LLC owned the airplane and Arrow West Aviation (dba Redtail Aviation) was operating it under the provisions of Title 14 Code of Federal Regulations Part 135. Visual meteorological conditions prevailed and a company flight plan had been filed for the non-scheduled cross country flight. The flight was originating at the time of the accident with a planned destination of Canyonlands Field Airport, Moab, Utah.

The pilot stated that the purpose of the flight was to transport the passengers back to Moab, which required him to depart from a remote paved road that was regularly used as a runway. The airplane began the takeoff roll, and after about 100 feet down the road, the pilot's seat slid back abruptly to the full aft position. Because his right hand was positioned on the power lever for takeoff, the pilot inadvertently retarded the lever to the idle position as the seat slid aft. The pilot released his grip on the control yoke in an effort to keep the nose down. His feet were unable to reach the rudder pedals and with the seatbelt in the locked position, he was not able to manipulate his body forward to regain control.

The pilot further stated that the airplane began to veer to the left, continued off the pavement, and collided into a wire fence. After the airplane came to rest, the pilot was able to move the seat forward where he could reach the shoulder harness unlock-lever. The pilot and passengers egressed the airplane without incident.

AIRPLANE INFORMATION

The Quest Kodiak 100 is a high-wing, unpressurized, single-engine turboprop-equipped fixed tricycle landing gear airplane manufactured by Quest Aircraft. The airplane was configured with 10-seats, two of which were adjustable seats in the pilot (left) and co-pilot (right) position. According to the records examined, the airplane, serial number 100-0059, was manufactured in November 2011, and was purchased by the operator in 2012. At the time of the accident, the airframe had accumulated a total time in service of 953.4 hours. The operator reported that the most recent annual inspection was completed on May 23, 2015, at which time it had accumulated 864 total hours in service.

Standard seating for the airplane consists of six-way adjustable pilot and front passenger seat each equipped with a four-point passenger restraint system. They may be moved forward or aft, adjusted up or down and the seat back angle may be changed.

The incident seat was part number 100-825-5010-01 and manufactured by Millennium Concepts, Inc. The seat was designed with two latches located on both the right and left side that are lifted to enable the seat to move along the track. The seat track consisted of two metal rails that were affixed to the floor along the longitudinal axis. The rails had two scalloped edges facing toward one another at one-inch spacing, creating numerous circular receptacles where the seat stop would engage when the seat was locked into position. The foot weldments would slide in the rails' channel under the scalloped upper layer.

The latches were comprised of a plastic rocker-type handle that rotated about a plastic pin when raised upward. When lifted, two swages from the latch-end of the seat stop actuator cable would be pulled and in response the swaged end from the seat-track end would raise the seat stop (a pin-like metal cylinder that engages in the seat track receptacles). Each latch contained a swaged-end from both a left and a right side seat-stop actuator cable enabling both the left and the right seat stops to raise at the same time.

The seat stop contains a groove where the actuator cable swages (one from the right and one from the left latch) are captured. The locking foot cap, a four pronged housing, engages the seat stop and the locking foot spring is located between it and the seat stop pin. With a latch raised, one of the swages captured

National Transportation Safety Board - Aircraft Accident/Incident Database

in the seat stop pin (depending on if it was the right or left side latch) would override the force of the spring that normally holds the seat stop pin down against the lip of the foot weldment. This in turn would raise the seat stop pin leaving room between it and the bottom of the weldment lip (where the scalloped edges of the seat track rail can slide between). The latch gives no positive indication (feel) when effectively raised or lowered.

The airplane's Pilot Operating Handbook contains a checklist in the "Before Takeoff" section that lists "seat locked and secure."

TESTS AND RESEARCH

The seat was removed and examined by investigators from the NTSB and Quest Aircraft. The complete examination notes with pictures are in the public docket for this accident.

An external examination of the pilot's seat revealed that both the left and the right locking foot caps were damaged. Specifically, they were bent and the locking foot spring was displaced from the ridge it rests on. The forward tabs were bent forward resting outside of their respective foot weldments, the steel piece that slides on the bottom of the track that is positioned in between the stop halves. The aft tabs were bent forward and crushed about the aft foot weldment groove.

Investigators removed the copilot seat and installed it on the pilot seat tracks. On the first attempts, the seat operation appeared normal and throughout the course of all the testing conducted, it was not possible for investigators to disengage the seat from the engaged position unless a latch was raised.

Over numerous tests sliding the seat back on the rail with the locking pin initially disengaged, investigators were able to get the seat to move freely (not automatically lock the locking pin) only when applying an extreme side load or pulling one swage taught on the latch. Since the two feet are on independent systems, it was not understood how that could have occurred. The lack of positive response of the finger actuated latch made it difficult to verify if the seat was actually engaged.

Investigators were able to replicate the position the seat would need to be manipulated to bend the locking foot cap. This could occur if the front legs weldments were out of the seat track and the seat was tilted backward. This likely would take place during maintenance and/or installation if the aft feet were not disengaged from the seat track and the technician wanted to push the seat all the way aft to the passengers' seats. The manufacturer provided detailed procedures illustrating the proper way to remove and install the crew seats. It is unknown if the damaged locking foot caps contributed to the incident.

ADDITIONAL INFORMATION

Following the examination, Quest queried their operators to see if any similar incidents had happened. A pilot reported that during takeoff, with the airplane configured in a steep nose-up attitude, his seat slid back and he asked the co-pilot to take the controls. The pilot stated he never adjusted the seat to see if the seat latch was engaged, rather entered into the cockpit and flew.

National Transportation Safety Board - Aircraft Accident/Incident Database

Accident Rpt# WPR16LA075	02/23/2016 1145 PST	Regis# N266RH	Torrance, CA	Apt: Zamperini Field TOA
Acft Mk/Mdl ROBINSON HELICOPTER CO R66-NO	Acft SN 0002	Acft Dmg: SUBSTANTIAL	Rpt Status: Factual	Prob Caus: Pending
Eng Mk/Mdl ROLLS-ROYCE 250-C300/A1	Acft TT 400	Fatal 0 Ser Inj 0	Flt Conducted Under: FAR 091	
Opr Name: ROBINSON HELICOPTER CO	Opr dba:	Aircraft Fire: NONE		

Events

1. Maneuvering - Miscellaneous/other
2. Maneuvering - Miscellaneous/other

Narrative

HISTORY OF FLIGHT

On February 23, 2016, about 1145 Pacific standard time, a Robinson R66, N266RH, sustained substantial damage to the tailboom following a precautionary autorotation at Zamperini Field Airport (TOA), Torrance, California. The pilot, the sole occupant, was not injured. The experimental (research and development category) test helicopter was registered to and operated by Robinson Helicopter Company (RHC) as a test flight under the provision of 14 Code of Federal Regulations Part 91. Visual meteorological conditions prevailed, and no flight plan was filed for the local flight that originated from TOA at 1145.

The purpose of the flight was to test the auxiliary fuel system, low RPM horn, autopilot, and sprag clutch.

The pilot reported that he had performed a takeoff to a hover, a hover taxi, and one hovering autorotation without incident. He then executed a maximum performance takeoff. About 200 feet above ground level, the pilot heard a noise and felt a momentary helicopter vibration. Subsequently, he performed an autorotation to a grassy area on the airfield. After the helicopter landed in soft grass with forward momentum, it experienced a fore and aft rocking motion, and the main rotor blades contacted the tailboom.

HELICOPTER INFORMATION

The five-seat helicopter, serial number 0002, was manufactured in 2009. The operator reported that the helicopter's maximum gross weight was 2,700 pounds, and it weighed 2,047 at the time of the accident. The helicopter was powered by a 300-horsepower Rolls Royce 250-C300/A1 engine. The last annual maintenance inspection was conducted on October 15, 2015, at the total engine time of 363 hours. The airframe had a total of 400.04 hours at the time of the accident, as it had operated 20 hours since its last maintenance inspection. The engine was examined on March 4, 2016, at RHC, Torrance, California.

TESTS AND RESEARCH

A visual examination of the airframe components was conducted and no anomalies were found. There were no metal particles found in the oil filter and the chip detector. The Engine Monitoring Unit (EMU) data was downloaded and reviewed by a representative from Rolls-Royce. The EMU provided general information about the operation of the engine including time, cycles, faults and any exceedances of engine operating limits. The downloaded data corresponded to the entire accident flight. There were no exceedances noted in the data; however, at the time stamp 32.27.1 the power turbine (N2) peaked at 107.76% and the Torquemeter Oil Pressure (TMOP) peaked at 95.304% (275 ft/lbs). According to the Rolls Royce 300 Operational and Maintenance Manual, the limit for N2 is 110% for 15 seconds, and the torque limit during takeoff is 288 ft/lbs with a maximum transient of 430 ft/lbs.

With no pre-accident anomalies noted with the engine, the engine was test run on the helicopter through various power settings. No anomalies were noted during the engine exam. The engine data was downloaded after the engine runs, and no faults were noted in the data.

Following the engine run, the sprag clutch was inspected and it was revealed that the sprag clutch had moved between 45-90 degrees from its original position. The sprag clutch was then removed, and it was observed that it took about 550 pounds of torque to loosen the clutch assembly compared to the 300 pounds of torque used to tighten the clutch in the assembly process. The clutch was then inspected, and no anomalies were found.

A review of the maintenance logbook revealed that the new Revision E sprag clutch had been installed on the helicopter before the accident flight. The Revision E sprag clutch was compared to the previously installed Revision D sprag clutch, and the wear patterns appeared normal and consistent with those observed in the Revision E clutch assembly.

The complete engine report is appended to this accident in the public docket.

The Pilot's Operating Handbook states that a vibration can be an indication of a drive system failure. However, a drive system failure is also accompanied by nose right or left yaw, and a decrease of the rotor RPM while N2 RPM increases.

RHC Safety Notice SN-39, issued in July 2003, stated that an unusual vibration can indicate a main rotor blade crack. However, those vibrations are characterized as severe and the helicopter would be difficult to control.