NTSB Identification: LAX98LA166

HISTORY OF FLIGHT

On May 20, 1998, at 0500 hours Hawaiian standard time, a McDonnell Douglas 520N, N112HD, experienced an engine failure and made an emergency landing, 5 miles north of Lanai City, Maui, Hawaii. The helicopter was subsequently destroyed in a postimpact fire. The helicopter, operated by Windward Aviation Inc., under 14 CFR Part 135, was chartered by the Maui Police Department. The commercial helicopter pilot, two Maui Police Department officers, and a police dog were not injured. The third police officer received minor injuries. Visual meteorological conditions existed for the flight and a company visual flight rules (VFR) flight plan was filed. The flight had departed the Kahului, Hawaii, airport at 0435, and was scheduled to terminate at the Lanai airport.

The pilot reported that about 500 to 600 feet above ground level (agl) the engine chip light illuminated. Approximately 10 seconds later, the engine out light flickered and then fully illuminated. The pilot stated that as he performed an autorotation he heard a loud "bang." He stated that in his peripheral vision he saw either sparks or flames coming from the rear of the helicopter. The terrain was uneven at the landing site, and the helicopter rolled over on its right side. The pilot shut off the fuel and helped his passengers exit the helicopter. He attempted to put out the fire with the fire extinguisher; however, the extinguisher did not work. He attributed this to damage the fire extinguisher had incurred during the rollover.

The three passengers reported seeing the engine chip light illuminate and then the engine out light illuminate accompanied by a beeping sound. They had all heard a loud bang and then the pilot announcing that he had an engine out and that they were going down. The onboard witnesses reported that they saw flames coming from the fuselage prior to impacting the ground.

According to a Federal Aviation Administration (FAA) inspector, large holes were found in the main rotor blades. The inspector further noted that the blades from the number three and four turbine wheels were missing.

PERSONNEL INFORMATION

According to the pilot's written statement, he holds commercial and flight instructor certificates with a rotorcraft-helicopter rating. At the time of the accident he had approximately 7,221 total hours of flight time, all in helicopters. He had 2,568 hours in the McDonnell Douglas 520N; this included 222 hours in the last 90 days, 79 hours in the last 30 days, and 5 hours in the last 24 hours. The pilot holds a second-class medical, dated June 24, 1997, with limitations for corrective lenses to be worn. In addition, his last biennial was conducted on February 19, 1998 in an MD500D.

The three passengers were all police officers with the Maui Police Department. Also onboard was a police dog.

AIRCRAFT INFORMATION

According to the owner/operator of the helicopter, the power turbine section (CAT15396) was sent to an Allison authorized repair facility for an inspection due to high engine temperature and a turbine rub. In return, the service center shipped a rental turbine section (CAT80080) to the operator for use. The rental turbine section was installed at the time of the accident.

A review of the maintenance logs revealed that at the time of the accident, the airframe had a total time of 3860.7 hours, and the engine had 3757.2 hours. Records revealed that the original turbine section (CAT15396) had been removed for high engine temperature and turbine rub, and had been sent to an Allison authorized repair facility for inspection. A rental unit (CAT 80080) was installed on January 3, 1998. The reason for the removal of the turbine section (CAT 15396) was an N2 lockup. During the inspection it was found that the N2 coupling shaft had chipped splines.

After installation, a ground run was conducted on the rental unit with no discrepancies noted. The helicopter was then returned to service on January 3, 1998.

On February 9, 1998, the rental unit (CAT 80080) was removed and the original repaired turbine section (CAT 15396) was installed. On March 9, 1998, and March 11, 1998, an engine chip light illumination occurred. On the first occurrence, maintenance removed, cleaned, and reinstalled the lower plug. On the second occurrence, maintenance removed, cleaned, and reinstalled the top plug. Aircraft records do not indicate what was found on the plugs.

The chief maintenance person stated that the oil system was flushed per attachment 9, section 72-00-00 of the Allison Engine Company 250-C20R Series Operation and Maintenance manual. However, a review of the aircraft maintenance records did not reveal what specific work was done to the helicopter.

On May 12, 1998, the turbine section (CAT 15396) was removed and sent out again for inspection for the turbine rub and high engine temperature. The inspection of the turbine section revealed a misaligned seal, which was subsequently replaced. The unit was inspected and returned to service.

A rental turbine section (CAT 80080) was installed on May 12, 1998; a ground run and flight test were conducted with no discrepancies noted. On May 19, 1998, an engine chip light illuminated. The operator found a pasty substance on the chip detector. The chip detector was inspected in accordance with Allison engines Operation and Maintenance manual. The helicopter was found in airworthy condition and returned to service.

The accident occurred on May 20,1998.

According to attachment 9, section 72-00-00 of the Allison Engine Company 250-C20R Series Operation and Maintenance manual (appended to report), if a paste substance is found it is the result of fine soft particles that result from normal wear due to "gear mesh, bearing rotation and/or spline engagement." The manual further states that the paste does not "generally" cause a warning light. If a light is encountered the operator is instructed to perform the inspection of the magnetic plug in paragraph 10.G(3) of the manual.

Paragraph 10.G(3) of the manual states that the magnetic chip plugs are to be cleaned and a 30 minute ground run at power with the rotor turning is to be conducted. If ground check is normal, the chip detectors are to be removed, cleaned and reinstalled and the engine returned to service. If during the first 30 minute ground run, a chip light is detected, the oil should be drained, a clean engine filter installed, the aircraft oil system should be flushed in order to remove any circulating debris, engine chip detectors should be cleaned, and engine should be serviced with new oil. A second 30 minute ground run is then required. If a second chip light is encountered during the ground run, the owner is required to remove the engine from service and send it to an Allison authorized repair facility for inspection.

If no chip light is detected then the engine can be returned to service. Allison further states that if within the next 8 operating hours following the 30 minute ground run the chip light illuminates the operator should remove the engine and send it to an Allison authorized repair facility for inspection. However, the note states that it is only applicable if the oil drain and flush portion of 10.G(3) (C) has been completed, otherwise it is considered to be another event (See Attachment 9 appended to this report).

TESTS AND RESEARCH, External Engine Examination

An external examination of the engine took place on May 22, 1998, at the Kahului airport under the supervision of the FAA. The engine was coated with a magnesium ash residue and other fire byproducts. The compressor and turbine sections were not attached to the accessory gearbox housing and cover. The third stage turbine wheel was not found, and the fourth stage turbine wheel was recovered remote from the helicopter. Also missing were portions of the exhaust collector support, horizontal fireshield, and various other components.

Inspection of the gearbox assembly revealed that the power turbine drive gear assembly bearing cage was suspended from the spur adapter gearshaft. It also revealed a destroyed No. 3 bearing journal and a damaged helical power train drive (Pinion) gear with approximately 50 percent of the gear teeth ground away. Allison subsequently attributed the failure of the No. 3 bearing to the transference of axial loads normally carried by the No. 5 bearing.

No. 4 bearing journal was unseated but remained in position with the retaining pin still in place. Visual examination of the torquemeter gearshaft did not reveal any damage.

The third stage turbine wheel was not recovered. The fourth stage turbine wheel was recovered remote from the engine. According to Allison, the airfoils exhibited separation fractures at or near their roots.

Engine Disassembly and Inspection

The engine was disassembled and examined by a Safety Board investigator at Rolls-Royce Allison Engineering and Research Facility in Indianapolis, Indiana, on June 29-30, 1998.

The No. 3 bearing exhibited a coat of magnesium powder. The bearing outer race was removed and a curved piece of metal was found underneath. Allison identified this as part of the bearing journal, which had been reduced to about 25 percent of its original length. There were no recognizable remnants of the inner race, rollers, or separator from the No. 3 bearing.

The No. 4 bearing was intact and displaced about 0.25 inch aft of its seat. It was also coated with a magnesium powder that was attributed to the ground fire. Examination of the bearing revealed that it had seized, but did not show signs of a mechanical failure. No signs of wear or other damage were noted on the roller elements.

The pinion gear appeared to have separated just forward of the internal splines on the journal surface of the No. 3 bearing. Damage to the gear teeth was uniform and there was smearing damage on the remaining teeth segments.

The No. 5 bearing is housed inside the exhaust collector support bore and supports the forward end of the power turbine rotor. It also supports the majority of the thrust load from the power turbine. The bearing outer race section was removed to expose the bearing separator. The bearing separator was in place; however, the ball pockets were empty and distorted. The separator was removed and metal deposits on the surface of the inner race were observed.

The power turbine support and gas producer turbine was inspected; no anomalies were noted with either component. Allison reported that the uncontained overspeed failure of the power turbine rotor was due to the loss of power turbine gear train tooth engagement after the loss of the No. 5 bearing.

The magnetic chip detector exhibited a hardened magnesium residue that was covered with metal debris and was encased on the tip of one of the chip detectors.

The pinion bearing oil nozzle was examined. Air could be blown through the passages and a x-ray examination revealed no blockages or other anomalies. It was noted that the nozzle was distorted due to exposure to heat.

Lubrication System

The lubrication system on the Allison 250 series engine has a dry sump circulating system. An engine driven pump moves the pressure oil through machined passages and tubing to all critical areas of the engine. The main line bearings receive direct pressure oil. The No. 5 bearing receives filtered oil that travels from the gearbox header passage through the oil delivery tube to the gearbox cover, through the pinion bearing cage, and then the pinion bearing nozzle.

An oil delivery tube supplies oil to the No. 4 and No. 5 bearings. An examination of the lubrication system revealed that the No. 4 bearing was intact and did not exhibit visible damage. The oil delivery tube that supplies oil to the No. 5 bearing was not recovered. Allison stated that the tube is made of aluminum and it was assumed to have been consumed in the postimpact fire.

ADDITIONAL INFORMATION

Additional components used for testing from the helicopter were released to the owner's representative on January 28, 1999.

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