# AVIATION OCCURRENCE REPORT

## ENGINE FAILURE

FIREWEED HELICOPTERS LTD.
BELL 206B (HELICOPTER) C-FNIQ
DAWSON, YUKON 60 NM NORTH
24 JULY 1997

REPORT NUMBER A97W0142

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## *Summary*

The pilot of the Bell 206B helicopter (serial number 1743) had departed an exploration camp after delivering supplies, and was going to pick up two workers at a site about three miles west of the camp. In cruise flight, at an altitude of about 100 feet above ground level (agl), the engine (Allison 250C20) suddenly failed. During the autorotation the pilot stretched the glide in order to cross a creek to a level landing area. The rotor rpm decreased resulting in a loss of lift, and at touchdown the left skid dug into the ground and the helicopter rolled onto its right side. The pilot reported that the engine had failed without any unusual noises or instrument indications, and that there was adequate fuel on board. There were no injuries, but the helicopter was substantially damaged.

*Ce rapport est également disponible en français.*

# *Other Factual Information*

The weather at the time of the accident was an overcast ceiling of 300 feet agl, visibility of 8 miles, temperature of 15 degrees Celsius, and light winds. Weather was not considered to be a factor in this occurrence.

The pilot was certified and qualified for the flight in accordance with existing regulations. He had about 8,000 hours total flying time, and about 6,000 hours on the Bell 206.

Records indicate that the helicopter was maintained in accordance with existing regulations. A 300-hour inspection had been completed 29.3 air hours prior to the occurrence. During the inspection, the fuel nozzle was replaced because it was time-expired, and the tail rotor was re-balanced. There were no reported unserviceabilities at the time of the occurrence.

When the engine quit, the helicopter had about 39 U.S. gallons of Jet B fuel on board. The fuel tank was ruptured at impact by the rear landing gear cross-tube, and ground evidence at the scene indicated spillage of a considerable quantity of fuel. All fuel lines and filters were intact, and contained fuel with no visible contaminants.

Field examination of the wreckage found no evidence of pre-impact failure of any structure or systems, with the exception of the engine driven fuel pump (EDP). The EDP drive shaft could be rotated, but did not drive the pumping gears. This drive shaft disengagement was a result of excessive wear of the splines on the drive shaft and the splines in the driver gear.

The EDP (Model No. MFP263, Part No. 113300-01A1, Serial No. AKV0216), was manufactured by Chandler Evans Control Systems Division of Coltec Industries (CECo), and installed on this engine on 15 November 1995. Total time since new (TTSN) and total time in service (TTIS), at the time of failure, was 6,55.5 hours. The recommended time between overhauls (TBO) is 3,500 hours.

The EDP model MFP263 is one of a new family of pumps which have been in production since 1993, and were placed in service by Allison Engine Company on their 250 series engines in late 1994. CECo has reported that none of the MFP 263 pumps had accumulated 3,500 hours TTIS as of the occurrence date.

This occurrence was one of three failures of the same model pump reported to CECo within the period of about one week, all with the same problem of the shaft-to-gear disengagement due to spline wear. The other two aircraft were on the ground when the pumps failed at around 800 and 850 hours TTSN respectively, and were not reported as occurrences.

The pump was disassembled and all components examined at CECo, with TSB investigators, Federal Aviation Authority (FAA) inspectors, and Allison Engine Company (Allison) representatives in attendance. Components of the pump met all of the physical and metallurgical specifications, with the exception of the drive shaft and driver gear spline wear. A reddish powder deposit was found coating the passages and shaft seal; it was determined that the powder matched the specification of the spline material and had oxidized. Small sections of

the splines which had previously broken away were also found in the high pressure fuel filter downstream of the fuel pump, after having passed through the pump bypass, inlet, and the pumping gears. It was not determined what caused the wear of the splines.

Several reports from operators in the field have indicated that the MFP263 pumps have a higher level of vibration and roughness during operation than equivalent pumps from other manufacturers on the same engines, and that the MFP263s are much noisier when operated on Jet B fuel than on Jet A fuel.

Material specifications indicate that Jet B fuel has a higher percentage of naptha to kerosene than Jet A, and therefore would have lower levels of lubricity. Jet B is blended for superior low temperature combustion properties, and is more widely available in colder climates. Initial certification endurance test information regarding fuels used and times run were not available, but both fuels are approved for use.

In normal operations, fuel from the tank is delivered to the EDP by electric boost pumps at a pressure of about 15 to 20 pounds per square inch (psi). The EDP then increases the fuel pressure for delivery to the fuel nozzle in the combustion chamber. A minimum operating pressure of 30 psi is required to open the metering valve in the nozzle to initiate a primary flow condition for starting, a minimum pressure of 150 psi is required to open the valve to a secondary flow position for idle and flight power, and the maximum pressure required at full throttle is about 600 psi. Failure of the EDP will cause the fuel pressure to drop to boost pump pressure, resulting in the closure of the metering valve, and shutting down of the engine.

# *Analysis*

It was concluded that the engine stopped when the engine driven fuel pump failed due to the disengagement of the drive shaft splines from the driver gear splines. Because of the suddenness of the failure, the pilot had no warning that a problem existed.

The pilot was transiting at 100 feet agl when the power loss occurred, which reduced the number of landing sites available for an autorotation landing. Stretching his glide to cross a creek resulted in a decrease in rotor rpm, which affected the pilot's ability to reduce the helicopter's forward speed and rate of descent prior to touchdown. As a result, the left skid dug into the ground and the helicopter rolled onto its right side. Many factors play a role in the ability of the pilot to carry out an autorotation without damage to the helicopter. In this case cruising at a higher altitude may have eliminated the need to stretch the glide, and allowed the pilot to maintain rotor rpm to control the landing.

# *Findings*

1. The engine stopped due to fuel starvation caused by the failure of the engine driven fuel pump.

2. The engine driven fuel pump failed due to excessive wear of the splines of the drive shaft and the driver gear .

3. It could not be determined what caused the excessive wear of the splines.

4. The pilot was flying at an altitude which reduced his choices of landing sites for the autorotation.

## *Causes and Contributing Factors*

The engine lost power because the engine driven fuel pump failed. The cause of the pump failure was disengagement of the drive shaft splines from the driver gear splines due to excessive wear.

## *Safety Action*

The Chandler Evans Control Systems Division is continuing to investigate a number of possible external causes of the premature and excessive wear of the splines, such as misalignment in the pump or engine gearbox, fuel contamination, harmonic vibrations, flow rate through the splines, and fuel lubricating qualities.

On 30 July 1997, Chandler Evans Control Systems Division initiated the collection of most of the 567 model MFP263 pumps that had been delivered at the time of this occurrence, for tear-down examination of the drive splines. It is reported that several pumps were found to have abnormal wear on the splines.

Allison Engine Company issued a Commercial Engine Bulletin on 21 August 1997, requiring removal and inspection of the affected fuel pumps for drive shaft backlash, which would be an indication of wear. Initial inspection is to be accomplished within 25 operating hours from receipt of the bulletin, with recurring inspections every 100 hours thereafter until further notice.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 18 June 1998.*