Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A00W0105

COLLISION WITH FENCE

BAILEY HELICOPTERS LTD.
BELL 206B (HELICOPTER) C-GIFR
HELMUT, BRITISH COLUMBIA
01 JUNE 2000

Canada

Aviation Investigation Report

Collision with Fence

Bailey Helicopters Ltd.
Bell 206B (Helicopter) C-GIFR
Helmut, British Columbia
01 June 2000

Report Number A00W0105

Summary

The pilot was conducting a positioning flight from Key Pile Camp, British Columbia, to the airstrip at Helmut, a distance of 10 kilometres. The pilot descended on approach over surrounding trees while headed in an easterly direction toward the west side of the threshold of runway 31. The pilot had been in radio communication with a helicopter operating in the immediate area and did not indicate any emergency situation. The helicopter descended rapidly in a nose-low, right-banked turn. The approach path was cluttered with temporary buildings, vehicles, and water-filled dugouts. The lower vertical fin of the helicopter struck a steel pipe fence located on the west side of the threshold of runway 31. The fuselage contacted the threshold surface in a nose-down, right-side-low attitude, breaking off the skid gear and cross tubes. The helicopter swung around in a clockwise direction, came to rest on a magnetic heading of 213 degrees, and was consumed by fire. The pilot did not escape from the wreckage and succumbed to the fire. The occurrence happened at about 0755 Pacific daylight time, in daylight conditions.

Ce rapport est également disponible en français.

Other Factual Information

The weather at the time of the occurrence was reported as sky conditions clear, light and variable winds, and temperature 10 degrees Celsius.

The Helmut strip is 2025 feet above sea level (asl).[1] The compacted earth surface of the runway threshold area is raised about two feet above the surrounding terrain. The steel pipe fence was installed in the lower terrain, and the top of the fence was about 17 inches higher than the threshold surface. Calculations indicate that the helicopter, which was equipped with high skid gear, would have had to have been in a flared attitude (nose-up) when the lower fin initially contacted the fence. This would have resulted in an abrupt arrest of forward flight and a severe nose-down pitching moment. The operator's helipad is about 600 feet east of the threshold of runway 31.

The pilot held a valid Canadian commercial helicopter licence, endorsed for the Bell 206. He had recently arrived from Australia and was flying commercially in Canada under a Citizenship and Immigration Canada permit. He had an Australian commercial helicopter pilot's licence and experience on the Bell 206, Bell/Kawasaki 47, Robinson R-22, and MD 269 helicopters. The pilot had flown a total of about 1000 hours, of which 63 hours were on a Bell 206 helicopter. He had successfully completed company training and had passed a Transport Canada pilot proficiency check. He was not wearing a helmet. Based on the autopsy and the toxicology examination, there was no indication that the pilot's performance was degraded by physiological factors. The pathologist reported internal deceleration injuries that are consistent with being thrown forward in the cockpit at impact.

The logbooks and the maintenance records indicate the Bell 206B, serial number 681, had been certified, equipped, and maintained in accordance with existing regulations and approved procedures. It was reported that, on departure from the camp at Key Pile, the helicopter had 50 US gallons of fuel on board. The helicopter had no known deficiencies before the flight and was being operated within its load and centre of gravity limits. The airframe had accumulated about 9903 hours since manufacture. The last inspection (100-hour) was conducted on 29 May 2000; the last recorded maintenance was the replacement of a time-expired engine bleed valve on 31 May 2000. The helicopter was not equipped with an automatic engine re-ignition kit. The Camair cabin heater system, installed in the helicopter, uses a heat exchanger shroud over the hot section of the engine and a circulation fan into the cabin.

The fuel-fed fire consumed the majority of the helicopter, except for the aft portion of the tail boom. The ignition source of the fire could not be determined. The flight controls, fuel system, hydraulics, instruments, avionics, electrical system, and annunciator panel were largely destroyed. The engine (Rolls-Royce/Allison 250-C20) and transmission were damaged by the fire but remained relatively intact. A strip examination of the engine and the transmission indicated that they were capable of normal mechanical operation.

A strip examination of the fire-damaged engine fuel control unit (Honeywell/Bendix DP-N2, part number 2524644-29) determined that one of the screw heads securing a ratio lever cover

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1 Units are consistent with official manuals, documents, and instructions used by or issued to the crew.

(fuel section) had separated and had been retained by a braid of lock wire. The O-ring providing a cover seal was found incomplete: a section had burned away in the vicinity of the failed screw. Examination of the separated screw head (Honeywell part number 78315) by the TSB Engineering Laboratory determined that the failure resulted from hydrogen embrittlement cracking. The hydrogen most probably originated from the cadmium plating operation and was retained or not removed during subsequent baking treatment. A few parts per million of hydrogen dissolved in steel can cause hairline cracking and loss of ductility. Even when the quantity of hydrogen in solution is too small to reduce ductility, hydrogen embrittlement cracking may occur.

The TSB Engineering Laboratory determined that the failed screw did not meet the strength specifications of the part drawing. The ultimate tensile strength (UTS) of the failed screw was significantly greater than the maximum specified UTS. Four additional screws of the same type were recovered from the fuel control unit and did not conform to the strength specifications. The failed screw, and other screws on the same fuel control unit, were unapproved parts. The fuel control manufacturer determined that the failed screw came from a large bulk purchase from a parts supplier in 1995 and had been installed when the subject fuel control had been overhauled at the manufacturer's west coast overhaul facility in 1996. It was determined from examination of sample screws from this shipment that the entire lot was non-conforming with the screw drawing requirements for heat treatment, marking of an X on the head, and pitch diameter shank dimensions under the screw head. The manufacturer's practice is to replace all screws at overhaul.

A bench test of a sample fuel control unit was conducted by the unit's manufacturer. With the screw head missing, the cover began leaking when the fuel flow reached about 177 pounds per hour (pph). When leaking started, the fuel flow decreased to about 111 pph. The engine manufacturer determined that at a fuel flow rate of 111 pph, the engine would be capable of 101 shaft horsepower. The normal power output at 177 pph is 250 shaft horsepower.

The fuel control unit is mounted on a drive pad on the right side of the engine gearbox, with the ratio lever cover facing downwards. The starter/generator is mounted directly under the fuel control unit. A cooling fan in the aft end of the starter/generator circulates outside air through the unit, exhausting near the forward mounting flange. Fuel leakage into this area could pose a risk of fire.

Typically, when a helicopter strikes the ground in a nose-low attitude and the main-rotor blades make ground contact, there are obvious indicators of high rotational energy. A number of low-energy signatures, indicative of low main-rotor rpm (revolutions per minute), were observed on the wreckage and impact area. These low-energy signatures included the short distance the fuselage travelled after impact, the minimal damage to the main-rotor blades, the lack of bending or distortion of the mast or stops, the lack of damage to the mountings for the transmission pylons, the lack of engine-to-transmission-coupler displacement, and the minimal pylon stop / spike contact.

There were no eyewitnesses to the ground impact, although some residents at the Helmut strip saw the descent and heard the crash. Apparently, the sound of a turbine engine accelerating was heard just before the ground contact. There were no reports of smoke or flames coming from the helicopter before impact.

Analysis

The failure of the fuel control unit ratio lever cover screw during normal engine operation would have resulted in a sudden spray of fuel into the engine compartment, producing a strong jet fuel smell in the cockpit through the cabin heater ducts. Although the fuel leakage may not have been sufficient to result in an engine flame-out, it would have decreased power output below that required to sustain flight. It is probable, based on the smell of fuel and the decrease in power, that the pilot would carry out an immediate autorotational landing. Because the area being overflown was cluttered with vehicles, trailers, and dugouts, the pilot would have attempted to stretch the autorotational glide to a clear area. Stretching the glide, with the helicopter at low altitude and relatively low airspeed, would have resulted in a loss of main-rotor rpm. This is consistent with the low-energy signatures found at the impact site. The cause of the reported sound of the engine accelerating just before impact could not be determined.

The pilot's deceleration injuries are the likely result of his being thrown forward in his seat when the helicopter struck the fence during the landing. Helmets have been found effective in improving tolerability to deceleration injuries that can temporarily immobilize an individual, thus reducing his chances of survival by subjecting him to post-crash hazards.

The following TSB Engineering Laboratory Reports were completed:

LP 63/00—Main Rotor Transmission Drive Shaft, and
LP 72/00—Fuel Control Unit Screw Head Separation.

These reports are available upon request from the Transportation Safety Board of Canada.

Findings as to Causes and Contributing Factors

1. A screw on the engine fuel control unit failed, resulting in fuel leakage and a decrease in engine power below that required to sustain flight.

2. The screw did not conform to the manufacturer's drawing or heat treatment specifications and failed because of hydrogen embrittlement cracking.

3. While the pilot attempted to autorotate the helicopter to a suitable landing area, the main-rotor rpm decayed, and the helicopter struck a steel pipe fence.

Findings as to Risk

1. The failed screw in the fuel control unit was an unapproved part.

2. The pilot was not wearing a helmet.

Safety Action Taken

Transport Canada has notified the manager of the US Federal Aviation Administration Suspected Unapproved Parts Program of the safety concerns of Transport Canada and the TSB regarding the failed fuel control unit screw.

Corrective action by Honeywell International Inc. is in process or has been taken, as follows:

- submit Honeywell Service Bulletins GT-316 and GT-317 to Rolls Royce, the engine manufacturer, to provide instructions for inspecting and replacing non-conforming screws. The inspection includes fuel controls installed on aircraft, in repair facilities, including spare units, and screw inventories;
- issue a Fuel Metering General Service Information Letter (SIL-100) requiring all non-conforming screws to be scrapped;
- revise the Honeywell South Bend part number 78315 drawing to clearly define allowed materials and hardness requirements;
- request an update to the AN503 drawing with recommendations for changes similar to those incorporated in the Honeywell 78315 drawing;
- issue Supplier Corrective Action Request (SCAR) to the screw distributor with flowdown requirements to all sub-tier suppliers and processors; and
- file a Suspected Unapproved Parts Notification form with the FAA.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 08 May 2001.