AVIATION OCCURRENCE REPORT
A98W0181

LOSS OF CONTROL/HARD LANDING

CANADIAN HELICOPTERS LTD.
EUROCOPTER AS350B ASTAR (HELICOPTER) C-FSLF
SLAVE LAKE, ALBERTA 22 mi S
31 AUGUST 1998

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Summary

The pilot of the Eurocopter AS350B helicopter, serial No. 1975, was on approach for landing at a remote site with a load of five fire-fighters. At about 20 feet above ground level (agl) on final, while reducing the rate of descent for landing, the pilot heard the low rotor horn. He was unable to control the descent rate, and the helicopter landed hard. The helicopter contacted the ground on the tail stinger and the right skid then bounced forward. The tail boom separated and the forward extension of the right skid tube broke off. The right forward cross tube dug into the soft sand surface, the helicopter pitched nose-down, pivoted in a clockwise direction, and fell on its right side. The engine (Turbomeca Arriel 1B) continued to run and was shut down by the pilot. The four passengers in the rear bench seat slid to the right as the helicopter fell on its side, forcing the right rear cabin sliding door off its track. The passenger sitting in the right rear seat fell partially out of the helicopter, and his upper body was pinned between the sliding door and the fuselage. The other passengers managed to lift the fuselage enough to rescue the trapped passenger. The occupants were taken to a local hospital for treatment.

Ce rapport est également disponible en français.

Other Factual Information

The landing site was a large, unprepared sand pad located beside a creek at about 2 300 feet above sea level (asl). Three sides of the landing site were bordered by 75- to 80-foot tall trees. The approach was conducted from the east over shorter trees along the creek bed. At the time of the occurrence, 1740 mountain daylight time (MDT), the temperature was reported to be about 17 degrees Celsius, and the wind light and variable.

The helicopter's weight and balance was within limits and the centre of gravity was within the normal range. The maintenance log-books contained no evidence of uncorrected deficiencies relevant to the circumstances of the occurrence. The fuel sampled was of the proper grade and quality, and contained no contamination. The emergency locator transmitter (ELT) activated on impact. Reference to the *Aircraft Flight Manual* determined that the helicopter was capable of hover out of ground effect in the conditions existing at the time of the occurrence.

The pilot was certified and qualified for the flight in accordance with existing regulations, and had flown a total of about 5 000 hours of which about 275 hours were on type. The pilot reported that the low rotor horn sounded while he was on final at about 20 feet agl and that, despite application of collective, a high rate of descent developed that could not be arrested. He was unable to recall any instrument readings during descent. The main rotor (NR) speed is normally 385 rpm, and the low rotor speed warning (horn/light) activates at 360 rpm.

Following examination of the wreckage, the engine was run in a test cell. It was determined that the bleed valve (Le Bozec - part No. 9550158260) was operating erratically and would occasionally close at a slower rate than normal. When the bleed valve was functionally checked on a test bench, it initially stuck in the open position. The bleed valve is an electro-pneumatic component that helps to prevent surging and compressor stall during engine acceleration by bleeding a certain amount of air from the outlet of the axial compressor overboard. It normally closes at 96 per cent gas generator (NG) speed and opens at 94 per cent NG speed. A delay in the closure of the bleed valve would result in a loss of engine performance. Test cell data indicated a loss of about 63 shaft horsepower (47 kW) if the bleed valve does not close.

Examination and testing of the bleed valve, as observed by TSB Engineering Branch personnel at an authorized overhaul facility, determined that the component had been incorrectly assembled when manufactured. The rack and pinion gearing that operates the butterfly valve had not been correctly indexed when it was assembled, resulting in the butterfly valve not opening fully. Following functional testing in the as-received condition, the bleed valve was disassembled, and when the butterfly valve gears were assembled correctly, the bleed valve operated normally. It was also determined that contamination had been deposited on the internal surfaces of the valve components. The air discharge from the engine compressor (P2) contains concentrated fine particles of dust and sand, ingested by the engine in normal operation. These deposits can result in reduced clearances and binding in the operation of the valve. Dust contamination was found in the small filter installed in the P2 inlet line fitting. The overhaul facility indicated that the contamination found in this valve is typical of the valves received for repair. The operator's records indicate a significant number of bleed valve

replacements in its AS350 fleet. Service Difficulty Reports (SDR) indicate six reported failures of this valve in service. The bleed valve had accumulated about 2 071 hours since manufacture, and is normally overhauled "on condition." This bleed valve had never been overhauled.

Examination of the helicopter wreckage indicated that considerable structural distortion had taken place in the passenger cabin, resulting in the right rear sliding door partially disengaging from its tracks. When the helicopter rolled on its right side, the weight of the four rear seat passengers sliding to the right, combined with cabin distortion, forced the sliding door open, allowing the right rear passenger to partially fall out. It was reported that the trapped passenger was in severe distress from the weight of the helicopter on his upper body. The rear seat passengers were wearing lap-belts, but not the available shoulder harness. The short duration of the flight may have influenced the passengers in not using the two-point shoulder harness provided.

Analysis

The analysis will focus on the operational effect of a malfunctioning bleed valve and the use of shoulder harnesses.

Failure of the engine to develop full power due to a slow-closing bleed valve at a critical stage of flight could result in the pilot raising the collective control excessively and over-pitching the main rotor blades. Over-pitching further reduces main rotor rpm which increases the rate of descent. Recovery from this situation would require lowering the collective which in this case would not be possible due to ground proximity.

Had the rear seat passengers been wearing correctly tightened shoulder harnesses, the tendency to slide sideways during rollover may have been reduced. The timely action of the passengers in lifting the helicopter off the trapped passenger likely saved his life.

The following TSB Engineering Branch Laboratory report was completed:

LP 109/98 - Bleed Valve Examination

Findings

1. The pilot was certified and qualified for the flight.

2. The bleed valve malfunctioned during descent preventing the engine from developing full power.

3. The pilot, while attempting to arrest the rate of descent, applied collective pitch which resulted in over-pitching of the main rotor.

4. The pilot was unable to arrest the rapid descent and landed hard.

5. The bleed valve was incorrectly assembled when manufactured and contaminated, resulting in erratic operation.

6. The rear right cabin sliding door was forced open during rollover, trapping a passenger.

7. The timely action of the passengers in lifting the helicopter off the passenger likely saved his life.

Causes and Contributing Factors

The helicopter pilot was unable to control the rate of descent while on a steep final approach because of a malfunctioning engine bleed valve and landed hard. The cause of the bleed valve malfunction was contamination and incorrect assembly during manufacture.

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 14 October 1999.