Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A05P0184

LOSS OF CONTROL

QUANTUM HELICOPTERS
MD HELICOPTERS MD500D C-GWPQ
TERRACE, BRITISH COLUMBIA, 35 nm NW
02 AUGUST 2005

Canada

Aviation Investigation Report

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Summary

The MD Helicopters MD500D helicopter (registration C-GWPQ, serial number 700755D) departed the Terrace Airport, British Columbia, at 1559 Pacific daylight time, to retrieve a geological survey crew from a mountain 35 nautical miles northwest of the Terrace Airport. The pickup point was on a 25-degree slope within a bowl-like feature commonly referred to as a cirque. The steepness of the slope required the pilot of the skid-equipped helicopter to conduct a toe-in procedure at the pickup site. During the attempt, there was a loud bang, and the helicopter dropped tail-low. The helicopter subsequently began an uncontrolled right turn and struck the terrain 30 yards downhill from the pickup point.

The fuel cell compartments ruptured from impact forces, and a fire ensued. The geological survey crew assisted the pilot from the burning helicopter and performed emergency first aid until the air ambulance arrived at 1840. The pilot, the sole occupant of the helicopter, was seriously injured. There were no injuries to persons on the ground. The helicopter was destroyed by impact forces and the intense post-crash fire.

Ce rapport est également disponible en français.

Other Factual Information

At the time of the attempted pickup, 1630 Pacific daylight time,[1] the weather was clear, the temperature was 15°C, and the winds were calm.

Approximately 50 per cent of the helicopter by weight was destroyed in the post-crash fire. Although the main transmission, rotor head, engine, and accessory gearbox were subject to the post-crash fire, it was possible to conduct a detailed examination of these components. No mechanical defects were found. The main rotor blades were broken at the root and were severely damaged during the accident sequence. Impact marks on the main rotor blade grips indicate that the blades were in a positive pitch position at impact. There were no ground scars at the pickup site resulting from a main rotor blade strike.

During the crash sequence, the last 12 inches of the tail boom, the majority of the tail rotor drive shaft, the tail rotor, and the tail rotor gearbox detached from the helicopter and landed 32 yards away from the main wreckage. These were the only aircraft components not damaged by the post-crash fire. The tail rotor blades were intact, but indications of a tail rotor strike with the terrain were evident. The tail rotor drive shaft exhibited a torsional twist and subsequent fracture at the forward end of the shaft, indicating that the tail rotor experienced a sudden stoppage while under power. Detailed examination of the tail rotor gearbox and tail rotor blades did not reveal any mechanical anomalies. The tail rotor blades had dried mud extending from the tips to approximately 80 per cent of the blade span. Similarly, there was mud splatter on the upper and lower vertical stabilizers and "T-tail." Ground scars aft and to the right of the pickup site were consistent with a tail rotor strike.

The flight controls were examined to the extent possible and no anomalies were found. However, the majority of the flight controls within the cockpit of the helicopter were consumed by the post-crash fire.

The engine was disassembled and examined by TSB and Rolls Royce investigators. Most of the fuel components and control lines were damaged by either the crash sequence or the post-crash fire. The fuel control unit (FCU), governor, and engine driven fuel pump were disassembled and examined for anomalies, but none were found. The turbine, compressor, and accessory gearbox were also examined and no anomalies or defects were found. However, there was sufficient fire damage to preclude a determination of engine rotation. There was insufficient fuel remaining after the fire to conduct a fuel analysis. The pilot did not recount any difficulty with the engine.

Weight and balance calculations of the helicopter at the time of the accident indicate that the centre of gravity (CG) was 103.98 inches aft of the datum, within the CG limits of the helicopter.

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1 All times are Pacific daylight time (Coordinated Universal Time minus seven hours).

The MD500D's main rotor rotates counter-clockwise (when viewed from above). The anti-torque tail rotor counteracts the helicopter's tendency to rotate in the opposite direction (to the right) of the torque produced by the main rotor blades. With a constant power setting, the reduction or loss of tail rotor torque would cause the helicopter to yaw nose right/tail left. Conversely, a reduction of main rotor torque would cause the helicopter to yaw nose left/tail right.

Two linear cyclic trim actuator assemblies are installed in parallel with the longitudinal and lateral control paths of the cyclic. The actuator is a motor-driven, variable length shaft that moves a spring assembly that counteracts feedback forces from the main rotor and compensates for imbalance conditions such as those imposed by crosswinds or unevenly distributed weight. Forces produced by the actuators and springs can be overcome by the pilot with an input force of 30 pounds or more. The actuators are operated by a trim switch located on top of the pilot's cyclic grip. The cyclic trim switch has five positions: off at centre, forward, aft, left, and right. When the trim switch is moved off centre to any of the four trim positions, one of the trim motors operates to provide trim spring force in the desired direction.

Although the actuators were severely burned, position information was obtained by X-ray analysis. The lateral actuator motor (part number 8222M6) was found to be 2.4 inches from the retract position, which equates to approximately neutral lateral cyclic position. The longitudinal actuator motor (part number 8222M7) was found to be 0.875 inch from the retract position, which equates to near full-forward cyclic trim. The trim control switch, located on the pilot's cyclic, was destroyed by the post-crash fire.

A search of Transport Canada's Service Difficulty Report database for this helicopter type revealed multiple trim runaway events, the majority of which were caused by defective cyclic trim switches. The pilot in this incident did not indicate a problem with the trim control of the aircraft.

Major repair work had recently been completed on the helicopter following a hard landing and rollover in June 2004 (TSB report number A04P0206). An overhauled engine, engine gearbox, and main rotor gearbox were installed. At the time of the accident, the helicopter had flown 5.1 hours since completion of the major repair work.

Paramedic personnel in British Columbia are provided by the British Columbia Ambulance Service (BCAS). The BCAS paramedics support the medical response of both air and ground ambulances. Air ambulance aircraft (helicopter and aeroplane) are hired under contract to BCAS from commercial air carriers. Dispatch of these air assets is controlled by the Provincial Air Ambulance Coordination Centre (PAACC).

Joint Rescue Coordination Centre (JRCC) Victoria is responsible for planning, coordinating, controlling, and conducting aeronautical and maritime search and rescue operations. Once the JRCC is notified, all available information about the person(s) in danger is gathered and recorded, and the positions of potential assisting resources in the area of the incident are identified. Search and rescue coordinators, within the JRCC, are trained to evaluate the situation and send the most effective resources (including those under the control of the PAACC) to deal with a particular incident.

The helicopter operator raised concerns regarding delays encountered during the rescue operation. As part of the investigation, the TSB was asked by the operator to determine why these perceived delays occurred. The TSB established the following timeline in order to determine what delays, if any, occurred during the rescue of the pilot.

At approximately 1645, the geological survey crew at the site started calling for assistance using a satellite phone, but the calls did not get out, perhaps because of the location of the accident site. At 1712, using a combination of radio and satellite communications, the survey crew contacted Quantum Helicopters and advised them of the accident and the requirement for immediate medical assistance. Quantum Helicopters then contacted the PAACC directly to request an air ambulance. JRCC Victoria was notified of the accident at 1714. JRCC Victoria did not dispatch search and rescue resources at this time, as actions initiated by Quantum Helicopters and the PAACC appeared to be providing fast transportation and medical response. Quantum Helicopters had a B206 helicopter ready to go, but it could carry only one medic and two were required. At 1724, the PAACC contacted Canadian Helicopters in Terrace to request a larger helicopter.

By 1800, it was verified that a suitable landing area was available, a Canadian Helicopters Astar was ready at Terrace, and the medics were en route to Terrace. By 1820, the Astar was en route to the accident site, arriving at 1840. At 1900, with the patient on board, the Astar departed the site, arriving at the Terrace hospital at 1930.

Analysis

The trim actuator motors indicated a near, full-forward cyclic trim position. The pilot did not indicate any problem with the aircraft longitudinal control. Therefore, it is unlikely that a trim runaway occurred or contributed to this accident.

There was no evidence to suggest that the previous hard landing and rollover or the subsequent repair contributed to this accident. Although the fire damage precluded a determination of engine rotation, the damage to the main rotor blades and the pilot's observations indicate that the engine was producing power at impact.

There are only a limited number of scenarios in which the tail of a helicopter would drop rapidly during a toe-in procedure. The first scenario is that a malfunction of the cyclic or collective pitch controls could cause the pilot to lose control of the aircraft resulting in a tail strike. However, due to the severe post-crash fire, continuity and functionality of the collective and cyclic pitch mechanisms could not be determined.

The nature of a toe-in procedure causes the tips of the skids to act as a pivot point for the helicopter. Another scenario is that any momentary loss of engine power or reduction in main rotor torque would likely cause the tail to drop rapidly and the helicopter to yaw nose left–tail right. Due to the damage to the engine and accessory components, it could not be determined if there was a power loss.

The tail drop and tail rotor impact marks to the right and rear of the helicopter, indicating a counter-clockwise yaw, are consistent with a reduction in engine torque. Once the tail rotor contacted the ground, the tail rotor drive shaft sheared and the helicopter began to yaw rapidly clockwise. Control of the helicopter at this point would be difficult to regain and, given the terrain, a successful emergency landing was not possible. It should be noted that, because the helicopter flew a short distance from the pickup site before striking terrain, some degree of engine power was likely available after the tail rotor strike. Due to the severity of the post-crash fire, the reason for the loss of control and the corresponding tail drop could not be determined.

As a result of the damage to the helicopter, there was insufficient physical evidence to explain what caused the loud bang before the tail strike.

Although there was some delay in the initial request for medical assistance from the accident site and some delays in organizing appropriate medevac transportation, the combined delay was not unreasonable given the remote location of the accident site.

It should be noted that Canadian Forces search and rescue resources were approximately two hours from the accident site. Due to this two-hour response time, rescue of the pilot was completed faster using local resources. Had JRCC Victoria taken control of the situation on initial notification, it is likely that it would have used similar local resources to rescue the pilot, and there would not have been a significant difference in response time.

Findings as to Causes and Contributing Factors

1. The reason for the tail drop and corresponding tail rotor strike could not be determined.

2. Once the tail rotor contacted the ground, the tail rotor drive shaft sheared and the helicopter began to yaw rapidly clockwise. Control of the helicopter was lost and, given the terrain, a successful emergency landing was not possible.

3. The fuel tank ruptured during the crash sequence, spraying the cockpit area with fuel. This resulted in an intense post-crash fire severely injuring the pilot and destroying physical evidence.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 16 August 2006.