Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A06C0154

LOSS OF CONTROL – IN-FLIGHT BREAKUP

HELI–LIFT INTERNATIONAL INC.
BELL 204B C-GSHK
STONY RAPIDS, SASKATCHEWAN, 22 nm SW
24 SEPTEMBER 2006

Canada

Aviation Investigation Report

Loss of Control – In-flight Breakup

Heli-Lift International Inc.
Bell 204B C-GSHK
Stony Rapids, Saskatchewan, 22 nm SW
24 September 2006

Report Number A06C0154

Summary

The Heli-Lift International Inc. Bell 204B helicopter (registration C-GSHK, serial number 2067) was being used to conduct external load operations south of Stony Rapids, Saskatchewan, slinging drill rods between drill sites. Approximately three minutes into the flight, the pilot radioed that his side bubble window door had come open and that he was having difficulty holding the door. The pilot released the sling load and the helicopter was observed climbing in a steep nose-up attitude before momentarily stopping on its tail, then dropping nose down. As the helicopter descended toward the ground, there was an explosion. The helicopter crashed approximately 22 nautical miles southwest of Stony Rapids and was destroyed by impact forces and a post-crash fire. The pilot, the sole occupant of the helicopter, was killed. The crash occurred during daylight hours at 1811 central standard time.

Ce rapport est également disponible en français.

Other Factual Information

Visual meteorological conditions were observed at the time of the occurrence. The 1800 central standard time[1] wind at Stony Rapids, 22 nm northeast of the accident site, was from the northwest at three knots. The wind at the accident site was estimated to be from the northwest at 13 to 17 knots.

The helicopter underwent a 100-hour inspection on 23 July 2006, approximately 80 flight hours before the accident. A review of the helicopter's technical records indicated that the helicopter was maintained and certified in accordance with existing regulations, all routine and special inspections were complete, and component life limits were adhered to. At the time of the occurrence, there was one defect that had not been rectified, the removal of the heater vent valve, which was minor in nature and did not affect the serviceability of the helicopter. A weight and balance computation for the accident flight indicated that the helicopter was operating within the weight and centre of gravity limitations.

The pilot was qualified for the flight in accordance with existing regulations and held a valid commercial pilot licence. His total helicopter flight time was about 10 700 hours, approximately 600 of which were in the Bell 204/205 series. He had about 3000 hours of experience in long-line operations. The pilot had completed a Transport Canada pilot proficiency check (PPC) on the Bell 205 on 22 December 2005. As the Bell 204/205 series are similar in nature, Transport Canada regards them as sharing a common licensing certification. The PPC was assessed as a good ride with a very experienced pilot.

The pilot underwent a Category 1 Civil Aviation Medical Examination on 29 June 2006. The pilot was assessed as being fit and in good health. An autopsy was performed after the accident and the post-mortem report indicated that the pilot had quite significant atherosclerosis in his left anterior descending and right coronary arteries with over 70 per cent stenosis or blockage. It could not be determined whether the blockage had an adverse effect on the pilot in this occurrence. The pilot had no recorded history of cardiovascular disease and his last electrocardiogram (ECG) on 12 December 2005 was considered normal.

The pilot had recently been hired by Heli-Lift International Inc. He took the company initial ground training and visual flight rules (VFR) flight training on 21 and 22 July 2006. The flight training included an initial type-training refresher on the Bell 204 system operation and failures, emergency procedures, company procedures, and flight exercises. The ground training included the recognition, prevention and recovery procedures associated with certain abnormal in-flight conditions such as vortex ring state and settling with power.

The ground training did not include training about the hazards associated with mast bumping, nor was it a requirement. A survey of operators of medium Bell helicopters found that the hazards associated with excessive blade flapping and mast bumping were not consistently included in recurrent training curricula.

---

[1] All times are central standard time (Coordinated Universal Time minus six hours).

The Heli-Lift International Inc. Bell 204B helicopter was being used under contract to move two drilling rigs from drill site to drill site as new exploration progressed to the southwest of Stony Rapids. The pilot's first job with the company was the repositioning of the drill rigs from Stony Rapids, which he began on 15 September 2006. The pilot had arrived in Stony Rapids approximately two weeks before the occurrence and had completed a full move of both drilling rigs during the first week. Late in the afternoon of 24 September 2006, the smaller of the two rigs was ready to be moved again, and the pilot was called to begin the move. The time between the movements of the drilling rigs was approximately one week. The pilot had not flown the week between the moves and was scheduled to be rotated out of Stony Rapids the day following the occurrence.

The helicopter can be flown from either the right or left seat position. The left seat position is equipped with a bubble window door that provides downward visibility to facilitate the positioning of the long-line hook for load pickup. On the day of the accident, the helicopter was parked at the Stony Rapids Airport, across the ramp from the fuelling source. In preparation for flight, the occurrence pilot got into the left seat and hover taxied the helicopter to the fuel tanks, where it was fully loaded with fuel. The long-line was stowed in the rear of the helicopter.

A ground worker noticed during the taxi that the bubble door was slightly ajar, indicating that it was closed but not latched. Before take-off after the fuelling, the ground worker again noticed that the door was slightly ajar. He walked over to the helicopter, pushed on the door, and rotated the outside handle to the latched position. The ground worker then waved at the pilot who departed for the 20-minute flight from Stony Rapids to the old drill site, approximately 20 nm to the southwest.

The helicopter landed at a temporary helipad, out of view of the workers at the old drill site. The pilot installed the long-line and moved the helicopter to the drill site where the first load of drill rods was attached to the long-line hook. The helicopter pilot and ground workers were in radio contact during the hook-up procedure. The helicopter lifted the load and transited from the drill site without difficulty.

Approximately three minutes after departure, the pilot radioed an urgent message that he was experiencing a problem with his door. A senior company pilot flying two or three miles away responded. The occurrence pilot asked whether he could release the sling load. The company pilot agreed and asked whether a landing was possible. The occurrence pilot indicated that he could not land because he was holding onto the bubble door with his hand and was afraid of losing the door. There were no more radio transmissions with the helicopter.

The helicopter was at an estimated height of 700 feet above ground level (agl). The helicopter had no sling load attached and was climbing in a nose-up attitude. The climb got progressively steeper until the helicopter was approximately 1000 feet agl. The helicopter paused momentarily in a nose-high attitude, and then dropped nose-down. It descended steeply and, at approximately 500 feet agl, an explosion occurred. Smoke and flames trailed behind the helicopter until impact.

The main wreckage was located 1.8 nm from the old drill site and approximately 0.8 nm south of a direct track to the new drill site location. Numerous helicopter components were found spread along a track of about 295°T for approximately 1950 feet. The length of the wreckage

trail and steep impact attitude were consistent with the helicopter suffering an in-flight breakup. A ground fire ensued, which started a forest fire and destroyed much of the main wreckage.

The first pieces along the wreckage trail were light items carried within the helicopter. The next items were pieces of main rotor blade skin, pieces of the cockpit and overhead windows, a piece of the instrument panel glare shield, battery cover pieces, the left horizontal stabilizer, and a piece of tail rotor blade. The main rotor assembly and stabilizer bar, the tail rotor assembly, and portions of the 90-degree tail rotor gearbox were approximately 600 feet from the main wreckage. The main rotor mast assembly was completely fractured and distorted in a symmetrical oblong nature from contact with the main rotor hub static stops. The wreckage path and damage pattern indicated that the main rotor mast had separated from the helicopter.

The bubble door hinges and latching mechanism were in the burnt remains of the main wreckage. The door was still connected by its hinges to the door frame, and the emergency door release handle was in the stowed position. The door latches and door handle were in the unlatched position. Most of the engine and engine accessories were destroyed by fire. A visual examination found the internal turbine wheels to be intact. The hydraulic flight control servos were completely destroyed by fire and could not be examined. An examination of the remaining flight control systems did not reveal any discrepancies.

The Bell 204B helicopter's left and right pilot doors are equipped with three roller-type latches, two at the top of the door and one at the rear of the door. When the door is initially closed, the rear roller rolls over a pawl extending out from the rear door frame to hold the door closed. To latch the door, the door handle is rotated 90° forward to the closed or latched position. The rotation of the door handle extends the top rollers and latches them behind plates mounted on the upper door frame. The rear roller extends and latches behind the pawl mounted in the rear door frame. A positive lock is accomplished by over-centre linkage. Care has to be taken when closing the door. Over time, these mechanisms often wear due to inherent airframe vibrations and the top rollers may not latch behind the plates if the top of the door is not pulled in tightly when the handle is latched. This often requires two hands to accomplish. If the door is not latched properly, normal airframe vibration may pop the door open in flight. If a cockpit door opens in flight, it will normally stay in the trail position and will virtually be impossible to close until the forward speed is reduced to a near-hovering condition. The doors are also equipped with an armrest to provide support for the pilot's arm during flight.

A door-opening incident happened on the occurrence helicopter two to three weeks before the accident. Another company pilot had been performing long-line operations from the left seat position. After completing the lift, the pilot set the helicopter down to load passengers into the rear cabin. The pilot exited the left door, removed the long-line, loaded the passengers, and re-entered through the right door to fly back in the right-seat position. Upon exiting the left bubble door, the pilot closed the door but forgot to latch it. During the return flight, at approximately 60 to 80 knots airspeed, the left door popped open. Neither the pilot nor any of the passengers in the rear cabin could reach the door. The door opened approximately six to eight inches and stayed in a trailing position. No significant door flapping or controllability problems with the helicopter were noted. The pilot slowed the helicopter and hovered over the ground where he instructed one of the rear cabin passengers to unbuckle, lean forward and close and latch the door. The flight continued on without incident.

The Bell 204B helicopter is fitted with a teetering, two-bladed main rotor system. The teetering design allows the main rotor blades to flap in order to compensate for asymmetrical lift during flight. Static stops are mounted on either side of the main rotor hub to physically limit the amount of blade flapping when the rotor is not turning. A condition known as mast bumping occurs if the static stops contact the mast due to excessive blade flapping during flight.

Excessive blade flapping and mast bumping can occur when there is sudden reduction in *g* loading on the main rotor. This can happen if the helicopter transitions suddenly from a climb to forward flight. The sudden level-off causes a reduction in *g* loading and thrust on the rotor blades as the helicopter becomes momentarily weightless. Because the main rotor is not generating thrust, the tail rotor thrust, being above the helicopter's longitudinal axis, causes the helicopter fuselage to roll sharply in the direction of the tail rotor thrust. The main rotor maintains its previous attitude and the clearance between the rotor head and the mast is reduced.

The application of lateral cyclic control on the unloaded main rotor has little or no effect to counteract the roll of the fuselage, and acts only to further reduce the clearance between the head and the mast. If the main rotor blades flap too far in one direction in relation to the mast, the static stops on the main rotor hub can strike the rotor mast violently enough to cause separation of the main rotor from the helicopter.

To recover from a low-*g* condition, the best corrective practice is to apply aft cyclic, which loads the rotor system and in turn produces thrust. Once lateral cyclic becomes effective, the helicopter can be rolled to a level attitude.

Analysis

There was no indication that a pre-occurrence mechanical discrepancy contributed to the accident.

A loss of engine power was not considered to be a factor in this occurrence because the helicopter was seen climbing and under power after the pilot declared a problem with the open door. The explosion was considered to have resulted from the flailing of the transmission to engine main drive shaft after the main rotor separated from the helicopter. The shaft is located in the engine compartment adjacent to fuel and hydraulic lines, any of which, if breached, could have caused the in-flight fire.

The pilot left the bubble door unlatched on two occasions during his flight preparation before departure from Stony Rapids. A ground worker latched the door, and the pilot transitioned to the old drill site with the long-line stowed in the rear of the helicopter. To use the long-line, the pilot would have had to exit the helicopter, remove the long-line from the rear cabin area, attach it, and then get back into the left seat position. Because the door latches had been functional just before the occurrence flight, and the door opened during the flight, it is likely that the pilot did not fully or properly latch the door upon re-entering the helicopter.

The sudden opening of the door in flight would be a startling event. During this phase of flight, the pilot would likely have been resting his elbow on the armrest attached to the door, which would have pulled away from him while opening. In forward flight, the door bubble would act as an aerofoil with the air stream pressure differential pulling the door open and making it difficult to close. The urgency in the pilot's radio transmissions and his stated action of trying to hold the door so he would not lose it indicates that he was unfamiliar with this type of event. In a prior door-opening event on the same helicopter, the bubble door opened approximately six to eight inches and stayed in a trailing position, with no major flapping of the door or controllability problems with the helicopter. If the pilot had been aware of the nature of a door-opening event, it is likely that he would have been less concerned.

The pilot indicated that he could not land because he was holding the door with his hand. This implied that the pilot was holding the door with his left hand and therefore could not operate the helicopter's collective control to adjust the rotor blade angle. To slow the helicopter to the point where he would be able to close the door, he would have had to ease back on the cyclic control with his right hand to raise the nose of the helicopter and bleed off airspeed. Without adjusting collective, the helicopter would climb in a nose-high attitude as observed.

The climb got progressively steeper before the nose suddenly dropped. The dropping of the nose is consistent with the pilot pushing forward on the cyclic control in an attempt to recover from the nose-high attitude. The pilot should have been aware of the dangers of mast bumping through the pilot's initial helicopter licensing training and subsequent experience with helicopter operations. It is likely that, in the pilot's preoccupation with the open door, he did not apply the corrective actions required to recover from a nose-high attitude. This allowed the helicopter to enter a low-*g* condition, which in turn led to mast bumping and the in-flight breakup of the helicopter.

The symmetrical oblong nature of the mast fracture indicates that both blade static stops contacted the mast equally. Had a failure occurred in one of the blades, the resulting difference in blade flapping deflections would likely have resulted in an asymmetrical failure or distortion of the mast.

It is not known if a pre-existing medical condition had any effect on the pilot during this occurrence.

Findings as to Causes and Contributing Factors

1. The pilot's left-side bubble door opened during flight, likely because it was not closed and properly latched.

2. In the pilot's preoccupation with the open door, it is likely that he allowed the helicopter to enter a low-*g* condition, which led to mast bumping and the in-flight breakup of the helicopter.

Safety Action Taken

As a result of this occurrence, Heli-Lift International Inc. has included additional documented training in its initial ground briefings to cover inadvertent door openings in flight and has fitted all of its helicopters with an automatic pneumatic door opener. This will prevent the doors from being closed unless they are fully latched.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 17 May 2007.

Visit the Transportation Safety Board's Web site (www.tsb.gc.ca) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.