

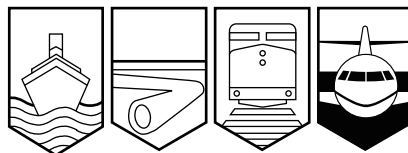
Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

AVIATION INVESTIGATION REPORT

A02Q0021



IN-FLIGHT ENGAGEMENT OF COLLECTIVE LEVER LOCK

HÉLI-INTER INC.

EUROCOPTER AS 350 BA C-FPOO

VAL-D'OR AIRPORT, QUEBEC

22 FEBRUARY 2002

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Aviation Investigation Report

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Summary

Héli-Inter Inc. AS 350 BA, registration C-FPOO, serial number 2508, with one pilot and two aircraft maintenance engineers (AMEs) on board, was making a series of flights to adjust rotor blade alignment and autorotation rpm. On the second autorotation of the flight, the collective lever locking plate accidentally engaged without the pilot's knowledge and locked the flight control against the low stop. About 800 feet above ground level (agl), the pilot tried to arrest the descent and pulled on the locked collective lever, but he could not free it. The aircraft continued its descent and, after the flare, landed hard. The pilot was uninjured and the AMEs sustained minor injuries. The aircraft did not catch fire but sustained substantial damage. The time of the occurrence was 1348 eastern standard time.

Ce rapport est également disponible en français.

Other Factual Information

History of the Flight

Three days before the occurrence, the pilot and the company check pilot did several practice autorotations. They noted that autorotation rpm was 60 rpm slower than the speed specified for the aircraft weight at the chosen altitude.

On the day of the occurrence, an aircraft maintenance engineer (AME) working for Hélicopter Inc., an approved maintenance organisation (AMO), backed off the collective low stop screw six turns to raise autorotation rpm. He also had to remove, adjust, and reinstall the collective lock located on the floor. The pilot and one AME then made three flights to adjust main rotor blade alignment. Those flights were without incident. The fourth flight, which was the occurrence flight, was to check the rotor rpm on autorotation. The pilot and two AMEs were on board the helicopter. At 1200 feet above ground level (agl), the pilot performed an autorotation with the collective against the low stop at a speed of 80 mph. On this check, he reduced drive power to idle. Rotor speed was 365 rpm. After increasing power, the pilot noticed a small amount of friction in the collective movement. He checked lever travel by raising and lowering it a few times. Noting that the control was moving normally, the pilot climbed to 1400 feet agl, where he initiated a second autorotation. The autorotation was normal down to 800 feet agl. After re-applying power, the pilot noticed that the collective locking plate was engaged and was impeding lever movement. The pilot tried unsuccessfully to disengage the locking plate with his thumb.

About 40 feet above ground, the pilot executed a flare and landed on Runway 36 at a speed of about 20 mph. After the initial touchdown, the aircraft bounced and fell hard on its belly. The tail rotor drive shaft was severed on the second impact, and the helicopter started to spin about its main rotor mast until an AME closed the throttle; the pilot was concerned that the collective would be released suddenly and cause the aircraft to lift off, so he used his left hand to hold the lever down rather than cut power. The helicopter came to rest and the pilot finished shutting down all systems before evacuating the aircraft.

When the aircraft came to rest, the pilot could not notify Val-d'Or radio because the radio was out of order. The emergency locator transmitter (ELT) activated at 1348¹. The airport security officer arrived at the occurrence site at 1350:50. Rescue 1 arrived at the site at 1356. An ambulance arrived at the emergency control centre at 1405, and was directed to the site 17 minutes after the crash.

The Pilot

The pilot was certified and qualified for the flight in accordance with existing regulations. He had about 4500 flying hours on helicopters, including about 900 hours on AS 350.

¹ All times are eastern standard time (Coordinated Universal Time minus five hours).

Helicopter Flight Manual

Section 4.1 of the AS 350 BA Flight Manual requires that the friction setting on the cyclic and collective levers be adjusted on the pre-flight check so as to prevent the levers from moving without pilot input during flight. During the pre-flight check, the pilot unlocked the collective control to adjust the friction setting, and could have noticed whether the locking tab interfered with the collective control.

Since the main rotor rpm was less than the speed published by the manufacturer, the pilot had to do autorotation checks. The correct range for autorotation rotor speed was 395-415 rpm. The target rpm would depend on the altitude and weight of the aircraft.

The procedure followed by the pilot, which was to reduce power when checking autorotation rpm, was different from the procedure published in the aircraft flight manual. First, the check should have been done at full power; and second, in the case of an engine-out drill, the fuel flow control should not have been returned to full power, while monitoring the T4 temperature, until the autorotation was completed and the aircraft was on the ground. The pilot followed the procedure he was taught during autorotation training on that type of helicopter.

The Helicopter

Eurocopter AS 350 BA, registration C-FPOO, serial number 2508, type certificate H83, had been repaired using structural/fuselage parts from a damaged AS 350 D aircraft, serial number 1131. Héli-Expert, who owned the two damaged helicopters, had obtained permission from Transport Canada to have the C-FPOO repaired and converted into an AS 350 BA. Héli Fix Services Inc., an approved maintenance organization (AMO), completed the project in one stage up to maintenance release.

Eurocopter had issued Service Bulletin (SB) 01-00-035 "Conversion AS 350 B Helicopter into AS 350 BA Version". But this SB was effective only if the AS 350 B was airworthy at the time of conversion. Transport Canada approved the conversion without regard to the effectivity limitation prescribed by Eurocopter. The project included 14 supplemental type certifications, including a powerplant change. Examination of the occurrence helicopter and its records indicate that modification 350A07-1995 (blanking of upper cavity in collective pitch lever stop), deriving from SB 01-00-035, was not completed. Moreover, modification 350A07-0679, which consisted of replacing the normal collective lever with a collective lever with a control box mounted at the end, was only partly completed; the collective lever low-pitch stop adjusting screw had not been inverted.

Upon receipt of a signed application for a Certificate of Airworthiness attesting that all applicable airworthiness requirements had been complied with and that the aircraft conformed to its type design, Transport Canada completed an inspection of the converted aircraft and issued a Certificate of Airworthiness on 08 June 2001. The helicopter had accumulated about 300 hours at the time of the occurrence.

Damage to the Helicopter

When examining the occurrence helicopter before it was moved, an AME noted and reported that the collective lever locking plate was not engaged and, after engagement, it disengaged normally with light pressure on the collective lever; these observations were corroborated by the

TSB investigator. But the space between the end of the collective lever and the electrical console was about 5 mm (see Figure 1), which is 11 mm less than the Eurocopter specification (16 mm \pm 0.5 mm) (see Figure 2).

Witness statements indicated that the space between the electrical console and the end of the collective lever was greater than was observed after the occurrence, and the locking plate did not interfere with collective lever travel.

Autorotation rotor rpm is set by adjusting the pitch links and rotor control links. Based on the rigging tool specified by Eurocopter, it was established that the adjustment of the pitch change links from the blades to the swash plate and the control links from the input rods to the servo-controls exceeded the manufacturer's dimensions by 5 mm and 8.9 mm, respectively. Consequently, the collective lever was lower than it should have been for a given blade pitch, resulting in low rotor rpm on autorotation.



Figure 1. Space for locking plate: 5 mm

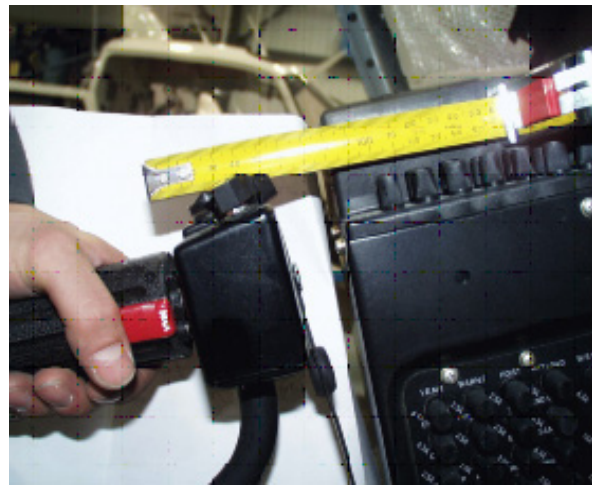


Figure 2. Normal position with space of 16 mm

The Approved Maintenance Organization

Héli Fix Services Inc. held an approved maintenance organization (AMO) certificate and was incorporated on 22 March 2000. The AMO was managed and operated by its president, who was also director of maintenance and an AME. He also provided a helicopter importing and rebuilding service. For the previous 12 years, he had held an aircraft maintenance engineer licence for rotary-wing aircraft, which was valid for the AS 350, EC120, B 206 and R22. He was also director of maintenance for three air operators and maintained their aircraft.

Analysis

Records indicate that the pilot was certified and qualified for the flight. Examination of the occurrence helicopter revealed that the locking plate disengaged readily when pressure was applied on the collective lever. However, the pilot was unable to disengage the lock. The pilot discovered he was in a critical situation at an altitude of about 800 feet agl when he realized that the collective lever was locked. The helicopter's high rate of closing with the ground allowed him little time to locate the cause of the problem and take appropriate action. The stress of the

situation and his heavy workload may have hindered his concentration and limited his ability to convey the urgency of the situation to the passengers. The pilot had to press on the collective lever to disengage the plate, then pull it back to arrest the descent. It is possible that incorrect timing of the pilot's actions to free the collective stick prevented him from disengaging the plate.

Autorotation rpm was low, and the in-flight checks were intended to correct that problem. When doing these checks, the pilot did not follow published procedures when he reduced engine power instead of leaving it at full as specified for a descent to check autorotation rpm. The procedure he had elected to use required more pilot inputs, thereby complicating his task.

Examination of the occurrence helicopter also revealed that some work had not been completed by the AMO. The stop screw was in an inverted position, and the connecting rods were shorter than those prescribed by the manufacturer, which allowed the collective control to overtravel down. This condition, combined with the down setting of the collective lever and the collective locking plate setting, contributed to the locking of the collective control by reducing the space between the electrical console and the collective lever.

Supervision by Transport Canada was inadequate before, during and after the rebuild and conversion of C-FPOO. The investigation determined that Transport Canada authorized the conversion of an AS 350 B into an AS 350 BA without regard to the effectivity limitation prescribed by Eurocopter; that supervision by Transport Canada did not detect the deficiencies in the work performed by the AMO; and that these deficiencies are not noted in the Transport Canada approval documentation for the aircraft. Consequently, Transport Canada should not have issued a certificate of airworthiness for this aircraft.

Findings as to Causes and Contributing Factors

1. The collective lever locking plate accidentally engaged, and the pilot was unable to free the collective and slow his descent sufficiently before touching down.
2. The stop screw was in an inverted position, and the connecting rods were shorter than those prescribed by the manufacturer, which allowed the collective control to overtravel down. This condition, combined with the down setting of the collective lever and the collective locking plate setting, contributed to the locking of the collective control by reducing the space between the electrical console and the collective lever.

Findings as to Risk

1. Transport Canada authorized the conversion of an AS 350 B into an AS 350 BA without regard to the effectivity limitation prescribed by Service Bulletin 01-00-35.
2. Transport Canada did not detect the deficiencies in the maintenance work related to the repair and conversion of the aircraft.

3. Transport Canada issued a Certificate of Airworthiness although the helicopter was not airworthy.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 21 May 2004.