

Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

AVIATION INVESTIGATION REPORT

A04P0033



IN-FLIGHT BREAKUP

**BEAR CREEK CONTRACTING LTD.
ROBINSON R22 (HELICOPTER) C-FILW
KUMEALON INLET, BRITISH COLUMBIA
20 FEBRUARY 2004**

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.

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Summary

The Robinson R22 helicopter (registration C-FILW), serial number 1457M) was on a flight from a logging camp at Kumealon Inlet to Prince Rupert and return, a distance of approximately 40 nautical miles. There had been a passenger on the leg of the flight to Prince Rupert and the pilot was returning alone. When the helicopter did not arrive at the logging camp, a search was carried out, and a day later the helicopter wreckage was located in the forest near its intended destination at Kumealon Inlet. The helicopter had suffered an in-flight breakup, and one of its two main-rotor blades was missing. The pilot was fatally injured during the in-flight breakup, and his body was found 15 metres away from the cabin/main wreckage. There was no fire. The accident occurred at approximately 1240 Pacific standard time.

Ce rapport est également disponible en français.

Other Factual Information

The weather reported from Prince Rupert for that day was suitable for visual flight, with winds at 10 to 18 knots. The crew of a Boeing 107 helicopter reported moderate to severe turbulence and winds blowing at 30 to 40 knots in the area that day. They had also encountered turbulence in the area of the accident, at the approximate time of the accident, 1240 Pacific standard time¹. This turbulence was sufficient to leave the entire contents of the co-pilot's coffee cup in the air and was described as an unusually sharp blow to the Boeing 107, which is a heavy and forgiving helicopter in turbulence.

The accident helicopter was owned and operated by Bear Creek Contracting Ltd. and was being used by the logging manager, the pilot, to get around the area (like one would use a pick-up truck if terrain and roads permitted). It was registered for private use.

The pilot carried out an extensive pre-flight inspection before the first leg of the accident flight. The flight to Prince Rupert was normal and relatively smooth. A few moments before the estimated time of the accident the helicopter was seen flying towards the logging camp, its destination.

The Robinson R22 flight manual has flight restrictions if surface winds exceed 25 knots, or if the wind gust spread exceeds 15 knots. There are also restrictions on continued flight in moderate, severe, or extreme turbulence. These restrictions apply only to pilots with less than 200 hours on helicopters, or less than 50 flight hours on type, or have not completed the awareness training specified in United States Special Federal Aviation Regulation No. 73. The pilot had approximately 1200 hours of flying experience on Robinson R22 helicopters, had the awareness training specified, and was very familiar with the local environment.

The area in the vicinity of the accident site was examined for main-rotor blade strikes to trees. None was found, but the tree branches immediately above the main wreckage impact area were damaged. That damage was not consistent with that found when rotating blades strike a tree.

The detached main-rotor blade was found three days after the accident approximately 150 metres from the main wreckage site. It was bent more than 90 degrees down at approximately 78 cm from the blade root. The pitch horn was bent and the pitch change rod was broken. Examination of the wreckage



Photo 1. Accident site

¹

All times are Pacific standard time (Coordinated Universal Time minus eight hours).

indicated that the blade attachment bolt had broken at the coning hinge, so an extensive search of the area was carried out. Part of the subject bolt was found a week later. It was examined with optical enhancement and determined to have broken/sheared from overload. The other blade attachment bolt was examined and found to demonstrate signatures of an impending shear. Both bolts were tested for hardness and dimension; they met design specifications.

The examination also revealed damage to the rotor system droop stops and teeter stops. The teeter stops were of an early design made of aluminium brackets with elastomeric bumpers. The elastomeric bumpers were missing. The droop stops were sheared off in a manner similar to that found when like rotor systems are subjected to negative loading. However, contrary to previous accidents where rotor systems were unloaded, there were no obvious main-rotor strikes to the cabin, landing gear or tail.

Robinson Helicopters, the manufacturer of the helicopter, issued a service bulletin (SB-78) in 1995 calling for the teeter stops to be changed to a newer design made of stainless steel brackets with elastomeric bumpers. The bulletin was to mitigate the risk of losing the elastomeric bumpers because of failures of the aluminium brackets. While the helicopter manufacturer stated a date of compliance (31 July 1995) for this airworthiness-related service bulletin, Transport Canada does not require compliance with service bulletins. It is however noteworthy that the service bulletin only referred to problems during starting and stopping the rotors in windy conditions.

The main-rotor damage signatures did not indicate excessively low rpm. The engine and its accessories demonstrated signatures of power/rotation at impact. The main-rotor transmission attachment area was torn and deformed. The structural firewall—the aft wall of the cabin—was deformed forward. The plexiglass windshield and roof were broken, and the pieces were found approximately 100 metres from the wreckage impact site. The centre post for the windshield was also broken; and part of it, with the compass, was found close to the pilot's body, which was resting along the debris trail before the main wreckage impact site. The main-rotor blade that remained attached to the helicopter had blood stains on the leading edge at 91 to 101 centimetres from the blade root. The tail-rotor and tail boom damage indicate that the tail-rotor deflected into the tail boom.

The sprag clutch assembly was damaged and excessively worn, the wear being uneven, and there were indications of hard engagements and slipping. While the helicopter manufacturer's assigned life for the sprag clutch assembly is 2200 hours, the sprag clutch assembly that was installed had 2906.5 hours of logged flight time on it. There were several other components that were over their time limits, but there were no indications of excessive wear and tear on them.

Light bulb analysis of the caution lights indicate that the main transmission chip (MR CHIP) detector caution light was illuminated at impact.

An autopsy of the pilot's body found, among other injuries, an incomplete tear of the pontomedullary junction of the brainstem. The fatal upper body and head injuries suffered by the pilot are consistent with what would be caused by the violent thrashing forces that deformed the helicopter in flight.

Analysis

The wreckage debris trail, the damage to the trees, the resting location of the pilot's body, and the damage to the helicopter were indicative of an in-flight breakup.

All indications are that the accident helicopter and pilot encountered quite severe turbulence. The turbulence, specifically a down draught, caused the rotor system to unload, evident by the droop stop and teeter stop/bumper damage. Because stops and bumpers from both blades were damaged, it was concluded that some of this damage occurred before one of the main-rotor blades separated.

When the down draught unloaded the rotor system it was sufficient to allow the main-rotor blades to flap and teeter enough to shear the droop stops and damage the aluminium brackets. At some point, the elastomeric bumpers fell out allowing the main-rotor to teeter excessively and overload the pitch change rod associated with the separated main-rotor blade. The pitch change rod broke, resulting in loss of control of the rotor system and the helicopter. The blade likely pitched down allowing aerodynamic forces to bend it. The uncontrolled behaviour of the rotor blades likely loaded the rotor system beyond its design strength, and one of the coning hinge bolts broke. The loads would have been immediately relaxed from the opposing blade and the coning hinge bolt; so while it showed signs of impending failure, it did not break. The blade associated with the broken bolt separated as that bolt served to attach the blade to the main-rotor head.

The imbalance resulting from the loss of one of only two main-rotor blades shook the helicopter violently. The main-rotor transmission tilted forward, port, aft, and starboard as the top of the mast was pulled away from its centre of rotation. The tube-frame main structure was deformed and broken, and the aft cabin fire wall was deformed forward. The deformation of the cabin fire wall allowed the pilot restraint system to loosen, and the pilot's body was ejected through the windshield into the path of the remaining main-rotor blade.

The illumination of the MR CHIP detector caution light was likely caused by the in-flight break-up, illuminating before impact.

Findings as to Causes and Contributing Factors

1. The helicopter encountered turbulent air that unloaded the main-rotor system resulting in damage that led to the helicopter becoming uncontrollable. Subsequent forces overloaded and broke one of the main-rotor blade attachment bolts, and the blade separated.
2. Gross imbalance resulted in deformation of the attachment area of the main-rotor transmission, and the helicopter broke up in-flight.

Findings as to Risk

1. There was extensive wear and tear on the freewheel unit sprag clutch, likely because it had remained in operation for more than 700 hours beyond its time limit before removal.
2. The operator continued to operate the helicopter after some component life limits had been exceeded.
3. The operator did not incorporate SB 78 nor was he required to. There was a risk that the teeter stops would fail during flight in severe turbulence, though not referenced in the bulletin.

Safety Action

On 11 March 2004, the Transportation Safety Board of Canada (TSB) issued an Occurrence Bulletin revealing the relevant facts as they were known at that time.

On 27 May 2004, Robinson Helicopter Company issued an updated Service Bulletin (SB-78A), that included background information regarding a recent accident and the risk of excessive teetering of the main-rotor, should the brackets fail. That service bulletin requested that owners, operators, and service centres determine if SB-78A was complied with, and, if not, to proceed with the instructions for SB-78A.

The USA Federal Aviation Administration (FAA) plans to issue a Notice of Proposed Rulemaking Airworthiness Directive (AD) to mandate the installation of the manufacturer's higher strength teeter stop brackets.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 19 October 2004.