Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A08W0096

LOSS OF CONTROL AND COLLISION WITH TERRAIN

SAHTU HELICOPTERS
MDHI 369D C-GNMG
DOCTOR LAKE, NORTHWEST TERRITORIES
24 MAY 2008

Canada

Aviation Investigation Report

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Summary

A MDHI 369D helicopter (registration C-GNMG, serial number 300693D) operated by Sahtu Helicopters was transporting personnel near Doctor Lake, Northwest Territories, when the aircraft started an uncommanded rotation and crashed at 0820 mountain daylight time. The helicopter was substantially damaged by impact forces and a post-crash fire. The pilot was seriously injured, one of the two passengers was fatally injured, and the other suffered minor injuries.

Ce rapport est également disponible en français.

Other Factual Information

Records indicated that the helicopter was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The aircraft had no known deficiencies before the accident flight. The aircraft weight at the time of the occurrence was estimated to be 2380 pounds, 600 pounds under the maximum gross weight limit, and the centre of gravity was within limits. There was sufficient fuel on board to complete the flight.

The 0900 mountain daylight time [1] weather at Norman Wells (35 nautical miles southwest) was as follows: wind 140° true at 8 knots, few clouds at 700 feet above ground level (agl), visibility 30 statute miles. At the accident site, good visual weather conditions existed, with winds reported as steady at 5 knots occasionally gusting to 10 knots from the south-southeast.

The pilot held a valid commercial helicopter licence, had completed the operator's 369D training program and had passed the pilot proficiency check in April 2008. The pilot had approximately six hours on type. The total experience on helicopters was approximately 820 hours, mostly on Bell 206 models. The pilot had been on duty for 14 hours in the past 24 hours and had flown 4.5 hours. The pilot's shift began at 0630; the previous day's shift ended at 2030.

The flight departed from the base camp to look for a water supply for a new drilling operations site approximately 35 nautical miles away. The pilot had arrived on site and was hovering into wind at approximately 300 feet agl to determine the best footpath between the water body and the landing pad. This had been accomplished and they were in the process of descending and hovering sideways to the left with the nose into wind toward a landing pad. When the helicopter was at about 75 feet agl, an uncommanded rotation to the right occurred.

The pilot tried to counteract the rotation with left pedal input, and also tried to attain some forward speed to weathercock the aircraft and slow down the rotation. The helicopter did not respond so the pilot reduced the engine throttle to decrease the power output and lowered the collective. This is a standard procedure at low airspeed or hovering, to lessen the torque output from the engine when a loss of tail rotor authority occurs. This seemed to improve the situation, but when power was re-applied, the rotation resumed. The power was reduced again, but the helicopter struck the ground before control could be regained. There were no reports of an audible low rotor rpm warning or caution light(s). The caution lights were completely melted and could not be examined.

Engine torque in a helicopter is applied through the main rotor and causes an equal and opposite reaction (rotation or yaw) in the airframe. This yaw is counteracted by the tail rotor, which pushes against the rotational forces created by the main rotor torque. The pilot controls the amount of tail rotor anti-torque by adjusting the foot pedals, which in turn varies the pitch of the tail rotor blades. The greater the amount of power applied to the main rotor, the greater the amount of tail rotor pitch required to counter the torque. A loss of tail rotor drive while in hovering flight results in a rapid uncommanded rotation of the helicopter in the opposite direction to the rotation of the main rotor. The loss of tail rotor drive also results in a rapid decrease in tail rotor rpm, especially if full pitch is applied through the pedals.

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1 All times are mountain daylight time (coordinated universal time minus six hours).

The front passenger, seated on the right side, extricated the pilot from the wreckage prior to the fire enveloping the cabin. The other passenger was seated in the right rear, and sustained fatal injuries due to the impact before the post-crash fire.

At the accident site, the investigators found that the airframe was relatively intact, lying level on its left side, with all components in place. The main rotor blades did not have damage consistent with high rotation speed or power at the time of ground contact. There were indicators of some power to the main rotors, in the tree contact by the rotors just before the aircraft rolled over. The engine compressor rotor blades had contacted the outer plastic surfaces and showed a slight degree of bending.

The helicopter touched down with a left sideward drift. The left-side landing gear support structure punctured the fuel tank and bladder area. A post-crash fire consumed the entire cabin from the engine firewall forward. The main transmission and rotor head sustained some heat damage but did not burn. Part of the engine air intake plenum was partially burned; however, the basic shape was retained. The engine accessory gearbox caught fire and melted most of the non-metallic connections to the engine and the engine cowlings. The engine had indications of running, but at a low setting at the time of impact.

The tail section had not burned. There was no indication of tail rotor drive shaft rotation at the time of impact. A break occurred in the aft boom at Station 242, and the drive shaft and flight control tubes were bent approximately 90 degrees at that point. The skin had rotated counter-clockwise 270 degrees at the same location. The drive shaft did not show any indication of torsional load at this bend or anywhere else. The tail rotor blades had strike marks only on the sides, toward both the leading and trailing edges. There were no strike marks on the leading edges. The front sections of the tail rotor drive shaft and flight control tubes were completely melted from Station 137 forward (see Photo 1). The tail rotor drive and flight controls were continuous forward to this burn point. The tail rotor controls were examined to the extent possible and no other disconnected controls were found. All the tail rotor components indicated no signs of failure before or at impact. There were no indications of flailing of the tail rotor drive shaft at any location.

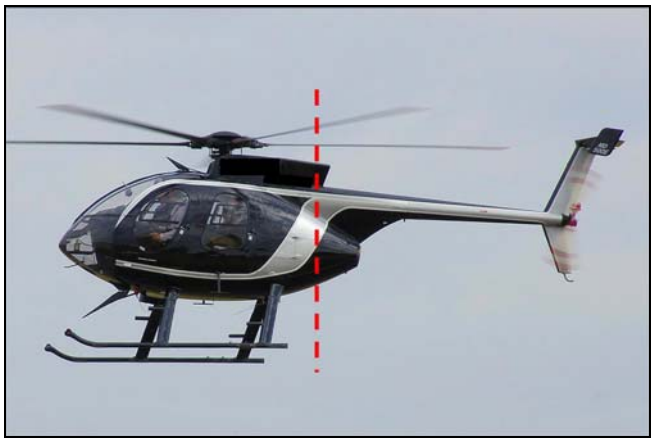

Photo 1. Approximate location of Station 137

The tail rotor drive shaft rear section coupling, forward coupling and broken sections were removed from the wreckage and examined by the TSB Engineering Laboratory to determine failure mode and presence of any pre-existing failures; none were found. The engine drive shaft K-flex coupling was also examined, with the same result.

The tail rotor drive shaft inspection/check in Section 63-15-10 of the Maintenance Manual, revision 20, [2] details a twist inspection of the tail rotor drive shaft only from the aft coupling at the tail rotor transmission forward to Station 137.5. There is no requirement to inspect forward of this point to the main transmission output quill coupling.

Four instruments were sent to the TSB Engineering Laboratory for a confirmation of the engine and main rotor speeds at the time of impact. Those were the engine gas producer speed (N1) gauge, the turbine outlet temperature (TOT) gauge, the combined power turbine and main rotor tachometer, and the engine torque gauge. The torque gauge was indicating approximately 22 pounds at the time of impact, which suggests that the engine was operating at or just above ground idle. No reliable information could be determined from the other instruments due to heat damage.

Analysis

The maintenance and airworthiness of the helicopter, as well as weather, were not considered contributory factors in this accident. Main rotor and engine crash signature indications confirm that the engine was operating at the time of impact. Therefore, the engine is also not considered a contributory factor in this occurrence.

At the time of the uncommanded right rotation, the helicopter was hovering laterally to the left. The relative wind was outside the critical azimuth, [3] and the rotation resumed after the pilot re-applied engine power. It is therefore unlikely that an airflow effect induced the rotation.

Damage to the aircraft indicated virtually no rotation of the tail rotor at the time of ground contact, but there was evidence of low-power main rotor rotation. The engine was producing power but this power was not being transferred to the tail rotor. It was most likely that the tail rotor drive shaft failed at the forward section, but evidence to confirm this was lost in the post-crash fire. Failure of the tail rotor drive shaft would result in an uncommanded rotation of the helicopter around the vertical axis. The helicopter response to changes in throttle setting corresponds to what would be expected for a loss of tail rotor drive. There was insufficient altitude to effect recovery before ground impact.

The following TSB Engineering Laboratory reports were completed:

LP071/2008 – Tail Rotor Drive Examination
LP080/2008 – Aircraft Instrument Examination

These reports are available from the Transportation Safety Board of Canada upon request.

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2 This Maintenance Manual applies to the 369 D, E and F as well newer models of this helicopter type.

3 A wind direction zone relative to the nose of the helicopter that should be avoided during out-of-ground-effect hovering. Directional control is difficult when hovering with a wind in this quadrant.

Finding as to Causes and Contributing Factors

1. It is likely that the tail rotor drive shaft failed, which resulted in an uncommanded rotation of the helicopter at an altitude from which recovery was not possible.

Safety Action Taken

The operator initiated a special inspection and measuring process on the forward section of selected tail rotor drive shafts operating in its fleet for this model of helicopter, in addition to the requirements of the Maintenance Manual inspection criteria.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 10 December 2008.

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