Hughes 369HS, G-DADS, 28 June 2002

AAIB Bulletin No: 11/2002	**Ref: EW/C2002/06/08**	**Category: 2.3**
Aircraft Type and Registration:	Hughes 369HS, G-DADS	
No & Type of Engines:	1 Allison 250-C20 turboshaft engine	
Year of Manufacture:	1972	
Date & Time (UTC):	28 June 2002 at 1301 hrs	
Location:	Gloucestershire Airport, Staverton	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - 1 Minor	Passengers - 1 Minor
Nature of Damage:	Extensive	
Commander's Licence:	Private Pilots Licence (Helicopters)	
Commander's Age:	50 years	
Commander's Flying Experience:	156 hours (of which 25 were on type)	
	Last 90 days - 14 hours	
	Last 28 days - 5 hours	
Information Source:	AAIB Field Investigation	

The helicopter was inbound to Staverton from Thruxton and the pilot followed the standard approach procedure to 'Heli South' at the south eastern corner of the airfield. He turned the helicopter into wind, which was given as 310° at 11 kt, and hovered at a height of approximately eight to ten feet, prior to obtaining ATC clearance to hover-taxi to his intended parking place, which was a short distance to the east. Whilst still in the hover, the helicopter yawed violently to the right. Application of left pedal had no effect and the helicopter continued to rotate and climbed a little. The pilot rapidly became disorientated and, approximately ten seconds after the onset of the yaw, the helicopter struck the ground heavily, causing the right hand skid to break off and allowing the main rotor blades to strike the ground. The helicopter came to rest rolled approximately 20° to the right, with the tail rotor assembly and empennage detached. The engine shut down without any action by the pilot. The occupants were able to vacate the helicopter through the front right hand door, having sustained only minor injuries.

Initially, the pilot considered that the helicopter had suffered a loss of tail rotor control, so further examination of the wreckage was undertaken by the AAIB.

Wreckage examination

The subsequent examination of the accident site and the wreckage suggested that the first part of the helicopter to strike the ground had been that part of the vertical stabiliser which protrudes below the tail boom. This had buckled, resulting in the tail rotor blades striking the ground and the subsequent detachment of the rear portion of the tail boom, which included the tail rotor gearbox and the empennage. The failure had occurred immediately ahead of the final circular frame in the tail boom and was a direct consequence of the vertical stabiliser contacting the ground. In addition, it had caused the rear section of the tail boom to be deflected upwards, resulting in a light contact with a main rotor blade; this was confirmed by evidence of paint transfer on the underside of one of the blades.

The sudden stoppage of the tail rotor assembly, on contact with the ground, had resulted in torsional failures at each end of a section of tail rotor drive shaft within the tail boom. This confirmed the pre-impact integrity of the drive shaft.

The yaw controls in this type of helicopter consist of a system of rods, levers and bellcranks connected to the yaw pedals and operating directly on the tail rotor blade pitch change mechanism. The system was examined in its entirety, with no evidence of a pre-impact failure or disconnect being found. Similarly, there was no evidence of a failure in the main rotor controls.

Engine examination

The circumstances of the accident were not consistent with an engine failure, as this would have caused a yaw to the left. Thus, in the absence of a failure in the tail rotor drive-train, flying control system, or a disconnect in the engine controls, it was considered that the only engine problem likely to cause a right yaw would have been an undemanded power increase. Whilst it was unclear as to the nature of any failure condition within the fuel control system capable of producing such an effect, it was decided to subject the engine to a functional test.

The engine was taken to an approved overhaul agent where it was examined prior to being installed in a test cell. The external damage appeared to be limited to dents in the rear of the combustion chamber outer casing; this would have occurred during the impact, due to the aft end of the engine being located close to the fuselage underside. Removal of the outer casing revealed the combustion liner to be heavily distorted around the fuel nozzle. It was also apparent that the fuel supply line had been crushed close to its union with the nozzle such that it would have caused a restriction in the fuel flow. This, plus the loss of the normal spray pattern resulting from the liner distortion, is considered the most probable explanation for the engine run-down after the accident.

During the examination it was observed that the oil pressure regulator adjuster was not screwed in, relative to its housing, as far as that normally seen on similar engines. The adjuster was wire-locked, and so had not become unscrewed in service. However, on subsequent investigation of the oil filter, it was found to contain significant quantities of red-coloured plastic debris, which was thought to be the remains of a blanking cap of the type commonly used throughout the industry for protecting exposed pipe unions. The absence of debris elsewhere in the engine indicated that the filter was not blocked to the extent that it was in by-pass mode. It seemed probable that a blanking cap had been ingested by the oil pump at some stage, which, when the filter became partially blocked caused a rise in oil pressure upstream of the filter. This could have been compensated for by backing off the adjuster, and thus may explain the as-found position.

The engine logbook indicated that a 62 day/50 hour inspection was conducted on 12 June 2002, sixteen days and approximately seven flying hours prior to the accident. The inspection included an oil change and filter check. No debris was evident, and the engineer stated that he had never had cause to adjust the oil pressure regulator, which is difficult to access when the engine is installed in the helicopter. Thus the presence of the debris could not be explained. However, its effect on engine operation would have been negligible and it was not considered to have had any relevance to the accident.

The engine was installed in a test cell with a slave combustion section fitted. It started normally, although the oil pressure was found to be low. The oil pressure regulator adjuster was screwed in three and a half turns, which rectified the problem. This reinforced the view that it had originally been adjusted out in order to compensate for the effects of a partially blocked filter. The engine could be accelerated and decelerated normally. Two performance points were taken during the test, one each for take off and normal cruise power. The results indicated that engine was slightly above the specification power requirements at these conditions.

Discussion

Witness accounts indicated that the rate of yaw started slowly and accelerated after the helicopter had turned through 90°. There was also some suggestion that the helicopter was establishing a hover on a northerly heading; this would have given the pilot a better view of his intended track for hover-taxiing when cleared. Having started to yaw to the right, the yaw rate would have increased markedly as the tail of the helicopter passed through the prevailing wind direction. It is possible that this occurred after the helicopter had turned through 90°.

The reason why the helicopter started to yaw is uncertain. Establishing the helicopter in a hover would have increased the engine power required. If the wind had then backed, or the helicopter had drifted onto a northerly heading, maintaining a steady hover would have been more demanding. Once the tail had passed through the wind direction, regaining a steady hover would have required greater control inputs than those needed at the end of a controlled spot turn. It is possible that the increasing yaw rate contributed to the pilot's disorientation.

In the absence of any technical defect, it is probable that this accident was the result of a combination of factors that resulted in the helicopter developing a high rate of yaw which was beyond the pilot's experience to control.