

ACCIDENT

Aircraft Type and Registration:	Bell 206B Jet Ranger III, G-BPWI	
No & Type of Engines:	1 Allison 250-C20B turboshaft engine	
Year of Manufacture:	1980 (Serial no: 3087)	
Date & Time (UTC):	4 October 2013 at 1610 hrs	
Location:	Upper Edgebold, near Shrewsbury, Shropshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - 1 (Minor)	Passengers - N/A
Nature of Damage:	Substantial	
Commander's Licence:	LAPL (H)	
Commander's Age:	61 years	
Commander's Flying Experience:	445 hours (of which 18 were on type) Last 90 days - 21 hours Last 28 days - 9 hours	
Information Source:	AAIB Field Investigation	

Synopsis

The pilot noticed that the engine turbine temperature had increased to close to its maximum limit and prepared to make a precautionary landing. During the approach the indication returned to normal, so he decided to continue the short distance to his destination. As the helicopter climbed away, the engine failed. The pilot carried out a forced landing during which the tail boom struck the ground. He candidly commented that, on reflection, it would have been better to continue with the precautionary landing, rather than having to attempt a forced landing without power from low altitude.

History of the flight

The pilot, who had recently converted onto the type, was returning to the helicopter's home base after visiting a maintenance organisation. No maintenance had taken place; the purpose of the visit was for the pilot to receive refresher training on performing the daily inspection. The start and pre-flight checks were normal. After departure the pilot climbed to 2,000 ft and set up a cruise using 70% torque, giving an indicated airspeed of 100 kt.

When the helicopter was about 5 nm south-west of Shrewsbury, the turbine temperature increased to 812°C, but all other engine indications were normal. The pilot decided to carry out a precautionary landing and reduced the power to approximately 40% torque and descended. The turbine temperature then decreased, so he increased torque to 60% and levelled off.

As the engine now appeared to be operating normally, the pilot decided to abort the precautionary landing and continue the short distance to his destination. When he increased the torque to 70% to climb, the turbine temperature increased to above the top of the scale on the gauge. The torque indication fluctuated and the engine sounded as if it was “hunting”. The helicopter was about 800 ft agl at this point. The pilot entered an autorotation and declared a MAYDAY to Sleaf Radio. During the ensuing forced landing the helicopter rolled over, coming to rest on its side. The pilot, who sustained a minor injury, was able to escape through the broken front windscreen and called the emergency services by mobile telephone.

Helicopter examination

The helicopter was recovered from the accident site by the maintenance organisation visited by the pilot prior to the flight. They reported that they had drained a significant quantity of fuel from the main tank to prevent it leaking into the ground. The engine oil tank had ruptured in the impact, but they reported evidence of residual oil in the vicinity consistent with the quantity expected to be in the tank. The helicopter was examined once it had been recovered to the maintenance organisation and no pre-existing defects were identified with the airframe, drivetrain or control systems. The engine controls were all connected and operated normally. The engine was removed and transported to an overhaul facility for detailed inspection.

Engine inspection

Prior to dismantling the engine, the engine control air tubes were checked for leaks; none were found. The compressor bleed valve was checked and operated normally. The thermocouple harness for the turbine temperature gauge was removed and bench-tested. It was found to be within normal limits.

Examination of the oil system revealed metal chips in the oil taken from the main oil filter housing and that the O-ring on the oil filter spigot was missing. The upper magnetic chip detector had collected debris, including metal chips; the lower magnetic chip detector was covered in a paste-like residue. The No 6 and 7 main bearing scavenge sump was dry, but contained metallic debris, as did the oil scavenge pipes.

On disassembly, the No 7 main bearing was found to be disintegrated, with evidence of severe heat damage and metal splatter on the turbine disc and casing, Figure 1. The failed parts were returned to the engine manufacturer for a detailed failure analysis. Any significant findings will be dealt with through their normal continued airworthiness processes.

A check valve situated in the output flow from the oil filter was found to contain a foreign body which appeared to be an O-ring similar to that fitted to the oil filter spigot, Figure 2. The O-ring had become lodged in the valve opening, preventing the check valve from operating. The check valve is designed to open whilst the engine is running, to provide a flow of filtered oil from the filter housing to the bearings, and to close on engine shutdown, to retain oil in the filter housing and prevent it leaking into the engine internal cavities.



Figure 1
Failed No 7 bearing



Figure 2
Oil filter housing check valve (disassembled) with foreign O-ring found inside

Relevant maintenance history

In July 2013, the engine had undergone a scheduled 300-hour inspection and new compressor casings were installed. As part of this inspection an oil flow check was carried out and a figure of 260 cc of oil in the specified time period was recorded. The engine maintenance manual specifies a minimum amount of 90 cc, but no maximum. The maintenance records show that the oil filter was not disturbed at this time.

In May 2013, 56.6 engine hours earlier, a 100-hour/12 month inspection was carried out. The engine oil was replaced and the oil filter was inspected and cleaned, before being

refitted. An oil flow check was carried out and a figure of 120 cc of oil in the specified time period was recorded.

In November 2012, a further 9.4 hours earlier, the engine was removed from the helicopter and sent to an overhaul organisation to remedy an oil leak from the torque meter. After installation in the helicopter an oil flow check was carried out and a figure of 130 cc of oil in the specified time period was recorded.

The pilot reported he had noticed that blue haze/smoke was visible from the engine exhaust for several minutes after every engine shutdown. This was to be investigated at the next maintenance input.

Discussion

Engine failure

The engine failure appears to be as a result of the disintegration of the No 7 bearing, which was most likely caused by oil starvation. This bearing supports part of the turbine assembly and therefore relies on oil flow for cooling, as well as lubrication. Any reduction in oil flow could lead to the bearing overheating and ultimately failing.

The foreign O-ring found in the oil filter housing check valve was probably the one missing from the oil filter spigot. The O-ring is likely to have caused a restriction to the oil flow around the engine, which may also account for the fluctuating torque indication, as the torque meter uses engine oil pressure for its operation. It also seems likely that this O-ring prevented the check valve from closing on engine shutdown for the previous few flights. With the engine shut down and the check valve still open, oil could leak from the oil filter housing into the hot parts of the engine and then vaporise, producing a blue haze/smoke in the exhaust similar to that reported by the pilot.

The oil flow check after the last filter disturbance indicated the oil system was operating normally. A subsequent oil flow check 56.6 engine hours later showed a much higher than normal oil flow, but still within maintenance manual limits. It was not possible to determine how or when the O-ring entered the check valve.

Precautionary landing

Following the first indications of high turbine temperature the pilot decided to conduct a precautionary landing, but when he saw the indications return to normal during the approach he decided to continue the flight to his destination only a few miles away. The engine failed shortly after he added power to climb away.

The pilot, on reflection, candidly commented that he would have been better to continue with the precautionary landing rather than having to attempt a forced landing without power from a low altitude. He added that in the final stages of the approach he probably flared too much, causing the tail boom to strike the ground.