

ACCIDENT

Aircraft Type and Registration:	Aerospatiale SA341G Gazelle, YU-HMC	
No & Type of Engines:	1 Turbomeca (Safran) Astazou 3A turboshaft engine	
Year of Manufacture:	1974	
Date & Time (UTC):	14 July 2018 at 1540 hrs	
Location:	Private landing field, Enfield, Greater London	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Helicopter destroyed by fire	
Commander's Licence:	Private Pilot's Licence (Helicopters)	
Commander's Age:	65 years	
Commander's Flying Experience:	266 hours (of which 266 were on type) Last 90 days - 17 hours Last 28 days - 7 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB	

Synopsis

While trying to reposition his helicopter from one part of his garden to another, the pilot perceived that the engine had lost power. He tried to return to the takeoff site but the helicopter came down about 20 metres short and rolled onto its side. The helicopter was destroyed by a post-crash fire. The cause of the reported loss of power could not be determined.

History of the flight

The helicopter was parked at the bottom of the pilot's garden while some building works were being carried out. The pilot intended to take off and position the helicopter nearer his house so he could clean and polish it, and then depart to Elstree for fuel. The takeoff weight with the pilot and 325 kg of fuel onboard was 1,524 kg (MTOW 1,800 kg). The wind was calm and the air temperature was 30°C.

After carrying out his usual daily inspection and pre-flight checks the pilot lifted off into a 5 to 10 ft hover. All checks were normal. He then moved forward and initiated a right turn. During the right turn he perceived that the engine had lost power. He tried to return to the takeoff site but came down about 20 metres short. The ground there was uneven with some large wooden pallets and other building materials. The pilot thought the helicopter

probably struck one of the pallets and then rolled onto its side, with the rotor blades striking the ground.

The pilot instinctively climbed out and moved rapidly away from the helicopter. He had omitted to operate the emergency fuel shutoff lever and he could hear the engine running, at low power, as he left the helicopter. He could see steam or smoke so he fetched a fire extinguisher. When he returned the helicopter was on fire with large amounts of smoke.

The fire service had been notified of the fire by a passer-by and arrived on scene 8 minutes after the call, at 1551 hrs. The fire service applied water around the fire to stop it spreading. It then took them about 5 to 6 minutes to set up a new foam machine before they started applying foam to the fire, by which time most of the helicopter had already burnt out.

The pilot stated that the incident happened very quickly and he did not recall seeing or hearing any cockpit warnings.

Accident site and aircraft examination

After the fire had subsided, there was very little remaining of the helicopter (Figure 1). The maintenance organisation recovered the helicopter wreckage to their facility and conducted an investigation but were unable to establish a cause of a loss of power. There was no evidence that the engine had suffered an uncontained failure and the turbine was intact and could be rotated through about 30°, but no further due to impact damage to the combustion chamber. There was very little remaining of the fuel system that could be examined. The engineer at the maintenance organisation thought that the fuel tank had probably been punctured by a pallet or metallic materials on the ground where the helicopter came down, resulting in the post-crash fire.



Figure 1

Remains of YU-HMC at the accident site
(image used with permission)

Engine examination

The engine had accumulated 4,914 hours since new and 1,424 hours and 2,279 cycles since last overhaul (maximum time between overhauls is 1,750 hours and 5,600 cycles).

The engine manufacturer examined the remains of the engine and performed a borescope examination. Their findings included the following:

- The engine air intake was found to be dirty with aggregated soot deposits.
- The axial and centrifugal compressors did not have any mechanical damage, with no evidence of foreign object impacts.
- Some soft material with the appearance of fibreglass cloth was found in the air path between the axial and centrifugal compressors, indicating continued engine rotation after impact.
- There was small unknown debris like sand or dust at the centrifugal compressor's trailing edge.
- The stator vanes between the axial and centrifugal compressors were coated in black deposits which the engine manufacturer considered may have existed prior to the post-crash fire.
- The diffuser outlet between the axial and centrifugal compressors was coated in deposits that appeared like thin soil, sand powder or dust, which the engine manufacturer considered may have existed prior to the post-crash fire.
- There was some dust in the combustion chamber inlet but no anomalies inside the combustion chamber.
- The 1st stage turbine wheel had damaged blade tips which were consistent with a T4¹ overtemperature condition at some point.
- The blade tips of the 3rd stage turbine were discoloured due to heat which was also consistent with a T4 overtemperature condition at some point.

The engine manufacturer stated that thin soil or sand powder deposits in the engine are commonly encountered during engine usage which is why routine chemical washing of the compressor is required. If these deposits build sufficiently it will result in a lower compression rate of the air entering the combustion chamber and therefore less power with the same fuel flow. The fuel control unit will attempt to maintain a constant engine speed so it will increase fuel flow, which will result in a higher temperature. This can lead to a T4 overtemperature and consequential turbine blade tip damage. The system does not have an automatic T4 limiting system and is reliant on the pilot noticing the T4 exceedance and reducing power.

Footnote

¹ The T4 temperature is the temperature measured at the 3rd stage turbine exhaust. It is a temperature indicated to the pilot and has an exceedance limit.

The engine manufacturer stated that the 'dirty airpath' could have led to a T4 exceedance in-flight at some point, resulting in 1st stage turbine blade damage and consequential loss of power. However, because the engine was still running after impact, it was also possible that the T4 exceedance and turbine damage were the result of the heat from the post-crash fire.

Maintenance involving compressor wash

The maintenance organisation stated that compressor chemical washes and water rinses were carried out on YU-HMC every 30 flying hours or 6 months, whichever came first, in accordance with the helicopter manufacturer's maintenance requirements. The last compressor wash was carried out on 27 February 2018 during the helicopter's last annual inspection and it had accumulated about 30 hours since then. The helicopter had been booked in for its 30-hour maintenance inspection on 16 July 2018, two days after the accident.

The maintenance engineer, who had 34 years' experience maintaining Gazelles, stated that he thought the deposits found in the engine were the result of post-impact ingestion.

The pilot stated that he had not flown YU-HMC anywhere dusty but that there was soil at the accident site.

Analysis

Although it was a hot day with calm wind, the helicopter was 276 kg below its maximum takeoff weight so it should have had sufficient performance for the taxiing manoeuvre the pilot undertook. It is possible that the airpath to the centrifugal compressor had accumulated deposits during operation which led to a lower compression rate and a higher temperature operation. This, combined with the hot outside air temperature, could have led to a T4 exceedance, turbine damage and a consequential loss of power, leading to the accident. However, it is also possible that the T4 exceedance occurred during the post-impact fire and that some deposits were ingested while the engine continued to run on the ground, with the helicopter on its side.