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Swiss Transportation Safety Investigation Board STSB
Servizio d'inchiesta svizzero sulla sicurezza SESE
Swiss Transportation Safety Investigation Board STSB

Summary report

A summary investigation into this serious incident was conducted in accordance with Article 45 of the Ordinance on the Investigation of Incidents in Transport
December 17, 2014 (VSZV), as amended on July 1, 2024 (SR *742.161*). The sole purpose of investigating an accident or serious incident is to prevent accidents or serious incidents. It is expressly not the purpose of the safety investigation and this report to determine fault or liability. If this report is used for purposes other than accident prevention, this circumstance must be taken into account.

The German version of this report is the original and therefore authoritative.

Aircraft	Airbus Helicopters Germany EC135 T2+		HB-ZUI
Owner	Air-Glaciers SA, route de l'Aéroport 25, 1950 Sion		
Owner	Air-Glaciers SA, route de l'Aéroport 25, 1950 Sion		
Pilot	Swiss citizen, born in 1978		
License	*Commercial pilot license* for *helicopters* (CPL(H)) in accordance with the *European Union Aviation Safety Agency* (EASA), issued by the Federal Office of Civil Aviation (FOCA)		
Flying hours	**Total**	7060 h **during the last 90 days**	67:05
	on the incident type	380 h **during the last 90 days**	12:20
Location	Rougemont (VD)		
Coordinates	582 435 / 147 725 (*Swiss Grid* 1903) N 46° 28' 50'' / E 007° 12' 35'' (WGS[1] 84)	**Altitude**	1350 m
Date and time	January 20, 2024, 12:44 p.m. (LT[2] = UTC[3] + 1 h)		
Operating	Rescue flight		
Flight rules	*Visual* flight *rules* (VFR)		
Takeoff	Saanen Airport (LSGK)		
Destination	Avoriaz (France)		
Flight phase	Takeoff and climb		
Type of serious incident	Engine failure		

[1] WGS: *World Geodetic System*, geodetic reference system: The WGS 84 standard was adopted for aviation by resolution of *the International Civil Aviation Organization (*ICAO) in 1989.

[2] LT: *Local Time*, standard time

([3]) UTC: *Universal Time Coordinated*

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Personal injury	Crew members	Passengers	Third parties
Not injured	3	0	Not affected

Damage to aircraft Slightly damaged Damaged engine

Third-party damage None

Facts

General

The following description of the incident is based on information provided by the crew and recordings from the cockpit camera.

Course of events

The crew, consisting of a pilot, a paramedic (HEMS[4] *Technical Crew Member*) and an emergency physician (*Medical Passenger*), was returning from a rescue mission at noon on January 20, 2024, in the EC135T2+ rescue helicopter, registered as HB-ZUI. During this flight, the crew was called to a follow-up mission in Avoriaz (F). The crew first flew to Saanen Airport (LSGK) to refuel the helicopter, where the HB-ZUI was refueled with the engines running and rotors turning. The helicopter then took off at 12:42 p.m. heading west.

Shortly after takeoff, when the helicopter was in cruise flight, a *needle* split between the two shaft engines became visible on the combined power indicator (*First Limit Indicator* – FLI) at 12:43:44 p.m. At 12:43:45 p.m., the right engine shut down on its own. At the same time, the corresponding warnings lit up on the display system (see Figure 1).

Figure 1: Sequence of images from the helicopter cockpit displays: immediately before the serious incident (❶); 1 second after the *needle split* first became visible on the FLI (❷); approximately 2 seconds later, when the right engine had already failed (❸) and the yellow warning indicators (❹) became visible.

The digital engine control system (*Full Authority Digital Engine Control* – FADEC) re-regulated the power of the left engine, which was still running, to the mode for operation with *one engine inoperative (*OEI).

The pilot decided to return to Saanen Airport and landed there without incident at 12:46 p.m. on runway 08 (see Figure 2).

[4] HEMS – *Helicopter Emergency Medical Service:* English umbrella term for emergency medical air rescue

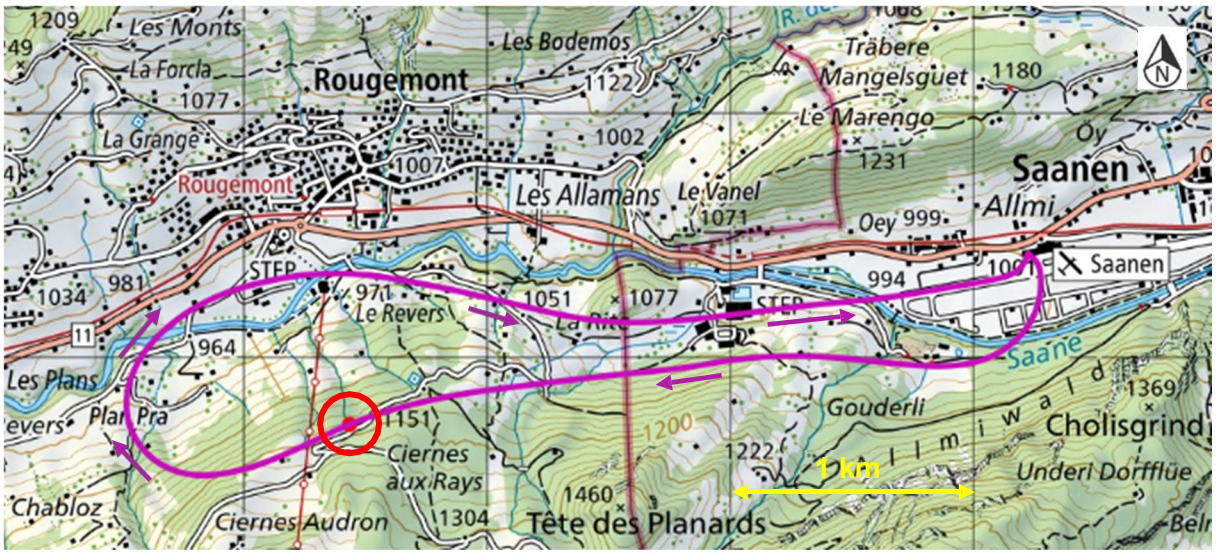

Figure 2: Flight path (purple) of HB-ZUI. The red circle with the dot indicates the position of the engine failure. Source of the base map: Swisstopo, edited by SUST.

Helicopter details

The Airbus Helicopters EC135T2+ is a civil, twin-engine helicopter with a rigid rotor head, four main rotor blades, a *Fenestron* tail rotor, and a skid landing gear. When equipped as a rescue helicopter, it can carry three additional passengers seated and one passenger lying down in addition to the pilot. The maximum takeoff weight is 2910 kg.

The helicopter is powered by two Arrius 2B2 shaft engines manufactured by Safran Helicopter Engines. The engines in the Arrius family are so-called free-running turbines, consisting of a module for the *gas generator* and a module for generating *shaft* power, which is required via a *reduction gearbox* to drive the main rotor gearbox. The *gas generator* shaft drives the *accessory drive train* by means of a drive gear. During operation, the *gas generator* can reach a speed of around 57,000 revolutions per minute (see Figure 3).

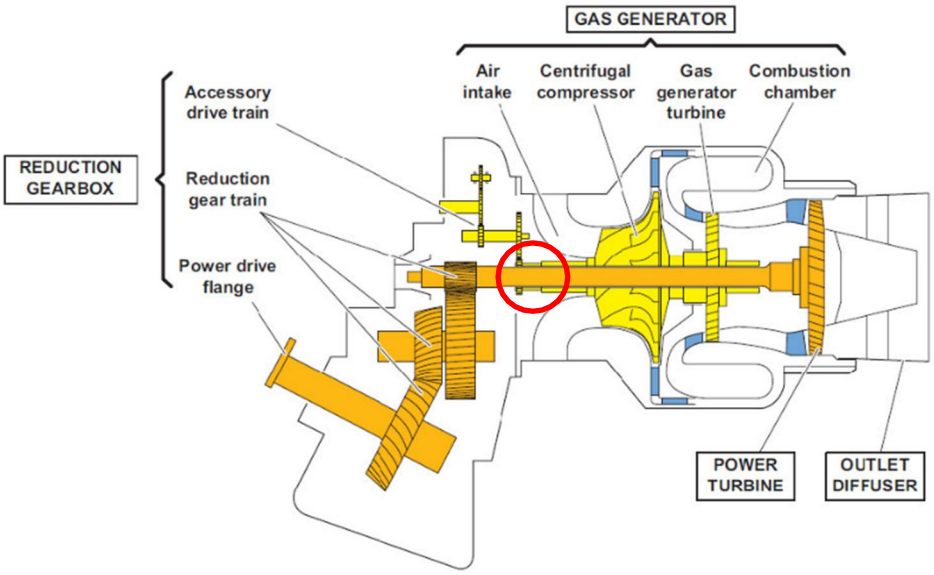

Figure 3: Schematic representation of an Arrius 2B2 shaft engine. The *gas generator* is shown in yellow, the *power turbine* and *reduction gearbox* in orange. The drive gear of the accessory drive train is circled in red. Source: Safran Helicopter Engines

Each engine can generate a *take-off* power of 633 SHP[5] and a cruise power of 580 SHP. If one of the two engines fails, the remaining engine can briefly generate a power of 819 SHP in OEI mode (*One Engine Inoperative*).

The OEI power calculation at the time of the serious incident showed a possible climb rate of around 350 ft/min at an indicated speed of 65 kt, based on an actual flight mass of around 2650 kg.

The time between engine overhauls *(*TBO) is 4000 hours. Each engine is digitally controlled and monitored by a FADEC system. The pilot can take manual control using a power control lever if the FADEC system malfunctions.

The shaft engine affected by the failure, with serial number 32862, was manufactured in 2014 and had 1815 hours of operation since manufacture (*Time Since New* – TSN) at the time of the incident.

Maintenance

The affected engine underwent scheduled maintenance in October 2023[6]. The *engine power* checks performed as part of this maintenance did not reveal any abnormalities.

Findings

The day after the serious incident, the engine was examined by the SUST. No external anomalies were visible on the engine. During the inspection of the *reduction gearbox* magnet tap, a metallic fragment was found.

The investigation of the engine in cooperation with the French safety investigation authority (*Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile* – BEA) and the manufacturer revealed that the drive gear of *the accessory drive* train was destroyed (see Figure 4). Other gears in the *accessory drive train* showed damage to the teeth.

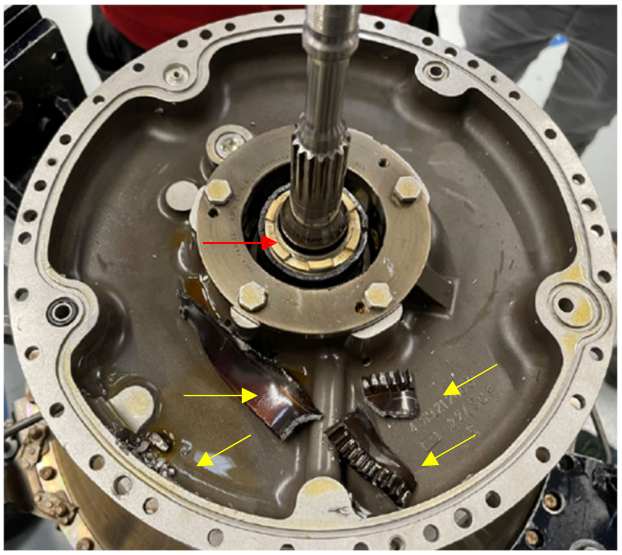

Figure 4: Rear of the *accessory gearbox* with the fragments of the drive gear (yellow arrows) and its main body (red arrow)

[5] SHP: *shaft horsepower*, Anglo-Saxon unit for measuring shaft power (1 SHP corresponds to 0.746 kW)

[6] The scheduled checks were carried out for the following operating intervals: 100h; 200h; 400h; 500h; 1000h; 24 months and other manufacturer and airworthiness instructions.

The fractures in the drive gear were examined in detail. A fatigue fracture was identified, originating at the surface of a tooth root, at the transition between the milled and cut areas during manufacture (see Figure 5).

The manufacturer was unable to explain the metallurgical singularity at the tooth root radius that contributed to the formation and propagation of the crack.

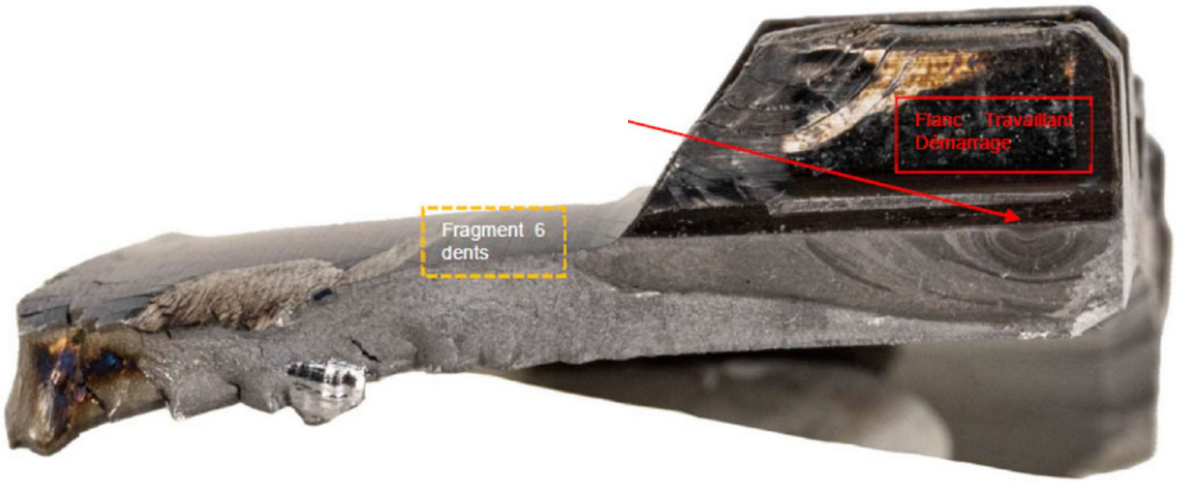

Figure 5: Detailed image of one of the fragments of the drive gear. The red arrow points to the starting point of the fatigue fracture. Source: Safran Helicopter Engines.

The notch that was identified as the starting point of the fatigue fracture probably occurred during the manufacture of the gear. The manufacturer cited a one-time overload during a tempering process as an additional possibility. Based on the production records, the manufacturer was able to identify two other engines that may have been affected by the same issue and initiated appropriate investigations. The gears from these two engines examined by the manufacturer showed no abnormalities.

Analysis

The engine failure during climb due to the destruction of the accessory gearbox drive gear occurred unexpectedly and without any prior signs that could have been detected by the maintenance organization or the flight crew. The destruction of the drive gear meant that the fuel supply to the affected engine was no longer guaranteed, which was the cause of the serious incident.

During the formation of a crack, which can ultimately lead to a fracture, no metal particles are produced that can be detected by detection systems such as a magnetic cap or by oil laboratory analyses. Since the engine had only reached around 45% of its operating time until its first overhaul, it was not possible to detect and repair the potential damage at an early stage.

The helicopter's twin-engine design, with FADEC engine control, and the available OEI power reserve enabled the pilot to maintain altitude during a non-critical phase of the flight and return to the airport of departure without further incident. This was only a few minutes' flight away and a suitable runway was available, so the decision was a safe one.

This serious incident highlights how important it is for flight crews to prepare for sudden engine failure through regular training in helicopters and simulators.

Conclusions

The serious incident, in which a shaft engine unexpectedly failed during the climb, was caused by the failure of the accessory gear drive gear. The drive gear failed due to a fatigue fracture that originated in a notch in the tooth root, which was probably caused during manufacture or by a one-time overload during engine start-up. However, an overload during start-up seems unlikely, as it would have been noticed by the crew.

The two other engines that may have been affected were identified and examined by the manufacturer. They did not show any defects, which is why this case can be assumed to be an isolated incident.

In view of these findings, the Swiss Transportation Safety Board concludes that no further findings are to be expected in relation to the serious incident under investigation that would be useful for the prevention of such an incident. The SUST therefore refrains from further investigative measures on the basis of Art. 45 para. 1 of the VSZV and concludes the investigation with this summary report.

Bern, September 15, 2025 Swiss Transportation Safety Investigation Board