AAIB Bulletin No: 8/2005 **Ref: EW/C2004/11/08** **Category: 2.3**

INCIDENT

Aircraft Type and Registration:	Gazelle HT Mk 2, G-GAZL
No & Type of Engines:	1 Turbomeca Astazou IIIN2 turboshaft engine
Year of Manufacture:	1974
Date & Time (UTC):	4 November 2004 at 0948 hrs
Location:	On approach to Sheffield City Airport, Sheffield
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Separation and destruction of right-hand engine cowling plus superficial damage to main rotor blades
Commander's Licence:	Private Pilot's Licence
Commander's Age:	58 years
Commander's Flying Experience:	2,657 hours (of which 384 were on type) Last 90 days - 46 hours Last 28 days - 6 hours
Information Sources:	Aircraft Accident Report Form submitted by the pilot, plus aircraft examination by the AAIB and a metallurgy report

Synopsis

Following a loud bang and a jolt during his approach, the pilot determined that the engine and rotor systems were operating within limits and so he landed normally. After landing the right engine cowling was missing and there were small marks on the main rotor blades. Two fractured portions of the missing cowling were later found. Each cowling panel has two hinges at the top, a lower latch and part of a single latch which secures the forward edge of both panels. It appears that at least one of the top spigot fittings had failed through cracking from previous overloads and the aft lower latch had probably not been fully secure. Tests showed that this aft lower latch can appear latched when it is not actually engaged. Two Safety Recommendations were made concerning detailed visual inspections of these fittings.

History of the flight

The pilot planned to fly from a private landing site near Derby to another private site near York, refuelling at Sheffield City Airport on the way. He states that he checked that all the cowlings and latches were secure before leaving Derby.

The flight proceeded normally until, about two miles south of Sheffield City Airport on a left-hand base leg for Runway 28, there was a loud bang and a jolt to the helicopter. The pilot thought he might have had a birdstrike and so he immediately lowered the collective lever as a precaution for a possible autorotation. However, the engine temperature, RPM and pressure indications remained normal so he continued on final approach to a landing.

After shutdown the pilot noted a small mark on one of the main rotor blades and then, upon leaving the helicopter, he realised that the right-hand engine cowling was missing. He reported the facts to ATC and looked for further damage. This was limited to small marks on the other two rotor blades. Later, an engineer arrived from the maintenance organisation with a spare pair of cowlings and the helicopter was returned to service the following day. Two items of wreckage, fractured portions of the missing cowling, were later forwarded to the maintenance organisation by ATC at Sheffield.

Engine cowling description

The engine cowling assembly on the Gazelle is formed of two large symmetrical cowling panels of complex curvature and composite construction. Together these cowling panels surround the engine and cover the engine connections and the portion of the tail rotor drive shaft located directly below the engine. Both the left-hand and right-hand cowlings are hinged at the top of the engine, with two spigots engaging hinge fittings close to the aircraft centreline. On this version of the Gazelle, the SA341 with the Astazou III engine, there is one latch on each cowling side with a further single, common, front latch attachment formed of two halves, with one half on the forward edge of each cowling. This simple over-centre latch below the centreline of the engine secures the two cowlings together and the other latches, farther aft, secure the cowlings to short roller fittings mounted on the engine.

This aft latch on each cowling is designed to engage automatically when the cowling is closed (see Figure 1). The latch is a very simple mechanism, with a latching lever marked OPEN and LOCKED. In addition, there is an 'anti-chatter' device; a length of spring steel formed into a curved W-shape (see Figure 2).

The lever is normally retained in the LOCKED position by a spring. To open the cowling, the operator holds the lever in the OPEN position, while lifting the cowling. To close the cowling, the

lever will move momentarily towards the OPEN position as the latch engages the roller fitting on the engine and then to its sprung LOCKED position. There is no additional visual indication to confirm that the roller is engaged in the latch.

Examination - G-GAZL

Only three items of the right-hand cowling were available for examination. These were the fractured spigot from the forward hinge at the top of the engine, the portion (approximately 300 mm by 180 mm) of the cowling which would normally be attached to this spigot and another portion (approximately 350 mm by 330 mm) of the cowling, including the aft latch. The forward spigot had been retained in the hinge by a safety pin.

G-GAZL was examined by the AAIB with the replacement cowlings in place. In operating the latches and opening and closing the cowlings, it was clear that if the forward latch joining the cowlings was left undone, it was visually obvious and untidy. With the aft latches, however, it was possible to close the cowlings so that these latches did not engage and the cowling appeared very similar to the same cowling with the latch fully engaged. In each case, the lever was in its sprung LOCKED position.

As a trial, the fractured item of cowling panel containing the aft latch was engaged with the roller on the engine. It engaged correctly and the application of forces in a variety of directions failed to disengage the latch indicating that it had very probably not been engaged at the time the cowling opened in flight.

Examination - fractured fitting

The fracture surfaces of the spigot fitting were examined by a metallurgist, who used both visual and fractographic (Scanning Electron Microscope [SEM]) methods. The metallurgist identified the material as low alloy steel and reported that the fracture surface was generally darkened and discoloured, consistent with cracking in the material, with two narrow bright regions, consistent with a final overload failure.

The SEM examination showed the fracture generally to be 'terraced' in appearance, ductile and primarily tensile in nature, with the path of the fracture being heavily influenced by the directionality of the microstructure. The discolouration showed that most of the fracture had been present for an extended period and it had probably developed as a result of a number of overload cycles. The small size of the final fracture surfaces indicated that the door was, when in position and properly secured, well-supported and that only small loads would pass through the hinge points.

In summary, the metallurgist reported that the pattern and orientation of the fracture was consistent with the door being rapidly opened a number of times beyond its normal position, such as when opening in strong winds and that this would have taken place over a long period of time, probably years. He also commented that a detailed visual inspection of the spigot fittings would, in most instances, reveal whether cracks were present.

Military and civil experience

With the assistance of the Defence Aviation Safety Centre (DASC), the occurrence records of the UK military services were examined for similar instances on Gazelle helicopters.

One incident in particular was very similar to the occurrence to G-GAZL. In this case, in late 2003, a Gazelle AH1 of the British Army had lost a right-hand engine cowling while descending to land and there was damage to the main rotor blades very similar to that to G-GAZL. The items of cowling could not be recovered so the state of the securing latches could not be determined. In common with G-GAZL, previous cracking was noted around the hinge spigots and the conclusion of the technical report was that the loss of the cowling had been a result of a combination of the cracking and the failure, or non-securing, of one or more of the lower latches.

In addition, there have been at least two cases in the UK of engine cowling separation from civil-registered Gazelle helicopters previously reported by the AAIB.

Maintenance requirements

The Gazelle helicopters currently registered in the UK are both from civil production, with Certificates of Airworthiness, and ex-military helicopters on CAA Permits to Fly, such as G-GAZL. Both ex-military and civil, however, are of the original SA341 design, with similar engine cowlings.

The maintenance schedule for the ex-military helicopters is based on the UK military schedule. For examination of the fittings on the engine cowlings, amongst other items, the main inspection is the 'T1', scheduled for every 500 operating hours (or a maximum of 24 months calendar time).

Discussion

The presence of the cracking around the hinges in G-GAZL was clearly significant. However, the indications from the metallurgist's report were that these hinges finally failed when an overload was applied and the design is such that normal flight applies only low loads to the hinges when the cowlings are correctly latched.

The absence of certain hardware items from G-GAZL, such as the right-hand portion of the forward latch, prevents a definite finding as to the cause of the separation of the right-hand cowling. However, the fact that the aft latch was found complete and undamaged, separate from the roller with which it would engage, makes it highly probable that the aft latch was not correctly engaged before flight. This accident, like the Gazelle AH1 in late 2003, occurred during descending flight, when the airflow around the fuselage would have a strong upward component and would draw the unlatched cowling outwards and upwards, applying further loads to the hinges. The AAIB could not determine whether the forward latch was insecure at the start of the flight or if it was released by distortion of the cowling under air loads. In either case, the likelihood in both accidents is that there was a combination of cracked hinge brackets and at least one unsecured latch.

This accident is a reminder to operators of Gazelle helicopters to exercise particular care in the positive latching of engine cowlings. However, the problem of cracking in the spigot fittings appears to be a common feature in these occurrences and a more detailed visual inspection should identify those engine cowlings at risk. Therefore, the AAIB issued the following Safety Recommendations:

Safety Recommendation 2005-049

The UK Civil Aviation Authority should review the periodic inspection of the spigot fittings on the engine cowlings of SA341-type Gazelle helicopters operated on CAA Permits-to-Fly, to reduce the number of cracked fittings in service.

Safety Recommendation 2005-050

The European Aviation Safety Agency should review the periodic inspection of the spigot fittings on the engine cowlings of SA341-type Gazelle helicopters operated on Certificates of Airworthiness, to reduce the number of cracked fittings in service.

Figure 1 - Engine cowling - Aft latch (outside) and latch lever

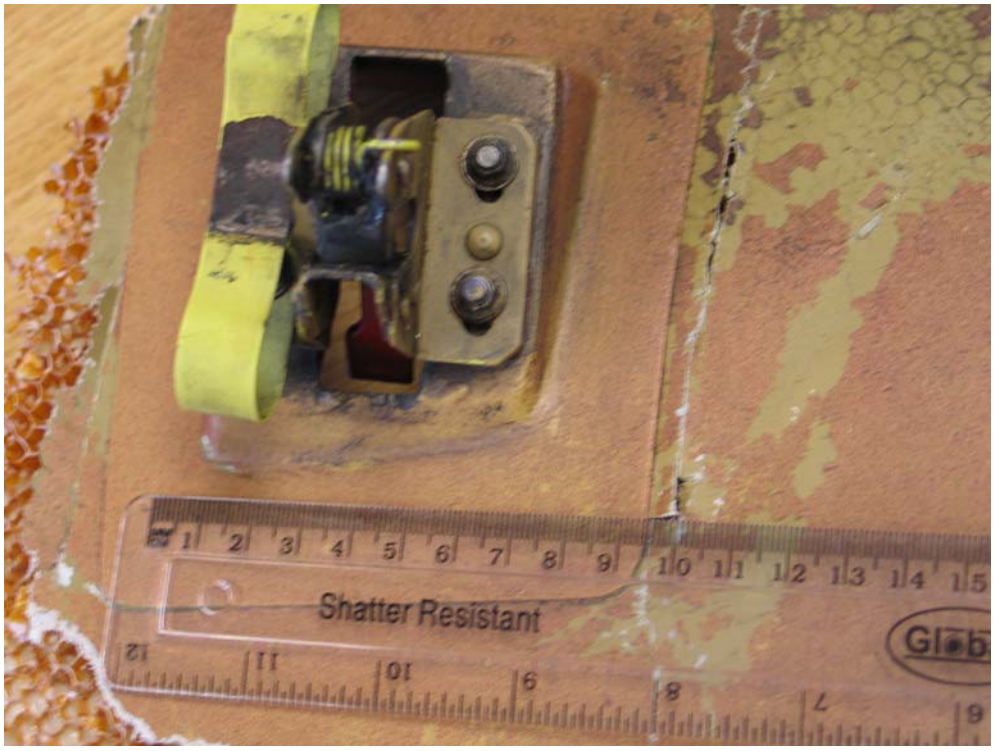

Figure 2 - Engine cowling - Aft latch (inside) and 'anti-chatter' device