SA314G Gazelle 1, G-PYOB

AAIB Bulletin No: 3/2001

Ref: EW/C99/6/3 - Category: 2.3

Aircraft Type and Registration:	SA314G Gazelle 1, G-PYOB
No & Type of Engines:	1 Turbomeca Astazou 3A turboshaft engine
Year of Manufacture:	1974
Date & Time (UTC):	30 June 1999 at 0910 hrs
Location:	Boones Farm, Braintree
Type of Flight:	Private
Persons on Board:	Crew - 1 - Passengers - Nil
Injuries:	Crew - Nil - Passengers - N/A
Nature of Damage:	Damage to main rotor blades, drive train and tail boom
Commander's Licence:	Private Pilot's Licence (Helicopters)
Commander's Age:	48 years
Commander's Flying Experience:	984 hours (of which 384 were on type) Last 90 days - 20 hours Last 28 days - 10 hours
Information Source:	AAIB Field Investigation

History of the event

The helicopter was landed and shut down normally on a concrete helipad. The rotor brake was applied, and as the blades were slowing down there was a loud bang and all of the main rotor blades dropped to nearly touch the ground. One blade struck the tail boom and the engine exhaust. An external inspection showed that two of the three Low Stop Ring supports had failed, allowing the Low Stop Ring to be displaced downwards. In this condition the main rotor blade mounted stops had passed over the ring allowing the blades to droop excessively.

Main rotor blade low support ring

The main rotor blade Low Stop Ring is retained on three supports, which in turn are mounted on the main rotor head assembly, one beneath each blade mounting (Figure 1). The ring is located at each support but free to move radially; the limit of such movement occurring when the ring contacts the inner vertical face of one or two supports (Figure 2).

The original supports (Pt No 341A31-4138.20) were subject to 'distortion pinching' and a service letter from Vought Helicopters, dated 8 Sept 1972, called for a 50 hour inspection. As a result of a modification in 1972 that introduced a reinforcing rib to the support (Pt No 341A31-4232.20), the inspection interval was extended from 50 to 500 hours. An upgraded support, Pt No 341A31-4232.21 was subsequently introduced.

The part numbers and locations of the low stop ring supports fitted to G-PYOB were:-

Yellow	341A31-4232.20	failed
Red	341A31-4232.21	failed
Blue	341A31-4232.20	

Examination of the main rotor head assembly by the new owner with advice from the manufacturer did not reveal any condition considered relevant to the failure off the Low Stop Ring supports.

Detailed examination of the supports

Following the event, the damaged helicopter was sold to another helicopter company. The droop stop ring supports were recovered and forwarded to Eurocopter for examination. There findings were as follows:-

Support No 1 Yellow

Both the upper and lower flanges had suffered static ductile bending fractures (Figure 2). The upper flange was recovered and had failed in downward bending and had suffered damage along the whole length of its outboard edge. The lower flange was not recovered. The lower flange fracture face on the support body had suffered some impact damage, as had the vertical inner face of the support.

The thickness of the upper flange was measured as 2.0 mm.

Support No 2 Red

The lower tab had failed downwards in static ductile bending and was not recovered.

The thickness of the upper flange was measured as 1.9 mm.

Support No 3 Blue

Neither flange had fractured but the upper one was slightly bent downwards.

The thickness of the upper flange was measured as 1.9 mm, lower flange 1.5 mm.

The nominal thickness for all support flanges is 2.0 mm. Material chemical analysis and hardness checks were all compliant with the relevant specifications.

Previous history

The helicopter manufacturer was only aware of one previous similar incident, occurring about fifteen years ago. On that occasion, following examination of the parts and discussions with the operator, it was concluded that wear of the support flanges was the first step in the sequence leading to weakening and failure of the flanges. The wear process had been accelerated by the operator's practice of embarking and disembarking passengers with the rotor turning. As the Gazelle rotor disc plane is quite low, it had been the operator's practice to push the cyclic to one side to lift the disc on the side of the passenger access. This had the effect of loading and moving the Low Stop Ring within the limits imposed by the supports, leading to friction and wear of the flanges.

Summary

On shutdown and application of the rotor brake, the main rotor blades drooped excessively and one struck the fuselage. This occurred because two of the three Low Stop Ring supports had failed, allowing the Ring to drop out of the plane of the main rotor blade mounted stops. The failures were all in static ductile bending and the material properties were all within specification. Only one support lower flange was recovered and this exhibited some wear, having reduced in thickness from 2.0 to 1.5 mm.

The likely initial sequence of events is that one or two support lower flanges, reduced in section by wear, failed, allowing the Low Stop Ring to become displaced, after which the supports suffered some secondary damage.