

INCIDENT

Aircraft Type and Registration:	Enstrom F-28A, G-KOLY	
No & Type of Engines:	1 Lycoming HIO-360-C1A piston engine	
Year of Manufacture:	1973	
Date & Time (UTC):	31 October 1992 at 1330 hrs	
Location:	Monmouth, Gwent	
Type of Flight:	Private (pleasure)	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Severe mechanical damage to engine, minor engine bay fire damage	
Commander's Licence:	Private Pilot's Licence with Night rating	
Commander's Age:	53 years	
Commander's Flying Experience:	787 hours (of which 17 were on type) Last 90 days - 5 hours Last 28 days - 4 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB examination of aircraft and engine	

The helicopter was in cruising flight at 1,200 feet amsl, around 700 feet agl, approaching rising ground when there was a sharp double bang from the rear. The helicopter immediately rolled onto its right side and the nose dropped. The pilot instinctively lowered the collective, and then regained a normal attitude and established autorotation at the normal 60 mph.

Available forced landing sites comprised small, sloping fields. The pilot chose the nearest and descended towards it, making 'S' turns to achieve the necessary flight profile. At around 100 feet agl it became apparent that there were power cables crossing the approach path but the aircraft cleared these by a small margin. As the ground sloped up around 10° along the direction of flight the pilot executed a sustained flare before making an engine-off landing at low groundspeed. No impact damage resulted but smoke was seen to be issuing from the aircraft. The pilot and passenger

evacuated without difficulty and used the cabin fire extinguisher to extinguish a small fire in the engine bay.

Engine inspection revealed major failure of the No. 2 connecting rod big-end. The rod had been released from the crankshaft and had holed the crankcase and fractured the camshaft. Reports indicated that the fire had probably resulted from auto-ignition on the exhaust pipes of oil that had been released from the engine. Only very minor fire damage had occurred.

Strip examination of the engine revealed the presence of a foreign washer in the sump, non-standard seal washers fitted to a number of the push rod cover tube seals and incorrect grade sparking plugs throughout, but the evidence did not indicate that these had contributed to the failure. At the time of the incident the engine had accumulated 1,314 hours since the last overhaul in 1982. Following an oil leak the crankcase assembly was replaced in 1986, 227 hours before the incident, with an inspected unit from another engine.

Detailed inspection showed that one big-end lug of the No. 2 connecting rod, providing the location for one of the big-end cap bolts, had fractured on two roughly transverse planes at the position of the seating face for the nut. The opposite cap bolt and the cap had distorted and fractured (Fig 1). Specialist materials examination concluded that the cap bolt and cap failures were the result of overload. One of the connecting rod lug fractures had resulted from a high stress low endurance fatigue mechanism and was consistent with secondary failure resulting just prior to the final big-end failure. The other fracture had resulted from a low stress high endurance fatigue mechanism consistent with progression over millions of load cycles (Fig 2). Examination of the microstructure and hardness measurement did not suggest that a material defect had adversely affected the fatigue strength. In both planes of separation the fatigue initiation region was at the bore of the big-end, *ie* at the surface of the big-end journal in contact with the outer surface of the white metal bearing shell. This surface had considerable galling damage, as did the big-end bearing journals of the other connecting rods, and expert evidence indicated that this would be likely to act as a fatigue initiator.

Records showed four other cases since 1976 of big-end failure on HIO-360 engines on UK registered aircraft (AAIB Bulletins 3/85, G-BAWI and G-BCFP, and 7/90, G-AVZC), and four cases to other types of Lycoming engine. Some of the cases were attributed to undertorquing of the big-end cap bolts but this condition was not present on the three intact big-ends in the engine of G-KOLY. One case was attributed to galling of the big-end journal.

There was evidence of appreciable overspeed at some stage; markings showed that valve springs had been overcompressed and become coil bound (*ie* contact of adjacent coils) and that all four intake valves had overtravelled such that the valve keys had contacted the top of the valve guides, in one case

driving the guide down in the head approximately 0.25 inches. In addition, damage to the bottom of the piston skirts consistent with contact with the adjacent big-end cap was indicative of crankshaft flexing due to appreciable overspeed. The freshness of the markings suggested that the overspeed event responsible had occurred recently, but it was not possible to ascertain whether it had occurred a few hours before the failure or had occurred as a result of the failure. The pilot at the time of the incident had flown the helicopter for only a few hours since his company had purchased it and believed that the engine had not been severely oversped in this time.

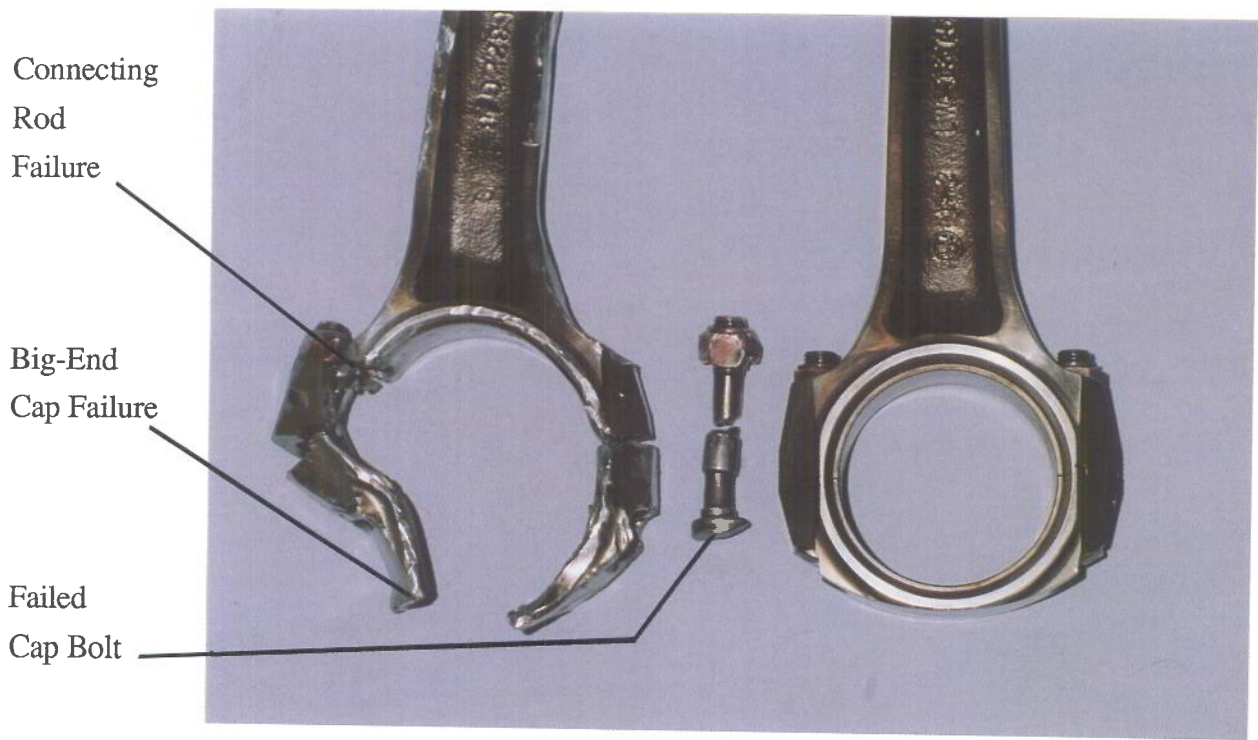


Fig 1 No. 2 Connecting Rod Big-End and Intact Example

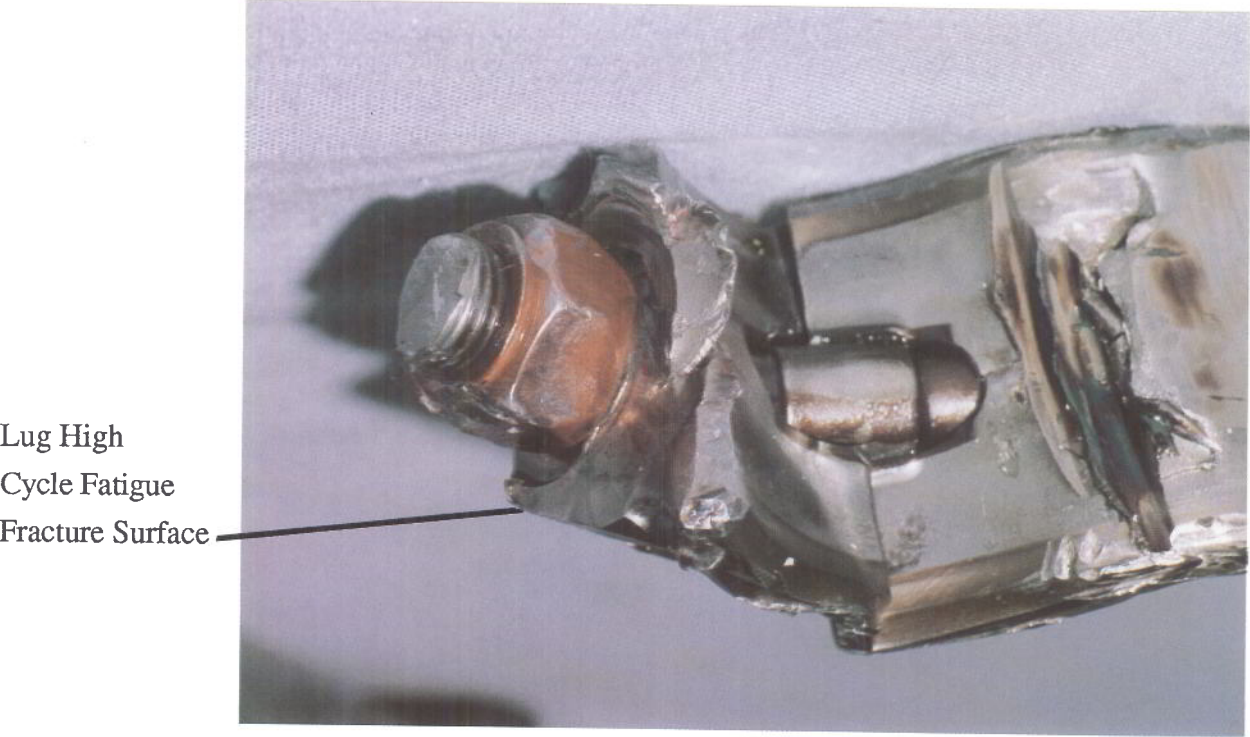


Fig 2 No. 2 Connecting Rod Failure