This accident was first reported without the relevant drawings, in Bulletin 2/87. It is reproduced here in full, complete with amendments and drawings.

No: 4/87 **Ref: 2c**

Aircraft type and registration:	Bensen B8-V Gyrocopter G-BIOT	
No & Type of engines:	One Modified Volkswagen 1835 cc piston engine	
Year of Manufacture:	Period of 1983 to 1986	
Date and time (UTC):	27 November 1986 at 1200 hrs	
Location:	1/2 nm north of runway 18 at Dunkeswell airfield	
Type of flight:	Training	
Persons on board:	Crew — 1	Passengers — None
Injuries:	Crew — 1 (fatal)	Passengers — N/A
Nature of damage:	Aircraft completely destroyed	
Commander's Licence:	Student Pilot	
Commander's Age:	49 years	
Commander's Total Flying Experience:	Approximately 33 hours (of which 18 1/2 hrs were fixed wing, 3 were on Gyrogliders, the remainder on Gyrocopters)	
Information Source:	AIB Field Investigation.	

HISTORY OF THE FLIGHT

On the day in question, the pilot had arranged to meet his instructor at the airfield with the intention of completing the final stages of his training in his own single seat gyrocopter.

As he had not flown for several weeks it was decided to refresh his circuit work and, accordingly, following a thorough briefing, a satisfactory right hand circuit was flown on runway 18. The brief for the following exercises was for him to confirm the minimum full power level flight speed of 18 knots, to lower the nose and regain 'flying' speed of 40—50 knots before climbing back into the circuit at 800 feet. The exercise was then to be repeated with a recovery without power.

After take-off, witnesses on the airfield reported seeing the gyrocopter fly downwind, turn onto its final approach and commence a descent. The rate of descent was then seen to markedly increase and, with a relatively low forward speed, the aircraft was seen to yaw from side to side.

One witness, who only heard the gyrocopter throughout this period, reported hearing a sound he described as a 'thwack' following which the sound of the engine could not be heard.

At a height estimated by witnesses to have been around 150—200 feet the rotor was seen to detach and spin off to one side and the machine fell to the ground.

The weather was reported as fine and sunny with a light south westerly breeze and a surface temperature of 8°C.

WRECKAGE EXAMINATION

All the component parts of the gyrocopter landed in a field just to the north of the airfield, the main structure coming to rest on its left side on a heading of 305° (M) with the mast buried several feet into the waterlogged surface. There was little evidence of any lateral movement of this structure as it contacted the ground, strongly suggesting that its path of descent had been essentially vertical. The complete but damaged rotor blades assembly, including the teeter bearing and rotor attachment bolt, lay some 85 feet to the East of the main wreckage immediately adjacent to the outer half of one propeller blade. Some 80 feet to the north east of the main wreckage lay one large wooden fragment from the propeller, the only others being several small fragments in and around the wreckage. On site examination of the propeller did not reveal any evidence of engine rotation at impact, the wreckage distribution suggesting that the half blade had detached in flight a short time before impact.

When examined, the five gallon fuel tank was empty but there was a strong smell of petrol around the wreckage for some time after the accident.

It was quickly established that all the flying control linkages and cables were intact and that the autogyro's main structure had been intact prior to impact. However, when the area of the mast head was excavated during the recovery, it immediately became apparent that a major failure had occurred in the rotor control system, in particular to the component known as the torque tube, see Fig.1.

This tube, which is made from extruded square section aluminium alloy, acts as the main support for the rotor assembly. It is pivoted to provide the fore and aft lateral control for the rotor and, at the rear, mounts the operating arms for the control rods. In addition in this area is mounted the Bendix unit, which is part of the rotor pre-spin system. A counterbored alloy block, which provides one half of the fore/aft control stop and local re-inforcement for the rotor attachment bolt, is positioned into this tube through a cutout in its lower surface.

Detailed examination of this component revealed its dimensions and material strength not to be in question, and that the mode of failure was predominantly one of torsion, see Fig.2. It was apparent that high torsional load had been experienced from the rear end of this tube upto the position of the rotor bolt attachment hole, sufficient to cause failure at a section through this hole and gross distortion of the material in the region of the central cutout. The sense of this torque was clockwise when seen from the rear. Little or no damage was present on the tube forward of the rotor bolt hole, but some was present, however, on all of the control head stops.

Three main items attach to the rear of the control head torque tube. Two push/pull control rods and the rotor pre-rotator flexible drive shaft. The two lightweight rods connect through a simple system of linkages to the pilots stick and only transmit loads generated or resisted by the pilot's hand.

The drive shaft runs in a curve between a fitting on the engine, just forward of the pusher propeller, up to the mechanism mounted on the control head. Each end of this shaft terminates in an aluminium sleeve swaged onto the outer rubberised sheath, into which is formed a shallow recess close to either end. The shaft is mounted by inserting each sleeve a short way into the appropriate socket and secured by tightening a single screw down into the recess. The screw is then wirelocked.

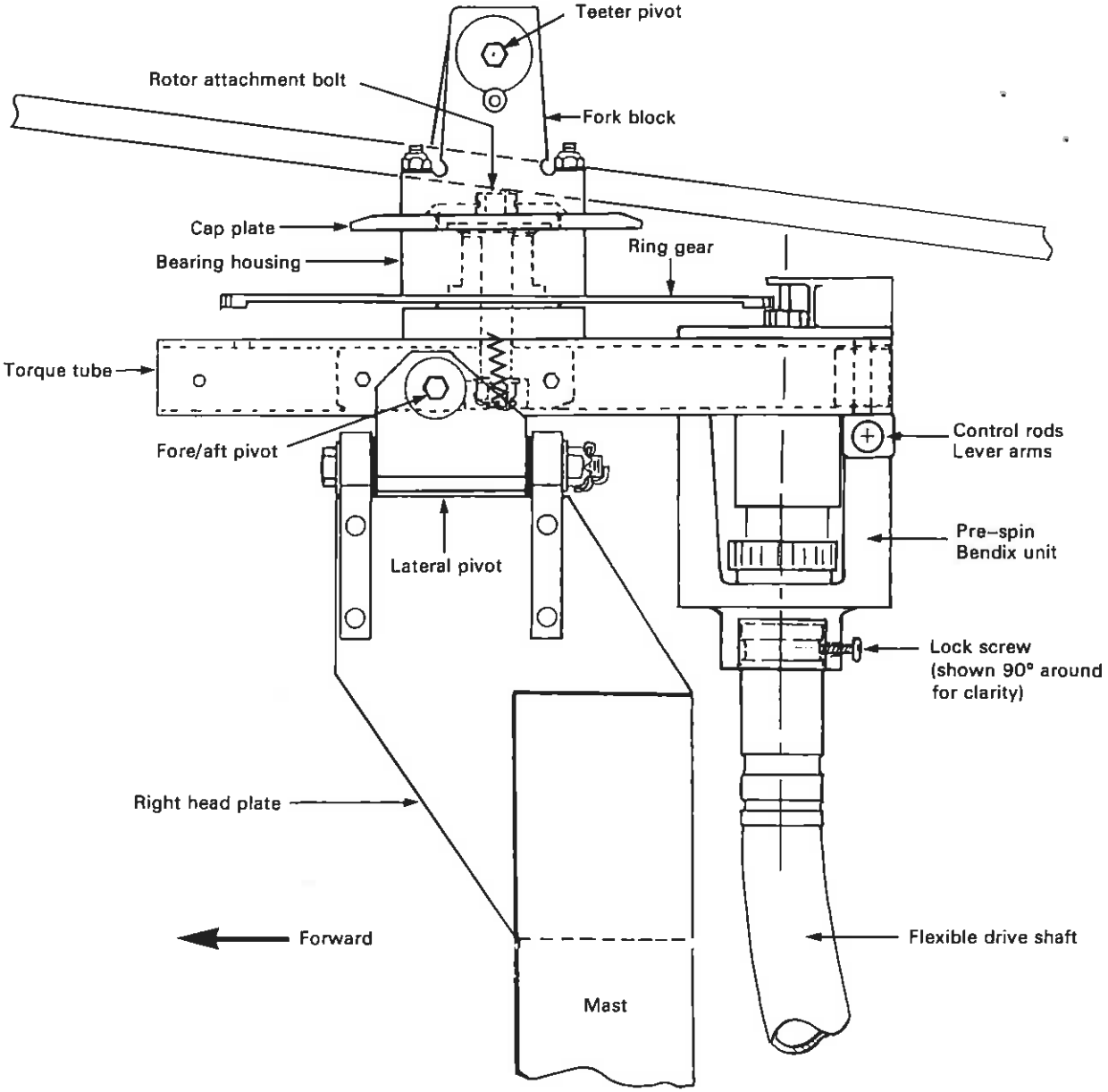
Examination of this drive shaft revealed that a significant amount of surface damage was present at a position several inches up from its lower end which was co-incident with a sharp kink of the whole shaft. When loosely re-assembled onto a re-construction of the wreckage it became apparent that a hard contact had occurred between the propeller and this shaft, the propeller blade failing against the direction of rotation but in the plane of rotation. Examination of the upper attachment of the shaft revealed the sleeve to have been forcibly rotated in the socket against the locking screw in a direction consistent with propeller contact and that the walls of this socket were split as a result of overload. By comparison, the walls of the lower

socket were undamaged and it was evident that the locking screw was not protruding significantly through the socket wall. No accident related damage was visible on this sleeve in the area of this screw contact but it was apparent that the screw had at some time been tightened partially onto the larger diameter section of the sleeve, rather than fully into the recess. Both screws retained evidence of wirelocking although it could not be established if the lower end of the flexible shaft had been correctly installed prior to the accident or if the wire locking had been secure.

After contacting the propeller, it would therefore seem that the flexible drive shaft was rotated with some force about its upper attachment point, causing the control head torque tube to twist and fail, in turn leading to rotor detachment.

There was no evidence from the wreckage, or witnesses who had seen the aircraft close to, to suggest that this shaft was restrained by any means other than the upper and lower attachments. An Emergency Airworthiness Directive, No.001-102-87, has been issued by the Civil Aviation Authority since this accident which relates to the security of this flexible shaft and its end attachments.

No evidence could be found that the pilot had renewed his CAA FCL form 150/A medical certificate since its last issue on 8 August 1985, although there was no evidence to suggest that any medical problem was a factor in this accident.



GENERAL ARRANGEMENT OF ROTOR HEAD
SHOWING POSITION OF FAILURE (≷)

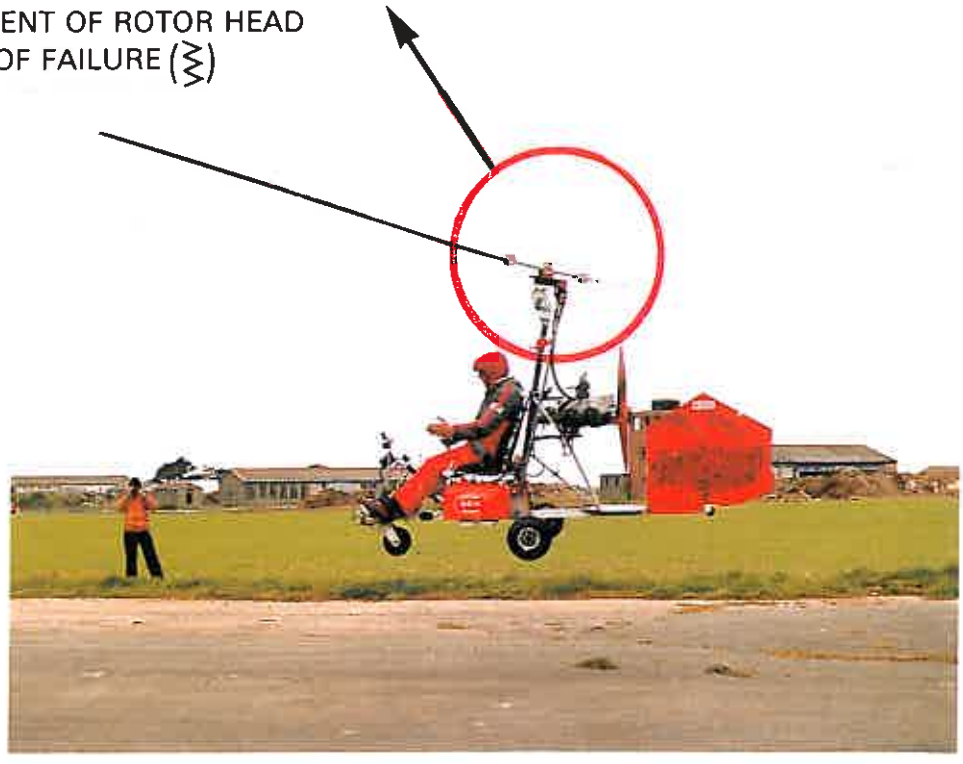


FIGURE 1

VIEW OF UNDERSIDE – SHOWING DAMAGE TO SOCKET

FORWARD SECTION OF
TORQUE TUBE

VIEWS OF TORQUE TUBE SHOWING FAILURE
AND DISTORTION OF AFT SECTION

FIGURE 2