

AIB Bulletin

3/85

No: 3/85

Ref: EW/C879

Aircraft type and registration: Bölkow BO 105D G-AZOM (twin engined light helicopter)

Year of Manufacture: 1972

Date and time (GMT): 24 July 1984 at approximately 1202 hrs

Location: 5½nms due east of Skegness, Lincolnshire

Type of flight: Public Transport

Persons on board: Crew — 1 Passengers — 2

Injuries: Crew — None Passengers — None

Nature of damage: Aircraft damaged beyond repair by impact and sea water corrosion

Commander's Licence: Airline Transport Pilot's Licence (Helicopters)

Commander's Age: 40 years

Commander's total flying experience: 9500 hours (of which 4100 were on type)

Information Source: AIB Field Investigation

1. History of the flight

The purpose of the 30 minute flight was to ferry two charter passengers from Strubby Heliport, in Lincolnshire, to Bacton gas terminal in Norfolk. The weather was good and the commander decided to conduct the flight at 1000 feet amsl, flying visually on a direct track from Strubby to Bacton. At approximately 1155 hrs, with one of the passengers in the front left (P2) seat, the aircraft lifted off for Bacton. The departure was normal and the commander levelled the aircraft at 1000 feet amsl and established a cruise speed of 110 kt.

This Bulletin contains facts relating to the accidents which have been determined up to the time of issue. This information is published to inform the public and the aviation industry of the general circumstances of the accidents at the preliminary/stage and must necessarily be regarded as tentative and subject to alteration or correction if additional evidence becomes available.

Short extracts can be published without specific permission providing that the source is duly acknowledged.

When the aircraft was about 5 nm off the coast of Skegness, the commander heard a 'dull bang' from the back and the yaw pedals gave a 'twitch'. His immediate impression was that something was wrong with the tail rotor and he decided to descend so as to be closer to the surface, and also to turn right towards Skegness. At this juncture there was no apparent loss of yaw control so the commander established the aircraft in a 70 kt powered descent, turning to the right. During this descent he felt further vibrations and so decided to alight on the sea. Accordingly, he inflated the helicopter floats and called Strubby to announce that he was going to ditch, but did not transmit a full distress message. He also told the passengers to don their lifejackets. By this time it was apparent that the yaw pedals, although still effective, were losing sensitivity. Nevertheless, the commander flared successfully but, as power was applied in order to reduce the descent rate, all yaw control was lost and the helicopter performed 2 or 3 (360°) turns to the right, before hitting the water.

As a result of rotating into the surface of the sea one of the four floats detached and the aircraft immediately rolled onto its right side. It stabilised for sufficient time to allow the front seat passenger to jettison his door, through which all three occupants escaped. Very shortly after that the aircraft rolled upside down.

2. Survival aspects

2.1 Evacuation

The aircraft was lying on its right side with the detached flotation bag beneath the commander's door, holding it closed. However, the passenger seated in the P2 seat had acquainted himself with the jettison mechanism of his door. As a result of his swift action, this became the most convenient egress from the aircraft and the evacuation was accomplished in less than 30 seconds.

On entering the water one of the passengers inflated his (type RFD 102) lifejacket and the commander, who had already inflated his own (Beaufort Mk 15), assisted the other passenger to inflate his. Both passengers were wearing immersion suits but did not have them fully zipped up. However, the water temperature was such that none of the three survivors suffered from hyperthermia in the half hour between the impact and the rescue. During this period the commander activated his personal locator radio beacon (type BE 375, SARBE) and, at approximately 1205 hrs, fired the first of his two red flares. He elected to keep the second one to guide the rescuers once he was certain that it would be visible to them, and fired it at 1236 hrs.

2.2 The Rescue

There were two sources of information providing details of the emergency to the co-ordinators of the rescue operation.

A visitor to Skegness, reported the accident to a mobile unit of the coastguard service as having occurred 'just over the horizon, straight out (due east) from the beach'. The coastguard, whilst attempting to identify the position, then saw the first red flare set off by the aircraft commander and, at 1205 hrs, alerted the Maritime Rescue Co-ordination Centre (MRCC) at Great Yarmouth. At the same time he requested and received permission to launch the offshore lifeboat (OLB) and the coxswain, having arrived at the boathouse, fired the maroons at 1215 hrs. The OLB launched at 1231 hrs.

In the meantime, the initial ditching call from 'OM' had been heard by another aircraft flying to Easington, and was thereby relayed to several stations including Royal Air Force stations Coltishall and Binbrook. The commander of the aircraft expressed his opinion that 'OM' was probably somewhere near Blakeney Point and it was this position which, at 1206 hrs, was relayed to the Rescue Co-ordination Centre (RCC) at Pettrivie Castle. The RCC was then liaising with the MRCC and authorised the launch of a rescue helicopter from Coltishall.

The conflict between these two position reports caused the MRCC to recall the ILB, as Blakeney Point was beyond its range and to activate the RNLi from the north coast of Norfolk. However, at approximately 1220 hrs, further red smoke was sighted and the Skegness ILB was relaunched. At 1235 hrs, it reported sighting of the survivors.

The ALB and the Wessex helicopter from Coltishall reached the survivors at about 1236 hrs and, by 1240 hrs, the ILB had taken the survivors aboard. They were then winched up to the helicopter and taken to the beach at Skegness from where an ambulance took them to hospital for a medical check. The Wessex's crew reported that the first weak 'SARBE' signals had been picked up at a range of 4 nm from the survivors and clear signals at only 1 nm, from 500 feet amsl.

At approximately 1305 hrs, the Skegness OLB arrived at the scene of the accident and took the helicopter under tow to the slipway at Skegness, arriving there at 1615 hrs.

3. Wreckage

Examination of the aircraft after salvage revealed considerable damage.

Of particular interest was a failure of the structure close to the top of the vertical fin, resulting in partial separation of the tail rotor gearbox. Although this was clearly not totally a pre-impact failure, examination of the fracture faces revealed the presence of a considerable amount of fatigue. (See Fig.1)

It was further noted that the upper coupling of the tail rotor drive rear Bendix shaft had failed and considerable relative rotation had taken place between the failed components of the coupling, causing the failed diaphragm to be machined away by the orbiting end of the shaft. Examination of the remainder of the tail rotor drive and control system showed no evidence of any other pre-impact failure.

The aircraft records show that the inspection of the structure in the area of the failure, which is required to be carried out at 50 hr intervals on higher life aircraft, had been carried out 17 hours before the accident. However, it should be noted that the position of the gearbox makes inspection of part of the affected area very difficult, and a considerable length of crack was growing from inside the bend radius of the sheet metal components where, again, inspection was very difficult. The failed Bendix shaft had been inspected within the time interval specified in the MBB schedule.

A balance check was carried out on the salvaged tail-rotor/shaft combination during the investigation. This revealed no evidence of significant tail rotor imbalance.

4. Analysis

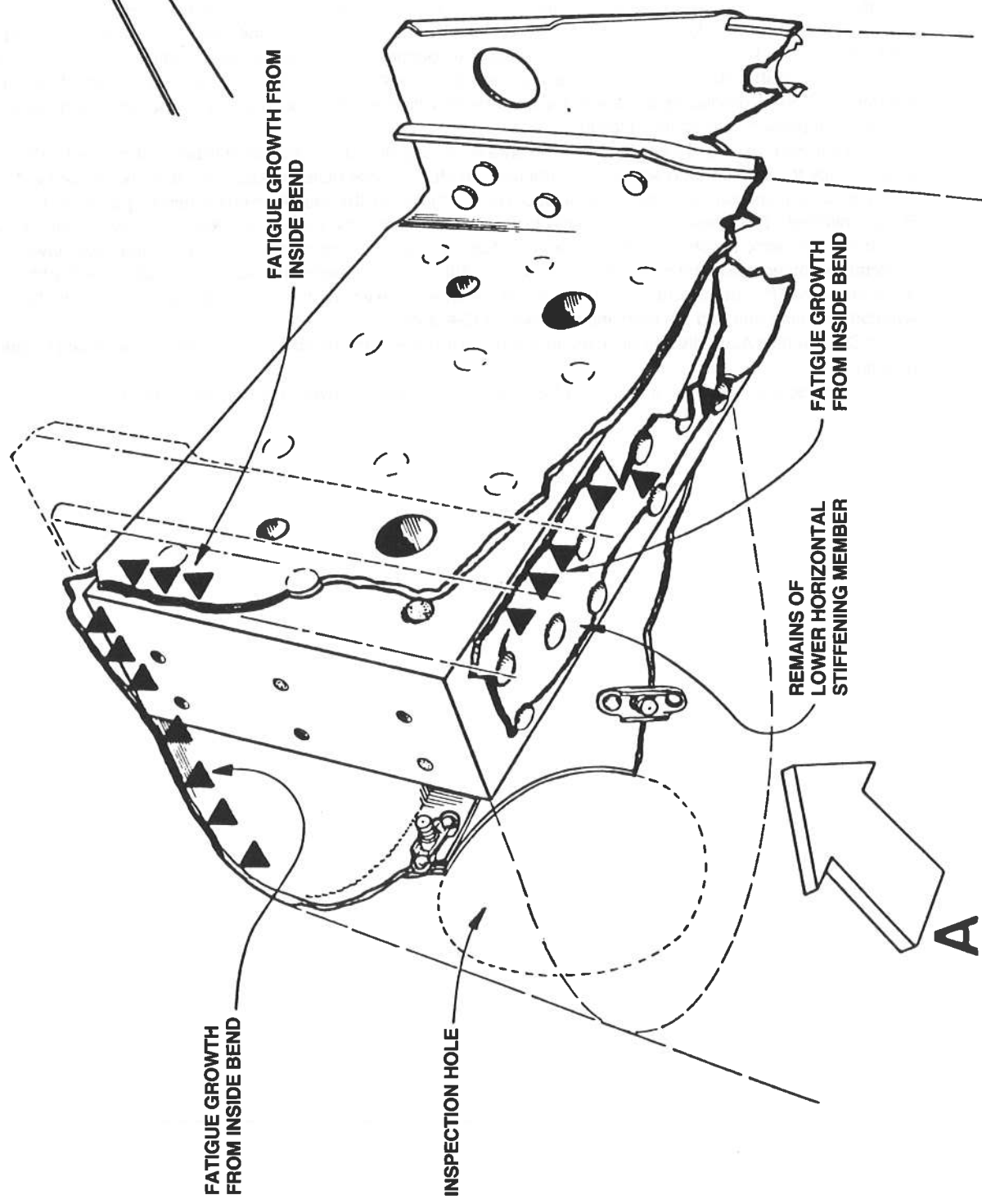
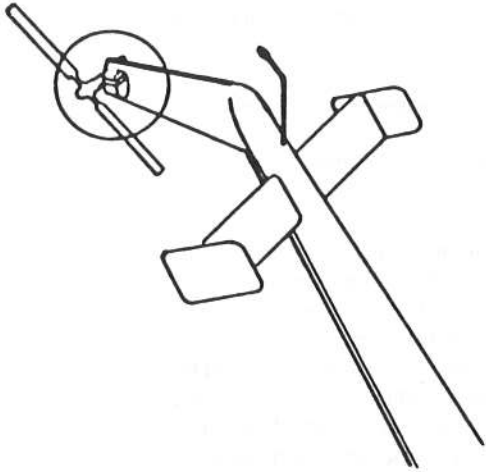
It was considered from the evidence that the unusual indications first experienced by the pilot occurred when the upper coupling failed, and that the orbiting end of the Bendix shaft continued to provide limited drive to the tail rotor gearbox whilst it machined away the failed diaphragm. The fatigue cracking of the tailfin appeared to have been exploited during the impact or salvage operation, so that complete structural failure of the upper tailfin section then occurred.

No direct evidence for the cause of failure of the shaft coupling could be found; the mode of failure of the diaphragm could not be established due to its subsequent destruction by the orbiting end of the shaft. The coupling design, however, permits very limited misalignment between input and output shafts to occur. It seems possible that the extensive fatigue cracking, noted in the tailfin, may have sufficiently reduced its stiffness to cause excessive structural flexing. Hence, loss of alignment between the Bendix shaft axis and the axis of the input shaft to the tail rotor gearbox could result. If such excessive misalignment occurred under high tail rotor loading, the upper coupling of the Bendix shaft would have been forced to operate outside its design limits. It must be assumed that such operation occurred, producing damage to the diaphragm, which was then exploited by normal operation leading to complete diaphragm and coupling failure.

The extensive cracking of the tailfin was in an area where significant modification has been introduced on BO 105 aircraft since the type entered service. In particular, an MBB service Bulletin, issued in 1976 and revised in 1978, called for local modifications to reinforce the upper part of the tailfin. It is described on the heading sheet as 'Urgently Recommended'. The following wording included in a section within the Bulletin headed "Compliance" states that, "An immediate accomplishment of this Service Bulletin is urgently recommended if discrepancies have been ascertained, otherwise at the next suitable occasion". Although this modification was approved by the Certification Authority of the state of manufacture, it had not, at the time of the accident, been made mandatory by the UK Civil Aviation Authority and had not been incorporated in G-AZOM.

The Civil Aviation Authority has since established that no other unmodified aircraft remain on the United Kingdom register.

The manufacturer has been informed of the relevant evidence discovered during the investigation.



FATIGUE GROWTH FROM INSIDE BEND

FATIGUE GROWTH FROM INSIDE BEND

REMAINS OF LOWER HORIZONTAL STIFFENING MEMBER

FATIGUE GROWTH FROM INSIDE BEND

INSPECTION HOLE

A

SKETCH OF DAMAGED TAIL ROTOR GEAR BOX MOUNTING STRUCTURE.

FIG.1

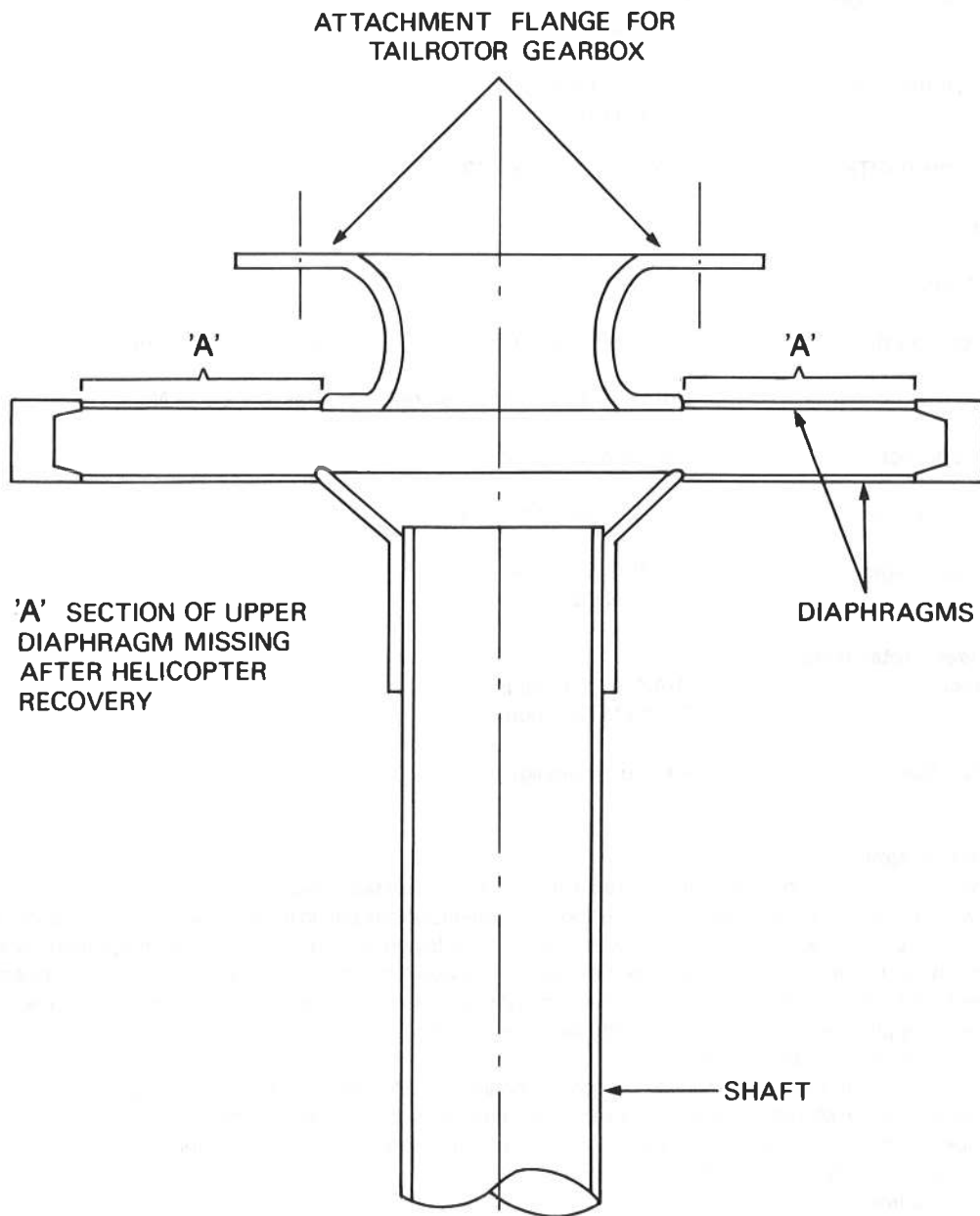


FIG 2: BENDIX COUPLING DESIGN