

No: 3/90

Ref: EW/C1139

Category 2c

**Aircraft Type  
and Registration:**

Agusta-Bell 206B Jet Ranger III, G-JOCO

**No & Type of Engines:**

1 Allison 250-C20J turbine engine

**Year of Manufacture:**

1989

**Date and Time (UTC):**

11 December 1989 at 1110 hrs

**Location:**

Micklefield, near Leeds, West Yorkshire

**Type of Flight:**

Private

**Persons on Board:**

Crew - 1

Passengers - 1

**Injuries:**

Crew - 1 (serious)

Passengers - 1 (serious)

**Nature of Damage:**

Aircraft destroyed

**Commander's Licence:**

Private Pilot's Licence (Helicopter)

**Commander's Age:**

49 years

**Commander's Total  
Flying Experience:**

95 hrs (of which 29 were on type)

**Information Source:**

AAIB Field Investigation

**History of the flight**

The pilot intended to fly from a private site at his home near Leeds to Beaulieu, Hampshire, with a refuelling stop at a helicopter facility near Pontefract. He was accompanied by another helicopter pilot, who occupied the left front seat. The weather forecast for the intended route was good with light winds and a broken layer of stratocumulus cloud between 4,000 and 6,000 feet. Visibility was affected by patchy mist, haze and hill fog.

At Pontefract the aircraft was refuelled to full tanks and the pilot rechecked the weather. When he was advised that much of his route might be affected by low cloud and poor visibility he decided to return home, stopping on the way to visit a friend at a quarry site near Micklefield. The aircraft was seen to fly a single, left-hand orbit of the quarry before making an approach to land at a site near the quarry offices. Eye witnesses described how the aircraft made a normal approach and came to a hover a few feet above the ground. It was then seen to rise rapidly in a tail-down attitude to a height of 40 to 50 feet, moving slightly backwards, before stabilising momentarily at that height. The fuselage then began to rotate clockwise and the aircraft fell to the ground. Two witnesses thought that the fuselage rotation ceased before the aircraft hit the ground. The engine continued to run for at least a minute after the impact and when it ran down

a small fire started in the area of the engine exhausts. This fire was quickly extinguished by a witness who ran to the scene to assist the occupants. The pilot had been thrown from the aircraft during the impact sequence and was moved clear of the wreckage by other witnesses. The passenger in the left hand seat had been thrown to the right side of the wrecked fuselage. The witnesses extricated him from the wreckage and moved him to a safe area.

After the accident, the pilot stated that he had intended to land at the quarry but had no recollection of approaching to land or of bringing the aircraft to a hover. He remembered the aircraft spinning round and remembered lowering the collective lever to avoid climbing any higher but he had no recollection of the crash. He did not remember making any control movement that could have caused the aircraft to climb. The passenger stated that he remembered the pilot making an approach to land and that the intended landing site was not obstructed. His next recollection was of the aircraft spinning rapidly but he was not aware of any control input that could have accounted for its behaviour. He stated that he was not handling the controls during the approach to land but recollected that he might have attempted to move the cyclic control after the aircraft began to rotate.

The pilot had a current Certificate of Test signed on 26 November 1988 and had since recorded 3 flights totalling 1 hour 40 minutes, all during November 1989.

The aircraft had been manufactured in September 1989, registered in UK on 8 November 1989 and had been certificated in the private category. The aircraft log book showed that 24 hours were flown up to the UK certification, of which 20 related to its pass-off, transit through Germany, certification in the UK and the four associated airtests. Documentary evidence was found of a further 3 hours 40 minutes flown in the hands of the new owners.

### **Ground Marks**

The accident site was part of a magnesium limestone quarry and consisted of a flat open area approximately 50 x 80 metres with a slight slope to the northwest for drainage purposes. It was surrounded to the north and east by quarry plant and single storey site buildings; to the south and west it was bordered by rough ground and piles of crushed stone, which separated the accident site from the quarry workings 20 metres below. The surface of the site was compacted fine limestone.

The initial ground impacts were two main rotor tip strikes to the right of the subsequent impact trail, these marks showed traces of yellow paint from the blade tips and gave blade angle below the horizontal and blade tip direction of travel. Rotor debris was found at a distance of up to 58 metres from the initial impact marks. Further marks were found which were identified as having been caused by the fuselage chin and front cockpit area, and a light impact by the starboard horizontal stabiliser tip which left behind traces of the navigation-light glass.

## Damage

The tail boom had failed in a downwards direction and had taken a light ground strike on its starboard horizontal stabiliser tip. The tail rotor blades had both bent under inertial loads, but had not been damaged by ground impact. The tail rotor drive had pulled out of its splined connection forward of the tail boom failure point and showed signs of torsional damage, but was otherwise intact. The tail rotor pitch control rod had failed downwards in bending at the point of the tail boom failure, but was still connected to the tail rotor pitch change mechanism.

The rotor mast had sheared below the spline carrying the rotor head and above the bump stop; the location of this failure was interpreted by the manufacturer as supporting evidence for a power-on ground strike. The gearbox and mast had rotated almost directly backwards through 60 degrees, with little evidence of side loading to the gearbox mountings, and the mast showed evidence of a ground impact. The main rotor blades had failed at the tips and at points approximately one metre from the hub. An additional break had produced a total of three main rotor pieces, plus tip fragments. The mast bump stops did not show contact marks. The engine drive to the main gearbox had pulled the female spline off the gearbox, consistent with the rotation of the mast.

Although the fuselage floor had failed in tension above the cargo hook, crush damage to the underside was confined to the forward section, with very little vertical force apparently passing through the rear skid. The nose and cockpit were completely disrupted and the damage continued round to the top of the aircraft. The aircraft crush marks showed that the fuselage impact sequence with the ground had ceased with the fuselage on a heading of 020°M, at an angle of 24 degrees below the horizontal, and with a roll angle to the right of 16 degrees. Witness marks on the fuselage showed that the helicopter had stopped rotating before impact.

The fuel tank had ruptured and most of the released fuel had drained away down the slope of the site. There was evidence that a fire around the engine exhaust had been extinguished with dry powder.

The right hand four-point harness had failed at the bolt hole on the inboard lower hinged mounting, the left hand harness was found undone.

A reconstruction of the impact sequence indicated that after two heavy ground strikes the rotor mast sheared just below the top splines. This impact rotated the helicopter to the right and may have added some right roll. The fuselage then struck the ground causing the skids to fail in a rearwards direction. The helicopter then pitched forward, and the tail boom separated under inertia loads and struck the ground. The helicopter then cartwheeled through 180° before coming to rest on its left side.

## Engineering Examination

*Collective Control System.* The control run operating the collective system had failed at three points; two tension failures in the bellcrank and the threaded end fitting to the control tube adjacent to the collective servo actuator, and a bending failure in the vertical control tube. These failures were consistent with the damage to the aircraft structure and the rearwards movement of the main gearbox. The right hand collective lever had been bent downwards during the impact and this distortion had caused the throttle linkage to jam.

*Cyclic and Yaw Pedal Controls.* The yaw control run in the front cockpit had been disrupted as a result of the impact with the ground, further control rod failures had occurred during structural distortion and the rotation of the gearbox into the overhead structure. No evidence was found of any pre-crash damage or disconnection in the cyclic or yaw controls.

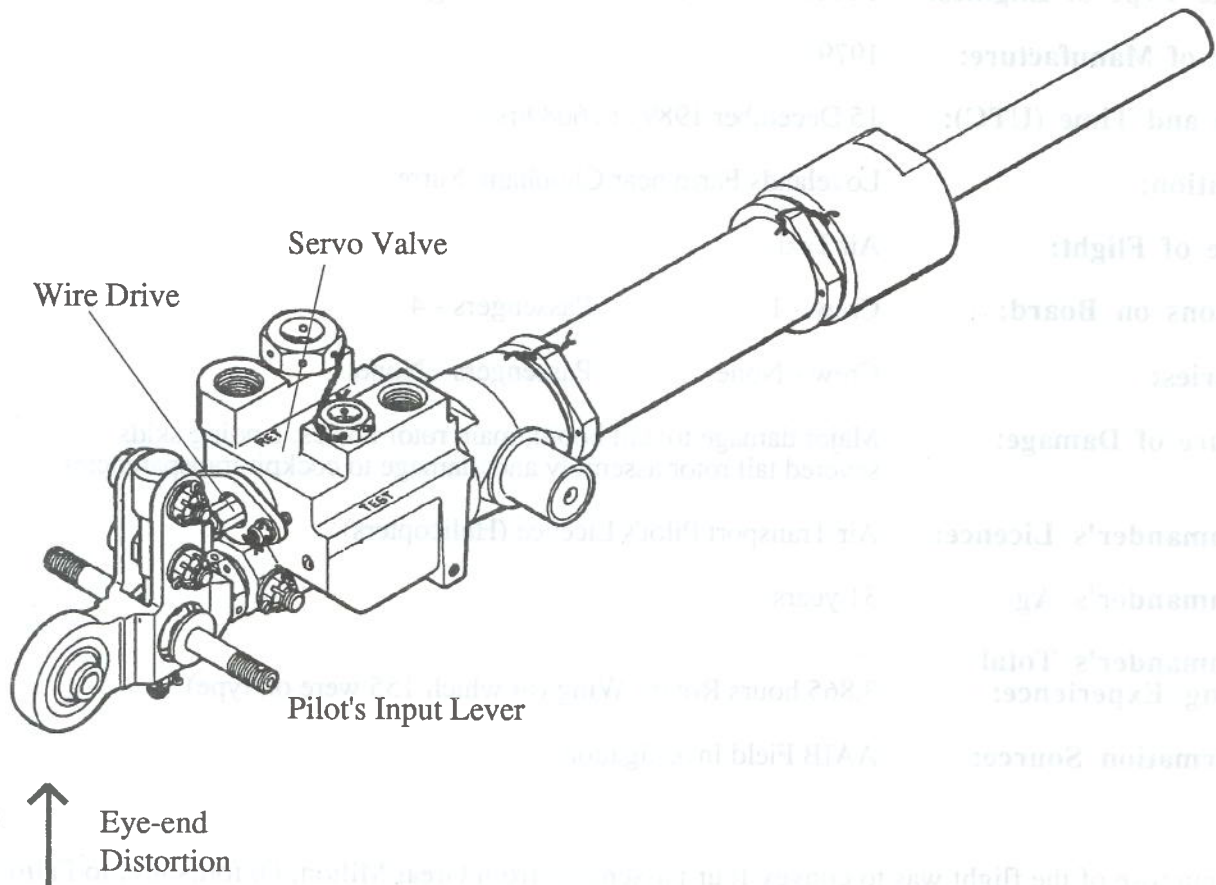
*Turbine Outlet Temperature (TOT) Indicator.* The TOT warning light was latched on; this warning is normally triggered by either a temperature of 810° for at least 10 seconds, or a temperature of 927° for at least one second. It is possible, however, that the light was set by impact forces.

*Power Turbine Trim.* The authority of the power turbine trim is limited to 3%, the trim actuator was extended 11mm within a total range of movement of 16mm.

*Engine.* The engine was examined by an overhaul agency and the manufacturer's representative. The air signal pipes to the fuel control unit (FCU) were checked for leaks and the N2 governor was bench tested. Both were found satisfactory. The gas producer was free to rotate, although signs of aluminium splatter on the turbine inlet shield and on the inlet nozzle guide vanes indicated that, at impact, the compressor had fouled the scroll, giving off graphite/aluminium debris and that the combustion chamber temperature was sufficient to separate these two and to deposit molten aluminium on the turbine inlet. The turbine outlet temperature was therefore estimated to be at least 600°, which corresponds to a cruise power setting.

*Hydraulic Flight Control Actuator - Collective Control.* As found, the jack ram had been pulled to the rear by the mast rotating backwards during the crash, ie maximum flat pitch or beyond. The rotation of the mast had raised the rear eyebolt attachment, causing the forward end of the ram and piston to penetrate the cabin roof.

The actuator was mounted in the test jig and the pilot's input lever centralised. When power was applied at 600 psi the ram ran fully forward towards full collective pitch. Inputs to the pilot's lever had no effect.



The actuator runaway was proved to be caused by distortion of the eye-end during the crash; which had displaced the wire drive carrying the spool further into the servo valve and moved the hydraulic neutral by 0.019" - beyond the limits of movement of the pilots input lever. When the valve was re-datumed with a new eye-end it operated correctly.

In summary, no pre-crash defects were found which could account for the behaviour of the helicopter.