

Agusta Bell 206B, G-OONS

AAIB Bulletin No: 3/97 Ref: EW/C96/10/7 Category: 2.3

Aircraft Type and Registration:	Agusta Bell 206B, G-OONS
No & Type of Engines:	1 Allison 250-C20J turboshaft engine
Year of Manufacture:	1989
Date & Time (UTC):	21 October 1996 at 1430 hrs
Location:	Near Enniskillen, Northern Ireland
Type of Flight:	Public Transport
Persons on Board:	Crew - 1 - Passengers - 4
Injuries:	Crew - Serious - Passengers - 2 Serious
Nature of Damage:	Aircraft damaged beyond economical repair
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	43 years
Commander's Flying Experience:	4,686 hours (of which 1,739 hours were on type) Last 90 days - 149 hours Last 28 days - 52 hours
Information Source:	AAIB Field Investigation

History of flight

The helicopter operators had contracted to complete a task for a local company. The task involved three Bell 206 Jet Ranger helicopters taking company staff and media personnel on flights around Northern Ireland. Of these three helicopters two, registrations G-OONS and G-CORT, were based at Aldergrove Airport and would be flown by free-lance pilots; the third helicopter, registration EI-HER, was sub-chartered from Dublin. The plan for the day was for the two Aldergrove helicopters to fly to Belfast City Airport where they would meet with the third aircraft, and all their passengers. The three helicopters would then fly the passengers on a sight-seeing trip to Florence Court, a large house located south of Enniskillen. At Florence Court, the passengers would disembark for some company promotional work and a lunch; the pilots would stay with the aircraft and the helicopter company had organised a fuel bowser to meet them and refuel the aircraft. Thereafter, the passengers would be flown on a scenic route to Eglinton Airport for another break and aircraft

refuel and then a flight back to Belfast Harbour for passenger disembarkation. Finally, the two Aldergrove aircraft would return to Aldergrove Airport and the third would return to Dublin.

On 21 October at 1125 hrs, the three aircraft departed from Belfast Harbour and, with four passengers each, fuel load was restricted to keep the aircraft within the maximum weight limit. As previously planned, G-CORT was flying as the lead aircraft with G-OONS second and EI-HER in the rear of the loose trail. All the pilots had been comprehensively briefed by the pilot of G-CORT, including action to be taken in the event of one helicopter having to make a forced landing. The weather was very good with a light surface wind and the aircraft flew uneventfully to Florence Court and landed at 1250 hrs.

The aircraft were refuelled while the passengers had lunch and completed some promotional work. On arrival back at the aircraft, two passengers within G-OONS exchanged their seating position; additionally, two passengers removed their jackets (black, fibro-filled, anorak style jackets, provided by the promotion company) and these were taken by the pilot and stowed, together with his own jacket, in the baggage locker. Then, with all passengers on board G-OONS, the pilot completed his pre-flight inspection. This included removing the main rotor tie-down, stowing it in the baggage locker and then closing the locker; the pilot specifically remembers closing the two latches as he had to bend down to do so. Thereafter, he checked that the passengers were correctly strapped in and that the passenger doors were closed. G-OONS and EI-HER were started first and there was a slight delay before G-CORT was started. The pilots carried out a normal departure at 1425 hrs and intended to fly a direct route to Eglinton Airport as they were running slightly behind time. G-OONS was again flying in trail behind G-CORT and was being followed by EI-HER. With the aircraft two miles south of St Angelo airfield and G-CORT at 1,500 feet amsl, G-OONS was slightly low and flying at approximately 100 kt. Suddenly, the pilot of G-OONS heard a 'Bang' and felt a jolt through the airframe; he was not aware of any yaw. He entered auto rotation, but maintained full throttle position and immediately broadcast a 'Mayday' stating that he had engine failure; the aircraft were working their company frequency and the pilot of G-OONS used that frequency to advise the other aircraft of his problem. As he descended, having reduced his speed to 60 kt, he was turning to the right and checking his engine instruments. There was no instrument indications of an engine problem and he assessed that the aircraft had a tail rotor problem. However, he seemed to be able to maintain a heading into wind and, at approximately 500 feet agl, he applied some collective to arrest his descent. As he did so, there was another 'Bang', the aircraft started rotating to the right and the pilot noted that the airspeed was indicating zero. He was aware of trees and power lines in his immediate area and, as he approached the surface, he applied collective to cushion the impact.

The impact was hard and the pilot was immediately aware of the sound of a passenger screaming. He shut down the helicopter and this included using the rotor brake to stop the rotors; these stopped very quickly. He then undid his straps and stepped out of the helicopter. One passenger was lying on his back on the grass to the right of the helicopter and two others were clear; one passenger was still in the middle of the rear row of seats and was in obvious pain.

Meanwhile, the other two helicopters had commenced their pre-briefed actions following the 'Mayday' call. The pilot of G-CORT acknowledged the distress call and climbed his helicopter in order to relay the call on the emergency frequency of 121.5 MHz. Additionally, when he reached 3,000 feet amsl, he called Aldergrove ATC, relayed the position of the crashed aircraft and, because he had seen a Puma helicopter in the area, asked for military assistance. His call was acknowledged by both Aldergrove ATC and by a military helicopter. At the same time, the pilot of EI-HER had contacted the nearby airfield of St Angelo and passed the exact location of the crash to the airfield

and to a Puma helicopter who was also on the frequency. With the alerting complete, EI-HER was landed close by the accident site and the occupants went to the assistance of G-OONS. By now, G-CORT had descended to 500 feetagl and was circling the crash site to direct the ground emergency services. Shortly afterwards, two Puma helicopters arrived. They assisted the rescue operation by transferring some of the emergency services from a nearby road to the crashed helicopter and then transferring the survivors to hospital.

Examination of the aircraft

Initial examination of the aircraft showed that it had struck the ground extremely heavily, the skid gear collapsing to the point where the aircraft belly had touched the ground but only relatively light crushing of the underside structure occurring. Marks left on the ground by the initial impact showed that the aircraft had been on a heading of about 320°M when it first struck, in an attitude which had been substantially level in roll and slightly nose down in pitch. It had then bounced about 5 metres forwards and slightly to the left, whilst yawing to the right, before coming to rest on a heading of about 030°M. The base of the fin had struck the ground at initial impact and the combination of vertical impact and the rotation of the aircraft had caused the rearmost part of the tailboom to cripple torsionally, just forward of the fin, resulting in the fin being rotated to an angle of about 45° with its top deflected to the left.

One blade of the tail rotor had some mud smears and two crease bending failures at right angles to the plane of its aerofoil but had no tip leading edge damage. This was consistent with its not being driven at the time of impact with the ground. It was observed that some black thread was wrapped round the tail rotor spindle. When the tail rotor drive cover along the top of the tailboom had been removed, it could be seen that one section of the tail rotor drive shaft, about halfway down its length, had suffered a torsional overload failure and that another section, where the tail boom had been torsionally distorted, had suffered a bending failure.

General examination of the airframe showed that although the skid gear had collapsed and the cabin section was bowed downwards at both ends, distorting the door apertures, the roof had not collapsed under the inertia of the transmission and rotor. This indicated that a considerable proportion of the aircraft's weight was being borne by the rotor at the time of impact. Although the aircraft was distorted, the only items to become detached from it were fragments of the nose glazing, which were found close to the point of initial impact, and the baggage locker door which was in an adjacent field, about 40 metres from the aircraft. As found, both its press latches were in the open position and the key latch was 'unlocked'. Both baggage door hinges had failed by bending of the lugs of the elements attached to the door itself.

The aircraft was recovered under AAIB supervision for further examination.

Subsequent investigation

The initial reports were that the tail rotor had been struck by a large bird. However, interviews with the three pilots revealed that they had not been aware of any birds in the area prior to the accident. Nevertheless, the pilot of EI-EHR had seen "an explosion of feathers from the tail rotor" of G-OONS.

Three farm workers had noticed the three helicopters flying overhead. All three men heard a 'slap' which drew their attention to the aircraft and when they looked up, they noticed one of the helicopters turning left and with its 'nose down'. Once the aircraft had gone out of sight, they saw a

black object spiralling down. Noting its landing position, they went to the area and found a diary, then a sleeve of a jacket and finally the rest of the jacket. At the time, the weather was good with a very light surface wind.

Interviews with the occupants of G-OONS revealed that the two passengers in the centre and right rear seats of the helicopter were wearing their company issued jackets during the accident flight. Of the three jackets put in the baggage locker, the pilot and the passenger from the front seat retrieved their jackets from the locker following the accident. The only missing jacket belonged to the passenger in the rear left seat of G-OONS. Subsequently, this passenger confirmed that the diary, which was found with the jacket discovered by the farm workers, belonged to him.

Further examination of the aircraft

The baggage door, its catches and the airframe aperture were examined. The door has two hinges on its forward edge and is normally held closed by two button type latches on its aft edge (see Figure 1 for operation of latches and Figure 2 for location). It also has a key operated tang lock for security which may be used additionally. Since the aperture had been distorted in the accident and the hinges broken, it was not possible to assess the fit of the door of G-OONS directly.

Examination of the wear patterns on the latch catch plates and the striker pads on the aperture frame, where the two were in contact when closed, showed that only about half the length of the catch plate had overlapped the edge of the door surround. It was observed that whilst the wear pattern on the upper striker pad was clearly defined and without evidence of smearing, that on the lower striker pad had a gouge in the paint running from its upper edge. This indicated that the catch plate was dragged upwards whilst the latch was closed. There was no evidence of significant abrasion of the paint where the key latch tang would have impinged, indicating that this had not been used during this flight. The pilot confirmed that he had not locked the baggage door; subsequent enquiries with a number of Bell 206 pilots revealed that they seldom use the key latch for anything but ground security purposes.

Examination of the aft edge of the baggage locker aperture revealed that the paint on the aperture lip was abraded at the position, and in a pattern, consistent with where the back of the upper latch catch arm would rest if the door were closed with the latches shown at Figure 1(d). There was no similar abrasion damage in the area of the lower latch. Examination of the backs of the catch arms of both latches revealed polishing wear in the position indicated in Figure 1(d).

The overall inference to be drawn from the latches and the aperture was that the back of the upper latch catch arm had been held against the outer lip of the door aperture and that the bottom latch had been correctly engaged although there was some evidence that, in the past, it had also been latched incorrectly.

Baggage door latch tests

A series of tests was performed on the door and its latches. The door from G-OONS was relatively undamaged, so it was set up in a mock-up of the aperture which modelled the lower sill of the baggage locker, the hinges on the forward edge and the latch striker pads on the aft edge. The operation of both latch mechanisms was observed to be correct (see Figure 1 (a) to (d)) and a satisfactory over centre condition could be achieved on both. Their position retention springs were intact, giving a satisfactory pre-load in the closed position.

The tests showed that it required a force of about 5 lb on the 'close' button of the mechanism to achieve a latch shut position, the exact force depending on the angle at which the 'close' button was pressed. The action of the latches was observed to be such that if the door was not quite closed, the catch plate acted as a jaw and pulled the door into the closed position (Figure 1(c)). For the catch plate to miss the striker pad completely as the latch was moved from 'open' to 'closed', the door had to be open at least 2 cm at the time the catch plate passed the aperture edge. However, with the lower latch correctly latched and the closed upper latch resting on the outside of the aperture (see Figure 1(d)), the aft edge of the baggage locker door gaped about 1 cm open at the top.

An experiment was performed to see the effect of an obstruction placed between the lower edge of the door and the lower sill of the baggage locker. This showed that if the gap were to be obstructed, the action of closing the upper latch did not necessarily cause much torsional distortion of the door. With a hard obstruction placed on the door sill about one third of the way between the forward and aft edges of the door a gap of about 4 cm existed between the door edge and the aft aperture edge. It was found to be quite easy to push the door closed so that the upper latch could be properly latched. It was also possible, by pushing on just the 'close' button of the upper latch, to close that latch without the catch plate grasping the striker pad and then subsequently force the aft end of the lower edge into contact with the aperture and correctly latch the lower latch.

The lower edge of the door was obstructed by placing fragments of the damaged jacket between it and the lower sill. It was found that a considerable bulk of jacket material, about 6 thicknesses or the equivalent of a doubly folded over sleeve, was required to prevent the catch plate from grasping the striker plate.

Investigation discussion

The accident resulted from a jacket, which had been stowed in the baggage locker, coming out of the locker and entering the tail rotor disc. Evidence from the wreckage indicates that the baggage locker was open before the helicopter struck the ground; this is deduced from the relative positions of the baggage door and the main wreckage, and the damage to the door and its aperture. This means that the baggage door had been left open or had opened during flight.

The pilot was certain that he closed the door before flight. Indeed, evidence from the passengers indicate that he was particularly conscientious when he checked that their doors were closed. The pilot's view is also supported by it being highly unlikely that a completely unlatched door would have remained closed during engine start and subsequent power changes during take off and flight. Furthermore, the pilot of EI-HER, who was following G-OONS and therefore needed to constantly monitor the helicopter, was not aware of any unusual aspects before the "explosion offeathers". Therefore, the door must have been held closed before the flight.

However, the door can be held closed by either or both of the normal latches; the key latch was not used. Both the CAA and Bell Helicopter were asked for information on previous instances of baggage doors opening in flight. This revealed no previously recorded instance in the UK; Bell reported that their records showed that this had occurred, but very rarely.

The physical evidence favours the scenario that the aircraft departed with the lower latch correctly fastened and the upper latch in the closed position but with its catch arm pressed against the outside of the aperture edge (as shown in Figure 1(d)). With the generally dark paint scheme of the aircraft it is possible that, from a viewpoint level with the baggage door, the visual impression would be that it was closed.

The AAIB tests also showed that if the closure of the door against the lower lip of the baggage locker were obstructed by a significant thickness of the jacket material, which was also dark, it was possible to push the upper latch into the 'closed' position without its catch plate grasping the aperture. It was also possible, subsequently, to push the lower aft corner of the door shut and close the lower latch correctly. In this condition, the upper aft corner of the door would be gaping by about 1 cm and this corner would then be restrained only by the torsional stiffness of the baggage door. The gaping edges would allow rotor generated pressure fluctuations to distort the door. The inference of the paint scrape evidence on the lower striker plate is that the door became distorted to the point that the lower latch disengaged from the aperture and allowed the door to swing open in flight and the jacket to escape.

The subject of the secure closure of doors and hatches has previously been raised in the GASIL and the CAA has agreed to publicise this aspect again.