Air Accident Investigation Unit Ireland

Reports 1/2007

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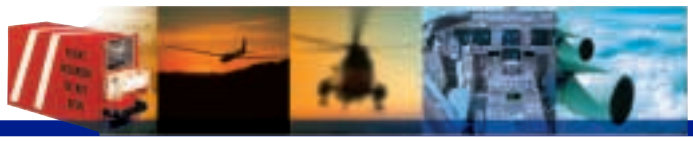

ACCIDENTS

SERIOUS INCIDENTS

INCIDENTS

** Preliminary Report*

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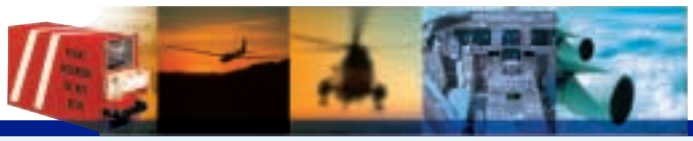
In accordance with Annex 13 to the International civil Aviation Organisation Convention, Council Directive 94/56/EC, and Statutory Instrument No. 205 of 1997, AIR NAVIGATION (NOTIFICATION AND INVESTIGATION OF ACCIDENTS AND INCIDENTS) REGULATION, 1997, the sole purpose of these investigations is to prevent aviation accidents and serious incidents. It is not the purpose of any such accident investigation and the associated investigation report to apportion blame or liability.

A safety recommendation shall in no case create a presumption of blame or liability for an occurrence.



AAIU Synoptic Report No: 2006-026

AAIU File No: 2004/0031

Published: 22/11/2006

In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on 14 June 2004, appointed Mr Graham Liddy, as the Investigator-in-Charge to carry out a Field Investigation into this Accident and prepare a Synoptic Report.

Aircraft Type and Registration:	Bell 206B, EI-BYJ
No. and Type of Engines:	1 x Allison 250
Aircraft Serial Number:	1897
Year of Manufacture:	1976
Date and Time (UTC):	13 June 2004 @ 18.15 hrs (19.15 hrs Local)
Location:	Inniskeen, Co. Monaghan
Type of Flight:	Public Transport
Persons on Board:	Crew - 1 Passengers - 4
Injuries:	Crew - None Passengers - None
Nature of Damage:	Tail boom damage following autorotation.
Commander's Licence:	Airline Transport Pilot's Licence (Aeroplanes) & Commercial Pilot's Licence (Helicopters)
Commander's Details:	Male, aged 45 years
Commander's Flying Experience:	8,830 hours, of which 263 were on type
Information Source:	Station Manager, ATC Dublin. AAIU Field Investigation

SYNOPSIS

The helicopter was carrying out routine commercial pleasure flights in the Carrickmacross area of Co. Monaghan. On the final flight the pilot reported that a "FUEL PUMP" warning light illuminated and the engine failed seconds later. He carried out an autorotation approach and landed in a cornfield. All on board exited the helicopter safely and without injury. There was no fire. The helicopter suffered significant damage in the landing. The Investigation found that the engine stoppage was due to insufficient fuel in the helicopter's fuel tank. This report makes four Safety Recommendations.

1. FACTUAL INFORMATION

1.1 History of the Flight

On Sunday 13 June 2004 the Operator, Celtic Helicopters Ltd., operated a pleasure flight service at Kilanny Sports Day, Kilanny, Co. Monaghan. It was a fine summer day, with a light wind of 330/10 kt and the operation was conducted in accordance with Visual Flight Rules (VFR). Operations started at 14.00 hrs local time. Initially, the service was operated by another company helicopter, EI-BIJ. The service consisted of short flights in the local area, typically of 5 minutes duration. After landing, the engine and rotors continued to run at idle speed while the previous passengers disembarked and the new passengers were boarded. During boarding, passengers were escorted by two Celtic staff members, who secured and fastened their safety belts.

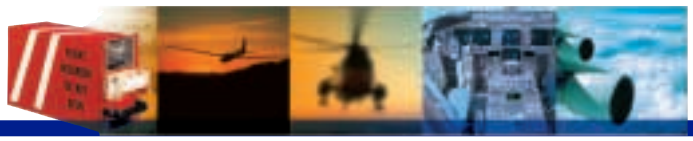
At this time, EI-BYJ was tasked on a separate company mission from the base at Knocksedan, near Dublin Airport, to Glandore, Co. Cork and back to base. Take-off was at 11.45 hrs with a return-refuelling stop at Cork Airport. On arrival back at base, the pilot received a phone call from his on-site colleagues in Co. Monaghan requesting his assistance with EI-BYJ, as they were *"snowed under"* with requests for pleasure trips. He agreed to this request and, after a very short time on the ground at base, he routed to Co. Monaghan to join the ongoing operations there.

EI-BYJ arrived at Kilanny at 16.40 hrs and immediately commenced operations. Subsequently, the Operator's ground staff carried out a hot refuelling of the helicopter. This entailed landing beside the Operator's mobile refueller, with the engine and rotors running at idle RPM, while the qualified refueller person carried out the refuelling. 33 U.S. gallons1 (123 litres) of aviation fuel (AVTUR) were uplifted. During this operation the pilot was seated at the controls of the helicopter, monitoring the fuel gauge and determining the amount of fuel to be uplifted. The pilot recalled landing with 20 U.S. gallons in Kilanny and that the total of 50 to 53 U.S. gallons was his requirement for his intended flights. He carried out between 12 and 14 trips, as he recalled, of 5-6 minutes duration each, which was normal in such operations. At some time around 19.00 hrs, the refueller operator asked the pilot, during a passenger pick-up stop, how he was for fuel. The pilot declined to take on fuel at that stage. The helicopter then took off and the engine stopped 2 to 4 minutes later at approximately 19.15 hrs. The pilot performed an autorotation but had to turn through 180˚ and land downwind due to terrain restrictions. The helicopter landed somewhat heavily with some forward speed, in a cornfield.

1.2 The Pilot

On the day of the accident, the pilot of EI-BYJ was an Airline Captain who occasionally flew helicopters on his days off or during annual leave. He renewed his helicopter licence in January 2004 and commenced part-time commercial flying with the operator in February 2004.

1 The fuel gauges and the Flight manual of the Bell 206 helicopter use US gallons as a measurement of fuel. For consistency, this reports uses US gallons in certain areas. 1 US Gallon equals 3.785 litres



On 13 June 2004, which was rostered as an "OFF" day by the Airline, the pilot was scheduled, by the helicopter operator, to fly from Dublin to collect a client in Co. Kildare and then route to Glandore in West Cork, back to Cork Airport to refuel and thence back to base in Dublin. He had expected to be stood down in the middle of the afternoon at Dublin at the end of this flight and thereafter to drive to his home.

He was scheduled by the Airline to report for duty in Shannon at 06.15 hrs the next day. However, the stand-down at Dublin did not occur, and, after a very brief stop there, the pilot flew on to Kilanny, as requested by the Operator's on-site pilot.

The Pilot stated that he had renewed his helicopter pilot's licence earlier in the year, after a break of several years. The day of the accident was his first time to operate such pleasure fights in more than 10 years.

1.3 Pilot's Recollection

The pilot stated that there were 20 US gallons in the helicopter when he initially arrived at Kilanny. He further stated that he refuelled on arrival, taking on 33 US gallons, bringing the total to 53 US gallons. He said the standard practice for this kind of operation was to fill the helicopter to about 50 US gallons (2/3's of capacity), in order to keep the helicopter reasonably light. The pilot stated he had a discussion with the refueller operator immediately before the last (accident) flight, saying he had enough fuel for this flight and would refuel after it. The pilot subsequently stated that prior to take-off on the last flight, he recalled seeing in excess of 10 U.S. gallons indicated on the fuel gauge. He recalled that, on the way back to the landing zone, at about 1,000 ft with the trip almost completed, the "FUEL PUMP" Warning light illuminated and about 5 or 6 seconds later the engine failed. He recalled that his front seat passenger had also pointed out this light illumination to him but that he had to react swiftly to events by entering into full autorotative flight and by quickly finding somewhere safe to land. As the local terrain was hilly with drumlins he had to execute a 180˚ turn during the descent and land downwind in a cornfield, with a slight forward speed on touchdown. The pilot recalled that the descent was difficult, with the engine failure warning horn continuously sounding, and the passengers were audibly upset at the turn of events. On the ground, once the rotors stopped turning, the pilot's main preoccupation was the safety and evacuation of his passengers. This was achieved, and there were no injuries to the pilot or his passengers. There was damage to the helicopter. The pilot advised his local ground operations of what had occurred, while the passengers, who were from the locality, were collected by some friends.

The pilot was unable to tell the Investigation exactly how many of these pleasure trips he had completed that afternoon at Kilanny, but he believed that it was 12 or 14. No log was maintained of the individual trips completed.

In his debrief to the Investigation he said that he relied on his fuel gauge and time flown to estimate the flying time remaining. He stated that, immediately prior to the final flight, he noted that the fuel gauge was at or slightly above 10 US gallons, which he felt was adequate to complete this trip. He was of the view that 10 US gallons would give him in excess of fifteen minutes flying time.

The pilot subsequently said that the event had occurred at the end of a long day's flying, and that he felt sure he had adequate fuel on board to complete the last trip as planned. He was also conscious of the fact that he still had to refuel the helicopter and then fly back to base. Even then, his day was not yet finished as he still had a lengthy drive to his home.

In response to the Draft Report of this event, the pilot subsequently stated "that after the helicopter was landed, he assisted the passengers to evacuate when it was safe to do so, i.e., when the rotor blades had come to a complete stop, he escorted them away from the aircraft".

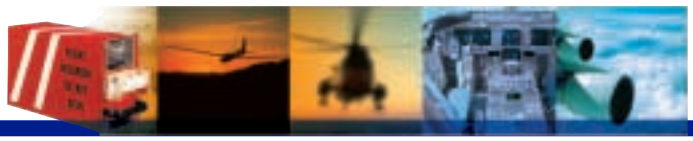
1.4 Passengers' Recollection

The passengers on the subject flight were a husband and wife and their two young boys. Confirming that it was a busy afternoon for the Operator, the husband recalled that they queued for almost two hours, awaiting their turn for a flight. As he had flown in a helicopter the previous year, his wife sat into the front seat alongside the pilot, while he sat in the rear seat on the left side of the helicopter. His younger son was in the centre and the elder son was in the right end of the bench seat. He asked the pilot to route towards Inniskeen, where his home was located, rather than Carrickmacross, and pointed out the direction. Immediately after take-off, the wife recalled, she saw a red light on with, as she thought, the letters ENG and some three other letters, which she could not recall. She pointed out this light to the pilot who seemed to acknowledge it also, but carried on with the trip. The wife felt that the flight may have lasted some 3 or 4 minutes after this red light came on and when the engine stopped she noticed that all lights (on the panel) came on. Her husband subsequently stated that the helicopter was still heading towards their home (i.e. outbound), at this point, with approximately 30 seconds to run before it would have been overhead their home. She recalled hearing two very loud sirens as the engine went quiet, the helicopter started wobbling and the children became upset, crying and screaming. However, the pilot got the helicopter down into a big green field and it tilted forward and backwards a few times on the ground before it came to a complete stop. The pilot jumped out and moved/ran some 20 yards away, as the wife unbuckled her seat belt with difficulty. She then alighted from the helicopter and assisted her husband by opening the rear doors from the outside, as he had experienced difficulty in locating the opening handle on the inside. Her action released him and their children into the field. The pilot came back and, having ascertained that all was well with his passengers, he apologised for what had happened, and offered them a flight back in the other helicopter. This was "refused point blank".

Friends of the passengers came from their nearby house and took them back to their departure field to collect their car. The husband came back later that evening and spoke to the pilot about the red light illumination, as seen by his wife. The pilot acknowledged that the red light did come on, but only seconds before the actual engine failure, in his recall of events. The wife was adamant that it had come on some minutes earlier, on take-off from the field. She only advised her husband of her recollection of the red light event after the landing.

1.5 Refueller's Recollection

The refueller operator subsequently stated EI-BYJ was not refuelled when it initially arrived at Kilanny but at some time later. He did confirm that 123 litres (33 US Gallons) of fuel were pumped into the helicopter during this refuelling. This is confirmed by the Operator's refuelling log. At the time of the accident, it was not company procedure to record the time of refuelling in the log. The procedure was subsequently changed to include time of refuelling. He also stated that, around 19.00 hrs, he made a routine check with the pilot, during a passenger pick-up stop, regarding the fuel situation. Because of the high ambient noise level, this conversation was conducted by radio. The pilot replied that he was O.K. for this and two more trips, i.e. 3 trips in all, after which he would refuel and then return to base at Knocksedan. The refueller operator believed that the engine stoppage occurred either on the next flight or the subsequent one.



1.6 Damage to the Helicopter

The tailboom struck the ground during the landing, causing a crease in the structural skin of the boom. The main gearbox rocked on its mounting during the landing, resulting in further significant damage.

1.7 Description of Fuel System

A schematic for the Bell 206 fuel system is shown in **APPENDIX A**. The helicopter is fitted with a single fuel tank, as shown on **APPENDIX B**. The tank is in the shape of an L, with the foot of the L facing forward. The fuel contents are measured by two float sensor units, which are wired in series. The upper section float sensor measures the contents in the vertical section of the L while the lower section float sensor measures the fuel in the bottom section of the tank. The fuel contents gauge registers the sum of these two sensors. As the tank contents reduce, the sensor from the upper section hits a bottom stop at a point where the fuel quantity is level with the top of the lower section. At this point the fuel quantity in the tank is approximately 15 US gallons. As the fuel is further exhausted, the contents are measured solely by the sensor in the lower section.

Because the two sensors are longitudinally displaced, the fuel quantity reading when the upper sensor hits the bottom stop can be slightly in error. This is caused by variation in the flight pitch angle of the helicopter. This means that in normal forward flight, with a nose pitch down angle, the fuel gauge indication remains at or about the 15 US gallon point for a short period.

Fuel is pumped to the engines by two electric pumps fitted in the bottom of the tanks. These pumps are connected in parallel, and pump fuel from the tank up to the engine. If either pump fails, or if the intake is uncovered (so that the pump draws in air), the loss of fuel pressure is detected by a pressure sensor on the pump outlet which turns on a warning light on the caution panel of the cockpit instrument panel. The sensor on either pump, feeds into the single warning light. This warning light is red and contains yellow script "FUEL PUMP".

Each pump is fitted with a non-return valve (NRV), so that in the event of pump failure, or the pump inlet uncovering, the fuel provided by the remaining serviceable pump is not lost by escaping back into the tank through the unserviceable pump.

The unusable fuel of the Bell 206 is approximately 2.4 US gallons. This relatively high figure is, in part, due to the relative large area of the tank bottom. The figure for the unusable fuel is somewhat approximate, due to the effects of longitudinal pitch changes. Because the two pumps are longitudinally displaced along the helicopters fore-aft axis, the rear pump will usually uncover first, as the fuel level reduces, when the helicopter is in the nose down altitude associated with forward flight. The fuel available from the time the first pump uncovers, and activates the warning light, until the engine stops due to the second pump inlet uncovering is not constant. It varies according to the nose down pitch angle, which changes considerably throughout the flight operating envelope.

If one or both of the booster pumps fail, the red "FUEL PUMP" warning light will illuminate, but the engine will continue to run as fuel will be sucked through the inoperative booster pump(s) by the engine driven pump, thereby maintaining the fuel supply to the engine.

If the inlet of one booster pump uncovers, its NRV will be closed by the pressure from the second booster pump and the fuel supply to the engine will continue, albeit with the red "FUEL PUMP" warning light illuminated. However, if the inlets to both booster pumps are simultaneously uncovered, the engine driven pump will suck in air through the uncovered inlets and the engine will stop due to fuel starvation.

The Investigation took a sample of fuel from the tank after the incident. Laboratory analysis of this sample showed that the fuel conformed to the specification of AVTUR and was free of contamination.

A separate "FUEL LOW" warning light modification, whereby a warning light comes on when fuel contents reduce to 20 US gallons, is available for the Bell 206 as an optional modification. The Flight Manual contains an instruction to land as soon as practical when such a light illuminates. This modification was not fitted to EI-BYJ.

The fuel gauge is shown at approximately full size in **APPENDIX C**. It is noteworthy that the graduations are small and that there is relatively little needle movement between 10 Gallons and zero. As the pilot is not seated directly in front of the gauge, the effects of parallax can lead to reading errors.

1.8 Fuel Management

Because of the problem of sloshing in the relatively large area in the bottom of the tank, the Flight Manual contains a warning:

"Operation with both fuel boost pumps inoperative is not authorized. Due to possible fuel sloshing in unusual attitudes or out of trim conditions and one or both fuel boost pumps inoperative, the unusable fuel is ten gallons".

Apart from this the manufacturer's Flight Manual does not make recommendations regarding minimum operating fuel quantities.

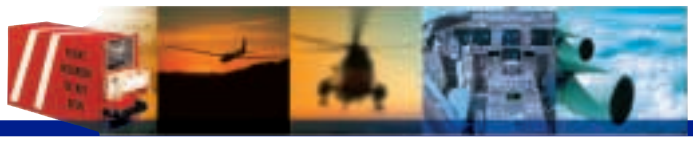
At the time of this accident the relevant Statutory Instrument (SI) of the Irish Aviation Authority (IAA) was S.I. No. 437 of 2002 IRISH AVIATION AUTHORITY (OPERATIONS) ORDER, 2002. Regulation 34 (4) (a) of this SI lays down the minimum fuel requirements for all helicopter operations:

(4) (a) In the case of a helicopter operating under visual flight rules (VFR) conditions (EI-BYJ was operating under these conditions at the time of the accident) the fuel and oil carried shall be at least the amount sufficient to enable the helicopter -

(i) to fly to the heliport to which the flight is planned,
(ii) to fly thereafter for a period of 20 minutes at best range speed plus 10 per cent of the planned flight time, and
(iii) to have an additional amount of fuel, sufficient to provide for the increased consumption on the occurrence of any potential contingencies for the flight concerned.

The USA, the State of Manufacture for the Bell 206, lays down in FAA CFR 91.15 1 *"no person may begin a flight in a rotorcraft under VFR conditions unless there is enough fuel to fly to first point of intended landing and, assuming normal cruising speed, fly after that for at least 20 minutes"* (20 minutes flying is approximately about 8.7 US gallons in the 206 B helicopter).

The Operator's own Operations Manual (OM) also addresses the issue of fuel states and in Para 7.2.5 of the OM is the heading "MINIMUM IN FLIGHT FUEL" which states that *" the minimum fuel to be left in the tank(s) before a landing must be made AS SOON AS POSSIBLE is: Bell 206/12 US GAL".*



The normal fuel consumption of the Bell 206 is approximately 26 US gallons per flying hour. While on the ground, with the engine at idle, the fuel consumption is about 6 US Gallons per hour. With regards to the type of flying being performed by EI-BYJ at the time of the accident, the Operator's Chief Pilot reckoned that, given the normal ratio of flying time and idling time on the ground, the fuel consumption in one hour of such operations (including ground time) is 20 US gallons.

1.9 Fuel Calculations

While there is varying evidence as to when EI-BYJ was refuelled at Kilanny, the available data is that the helicopter arrived there at 16.40 hrs, with 20 US gallons on board and immediately commenced continuous operations. At some stage a further 33 US gallons was added. The engine stoppage occurred at 19.15 hrs. Thus the helicopter operated for a total of 2 hrs 35 min (=2.583 hrs), including ground idle time. Using the Chief Pilot's estimate of 20 US gallons per hour of such operations, the helicopter would have consumed 51.7 US gallons during this period. When this is added to the approximately 2.4 US gallons of unusable fuel, the total required is 54.1 US gallons. This corresponds closely to the total of 53 US gallons known to have been in the helicopter. Thus if the pilot kept track of his fuel consumption using this simple calculation, he would have been aware that the fuel situation was critical before the final take-off.

1.10 Rear Door Mechanism

The cabin has a door on either side of the helicopter. These doors are hinged on their leading edges and open outwards. The door locking/opening mechanism consists of a rotating handle as shown in **APPENDIX D, Photo 1**. The handle is rotated clockwise to open the door and anticlockwise to lock it. The handle is located somewhat low and towards the rear on the door.

The Investigation noted that a person seated beside either rear door does not have a clear view of the door operating handle, as it is obscured by their own leg, as shown in **APPENDIX D, Photo 2**. Furthermore, their view of the operating handle on the opposite door would be obscured by the person sitting next to that door. The door can also be opened and locked from the outside by a corresponding rotating handle on the door's external surface.

1.11 Survival

The Investigation noted that the helicopter operator's safety brief to passengers during such pleasure trip operations was by means of a safety card ("Passenger Briefing Card" – see **APPENDIX E**) displayed in the booking area. This safety card did not contain any information on how to open the safety belts, in particular the 4-point harness fitted to both front seats. This harness fastens and releases in a totally different manner to normal passenger lap straps (such as those fitted to the rear seats). Neither did the leaflet indicate the location of the internal door-opening lever on the rear cabin doors.

The Investigation found that there was no safety card in the helicopter.

The operator's Operations Manual, in para 8.3.16 states: *" The commander is responsible for ensuring that all passengers are given the appropriate briefing, or safety equipment demonstration for the various stages of the flight, as outlined in the following paragraphs"*. In the subsequent paragraphs, section 8.3.16.2 (c) includes *"location and use of emergency exits"* and section 8.3.16.3(a) includes *"the use, fastening and unfastening of safety belts/harnesses"*. These responsibilities are repeated in section 1.4.3(f) of the same manual. Such responsibilities are consistent with the appropriate JAR-OPS regulations.

1.12 Tests on Helicopter

After the helicopter was returned to the Operator's base by road, the Investigation examined the helicopter. Due to the extent of the damage, it was not possible to run the engine at this stage. The helicopter was inspected for any indications of fuel leaks. None were found.

A series of tests were then conducted on the fuel system. The fuel gauge was showing approximately 2 US gallons at this time. The tank was then drained completely and the contents were found to be 9 litres (2.4 US gallons). The tank was then filled progressively in 10 litre (2.6 US gallons) increments, to 60 litres (15.8 US gallons), and the gauge reading was noted at each addition. This test showed that the fuel gauge was accurate to within 10% over this range. This test was conducted with the helicopter in the level (approximately hovering) attitude.

The operation of both booster pumps was also checked, running both separately and together. This test showed that both pumps were operating satisfactorily. The pumps were then allowed to run until the reducing fuel in the tank caused one of the booster pump intakes to uncover, thereby drawing in air. This in turn activated the pressure sensor and caused the warning light to illuminate. This occurred when the fuel gauge was reading 5 US gallons. **APPENDIX F** shows the instrument panel when the booster pump warning light is illuminated. This is the same configuration of the warning panel that was seen on EI-BJY after the first booster pump uncovered but before the second pump uncovered and the engine failed.

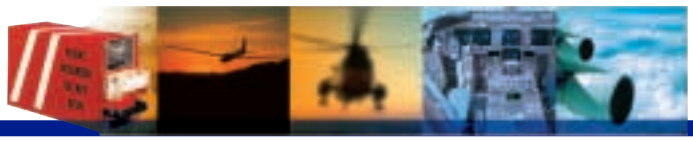
After the helicopter was repaired, similar tests were conducted with the engine running and the rotor rotating. For safety reasons[2] it was not feasible to run the engine above idle power. In these tests the fuel pump warning light came on when the gauge was reading 2.5 US gallons. The engine then cut out when the gauge was reading just under 2 US gallons. These tests were conducted with the helicopter resting on the main undercarriage.

1.13 Other information

The Investigation examined the pilot's logbook and his annual flight time record as maintained by his principle employer. These records showed that in the 12 month period, from 1 April 2003 to 31 March 2004, he had flown 890 hrs on medium weight turbo-jet public transport aircraft and 9 hrs on helicopters, giving a total for the year of 899 which was just within the laid down limit of 900 hours. The Investigation also found that the pilot's principle employer, the Airline, had issued, in February 2003 a Flight Crew Instruction (FCI) which required all Flight Crew members to provide details of all flight times flown on aircraft other than those of the Airline.

The Chief Pilot of the Airline informed the Investigation that he had not been informed by the pilot of the accident helicopter that he was flying aircraft for other operators. The pilot also confirmed to the Investigation that he had not informed the Airline of his helicopter flying.

2 If the helicopter suffered ground resonance, it would not be safe to follow the normal recovery action of lifting the helicopter off the ground. This is because the helicopter was running with minimal fuel in the tank. Therefore, engine fuel starvation, and consequent engine shut-down, was a real possibility.



2. ANALYSIS

2.1 The pilot's statement said there was a gauge indication of "over 10 US gallons" at take-off. However, given the amount of fuel found in the helicopter tank after the event (2.4 US gallons) and the fuel consumed in the flight of approximately 6 minutes duration before the engine failed (2.6 US gallons), and the absence of any indications of fuel leaks, the Investigation estimates that there was approximately 5 US gallons in the helicopter when it took off on the final flight. This is less than the 12 US gallons required by the operator's Operations Manual. As this Manual was part of the requirements of the JAR FCL under which this operation was taking place, the pilot was required to conform to the stipulations of this Manual. The fuel contents at take-off were also below the requirements stated in the IAA regulations.

2.2 In his debrief to the Investigation the pilot said that he relied on his fuel gauge and time flown to estimate the flying time remaining. Hence, on the final trip, he noted that the fuel gauge was at or slightly above 10 US gallons, which he felt, was adequate to complete this trip. He was of the view that 10 US gallons would give him in excess of fifteen minutes flying time. However this belief made no allowance for the sloshing problem. It also indicated that the pilot was depending totally on his fuel gauge for information on his fuel situation. The fact that the pilot was not aware of the exact number of trips completed further indicates that he was not using time flown as a cross check on his fuel status. Total reliance on gauges for fuel contents information in small helicopters is generally recognised as inadvisable. Furthermore there is the possibility of misreading the gauge as discussed in para 2.12 below.

2.3 The Investigation has not been able to reconcile the statement of the pilot that this was the last trip before refuelling, with that of the refueller operator who stated that the pilot informed him that he intended to perform further additional flights before refuelling.

2.4 In the event, the pilot never completed further trips because of the engine stoppage. The evidence that no useable fuel was found in the helicopter fuel tank after the event clearly indicates that the engine shut-down was caused by a lack of fuel supply to the engine.

2.5 The tests on the fuel pumps and the warning system indicate that there was no mal-function in the system.

2.6 It cannot be precisely stated what fuel levels will cause the first (uppermost) booster pump to uncover. Neither is it possible to state precisely at what level the lower booster pump will uncover and cause the fuel supply to the engine to cease. This is because the attitude of the helicopter varies significantly, in pitch and roll throughout the operating envelope. Furthermore, transient manoeuvres, such as accelerating, turning, banking etc., will produce movement, or sloshing, of fuel in the tank. This causes a build up of fuel in one side of the tank, and can lead to uncovering of a pump inlet. If both pumps' inlets uncover simultaneously, then the fuel supply to the engine will cease and the engine will fail.

2.7 Unfortunately, even if the fuel levels out again, and a pump inlet is again covered by fuel and the fuel supply to the engine is restored, the gas turbine engine will not restart automatically. This is because the temperature falls rapidly in the combustion chamber, to such an extent that the fresh fuel will not ignite. Consequently engine power is not restored. Auto-ignition is available as an optional modification. This system senses the loss of combustion in an engine and powers up the electronic igniters, which are normally only used during initial engine start-up. This modification would, to some measure, assist in the restoration of engine power in such a situation. However, EI-BYJ was not equipped with this modification.

2.8 The ground tests demonstrated that there was a reduction of fuel of approximately 3 US gallons between the first and the second booster pump uncovering. This would equate to approximately 7 minutes flying. This would appear to co-relate well with the front passenger's statement that the warning light came on shortly after take off. However the effects of pitch changes and fuel sloshing must also be considered in this regard. Unfortunately, this effect is impossible to quantify.

2.9 There is a significant difference between the statements of the pilot and the front seat passenger with regard to what point in the flight the booster pump warning light illuminated. Because of the effects of pitch change and sloshing, the Investigation cannot make a definite determination as to precisely when the warning light came on. However it is probable, based on the tests conducted in the course of this Investigation that the light did come on more than 5 or 6 seconds before the engine shut down.

2.10 As the pilot himself stated, the event had occurred at the end of a long day's flying. He felt sure that he had adequate fuel on board to complete the last trips as planned. He was also conscious of the fact that he still had to refuel the helicopter and then fly back to base. Even then, his day was not yet finished as he then to complete significant drive to his home. This amounted to insidious pressure, knowingly or unknowingly, on the pilot. He accepted that the day had not turned out as he planned, in any respect, and that, with hindsight, accumulative fatigue may have impaired his judgement in operating EI-BYJ for the last trips.

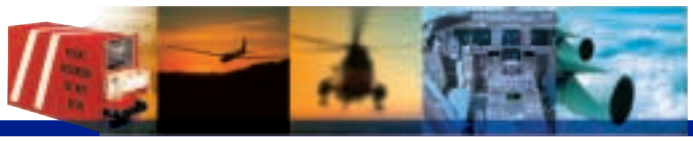
2.11 The fact that the pilot had not flown such short duration pleasure flight operations for 10 years may have dulled his awareness of the pitfalls associated with this type of operation.

2.12 It is possible that the pilot, at the end of a long and tiring day, misread a fuel gauge reading of 5 US gallons (or slightly above) for a perceived reading of 10 (or slightly above) US gallons. The Investigation concludes that there was probably 5 US gallons in the tank at the time of the final take-off. While this possibility cannot be proven, it is consistent with the facts. Examination of **APPENDIX C** indicates the possibility of such a misreading.

2.13 The Pilot's belief that an indication of 10 US gallons would provide 15 minutes flying is accurate in that, at a consumption rate of 26 US gallons per hour, the remaining usable fuel of 7.6 gallons would theoretically provide 17 minutes of flying. However, this belief made no allowance for the possibility of the inlets of both pumps becoming simultaneously uncovered due to a combination of low fuel level and fuel sloshing. In this regard it should be noted that the effects of fuel sloshing become more pronounced when the fuel level reduces to the point where there is only fuel in the broad bottom section of the tank, i.e. less than 15 US gallons.

2.14 This aircraft was not fitted with the optional modification of an independent low-level fuel warning light. Apart from the obvious advantage of a back up for the gauging system, which can be inaccurate on smaller aircraft and helicopters, it is possible that the illumination of such a light may have made the pilot aware, at an earlier point, of his critically low fuel situation. Because of the difficulties of performing successful autorotations at the typical low level of such helicopter operations, the Investigation sees merit in the fitting of such warning systems to helicopters engaged in commercial operations.

2.15 In this type of short duration, high frequency pleasure flights, the passengers board the helicopter with the engine running at idle and the rotors rotating. This noisy environment precludes any effective safety briefing of the passengers by either the pilot or the ground handling staff. While it is the commander's responsibility to ensure an adequate safety briefing of passengers, it is not feasible for him to effect such a briefing in this type of operation, due to the following factors:



- There are no other crew members with him in the helicopter
- The high ambient noise levels due to the engine and spinning rotors
- The physical divide of the bulkhead between the pilot and the passengers in the rear seats in the Bell 206

The Investigation is concerned that it is not feasible for the pilot of such operations to effectively ensure that the passengers are properly briefed.

2.16 The time pressure of this type of operation also mitigates against effective briefing. As a result, the front LH seat passenger was not aware how to open the 4-point harness fitted to her seat. It is also noted that the operation of this somewhat unusual harness release is not covered in the safety card. For the foregoing reasons, her difficulty in opening it is understandable.

2.17 In the case of this particular accident, the father was seated by the left rear door. Hence his view of the door-opening handle was obscured by his left leg and he was unable to locate it. His view of the operating handle on the right door was obscured by the two children. The Investigation noted that there were no instructions in the Safety Leaflet covering the location or operation of the handle, or on opening the door, particularly from inside the helicopter.

2.18 The Investigation has not been able to reconcile the pilot's account of events after the landing with those of the passengers. The difficulties of the passengers in opening the front seat harness and the rear door would indicate that the pilot was not in the immediate proximity during these difficulties.

2.19 The pilot had undertaken to complete a task of commercial flying for the helicopter operator on his day off from his airline flying. The original plan was for a somewhat less strenuous day's flying. He then became involved in on-going flying and a long day of activity. The final type of operation - short duration, high frequency pleasure flights - is particularly unrelenting. The Investigation is of the opinion that fatigue may well have blurred the pilot's judgement and airmanship towards the end of the day. The Investigation also notes that the pilot's annual flying activity in the previous period was just short of the 900-hour annual flying limit laid down by the IAA. The wisdom of getting involved with further commercial operations is therefore dubious, particularly when this was done without notifying his prime employer.

3. CONCLUSIONS

(a) Findings

1. The pilot was qualified to carry out the Operation in accordance with JAR regulations

2. The helicopter was serviceable when the engine stopped.

3. The fuel was of the correct type and free of contamination.

4. The engine stoppage was caused by fuel starvation due to insufficient fuel in the helicopter's fuel tank.

5. At the start of the final flight the fuel quantities did not meet the minimum requirement of the IAA or the approved Operations Manual. In fact, there was insufficient fuel in the helicopter to actually complete this flight, as subsequent events demonstrated.

6. By deciding to undertake the final trip the pilot displayed unsound judgement that was contrary to the Operator's Operations Manual, the prescribed fuel minimum requirements and good airmanship.

7. The passenger briefing was inadequate.

8. In the circumstances, the pilot carried out a successful engine-off autorotation into the cornfield, from which all persons on board exited the helicopter safely.

(b) Causal Factors

1. This accident was caused by insufficient fuel in the helicopter, leading to fuel starvation and engine shutdown

2. Contributory factors include the pilot's failure to adequately monitor the available fuel, non-adherence to the Operator's SOP's and possible cumulative fatigue.

4. SAFETY RECOMMENDATIONS

1. The Operator should revise the Safety Card used on its helicopters to cover the opening of all types of seat harnesses fitted to its aircraft and to give instructions on how the doors should be opened from inside the helicopter. The Safety Cards should be always available, in the helicopter, particularly in the rear seat area. Consideration should be given to permanently fixing such Safety Cards to the rear of the bulkhead immediately in front of the rear seats. **(SR 15 of 2006)**

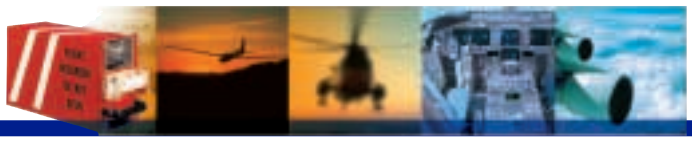
2. The IAA should review the operation of high frequency, high turnaround commercial helicopter operations with the objective of devising an operations procedure that would ensure that passengers are effectively briefed on safety matters. **(SR 16 of 2006)**

3. The European Aviation Safety Agency (EASA) should review the certification for helicopters engaged in commercial operations, with the objective of requiring such helicopters to be fitted with an independent low fuel contents warning light. **(SR 17 of 2006)**

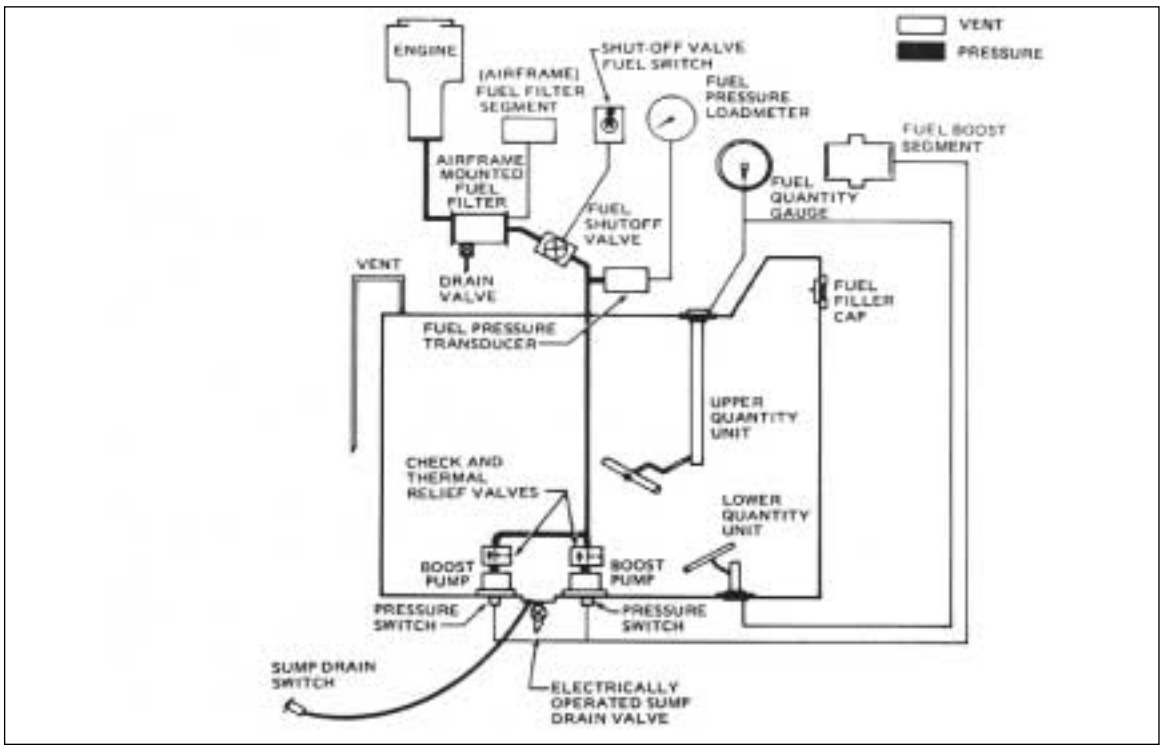
4. In recognition of the reality that pilots may exercise the privilege of their licence in more than one form of flying, the IAA should issue a notice to pilot licence holders bringing to their attention:

   - Their responsibilities to regulate their flying activities in accordance with their employers FTL schemes.

   - Their responsibilities to use duty /days off so as to ensure that they are adequately rested and in a manner acceptable to the Authority. **(SR 18 of 2006)**

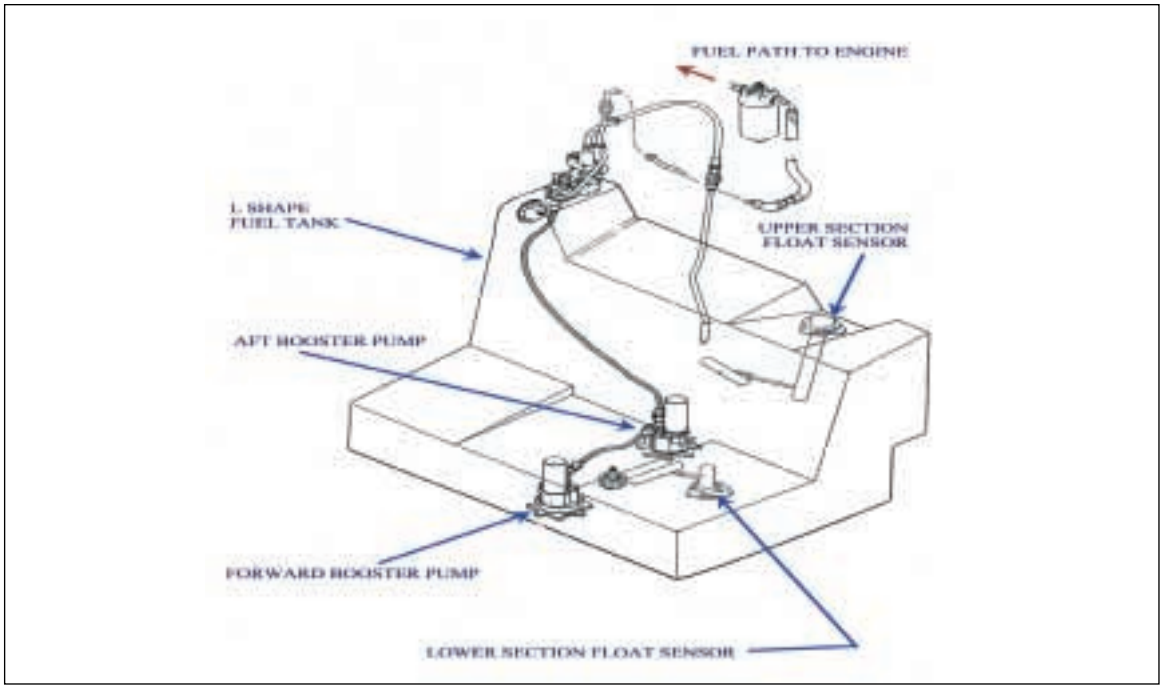


APPENDIX A



Fuel System Schematic

APPENDIX B



Fuel Tank Layout

APPENDIX C

This photo shows a section on the instrument panel of EI-BYJ containing the fuel gauge, which is located at top centre. The photo is scaled at approximately full size. The gauge is located approximately 60 cm from the pilot's eye (an arm's length), below and to the left of his line of vision. The contents indication when this photo was taken was 15 US gallons. Empty is indicated by the orange line with the symbol E to the right of it. The graduation immediately above this zero mark is 5 US gallons and the next one up again is 10 US gallons.

APPENDIX D

Photo 1
This photo shows an unobstructed view of the operating handle of the RH door on EI-BYJ

Photo 2
This photo shows how the view of the operating handle of the RH door on EI-BYJ is obstructed when a person sits beside the door.

APPENDIX E

PASSENGER BRIEFING CARD

PLEASE READ THIS CARD CAREFULLY

THIS CARD HAS BEEN PREPARED FOR YOUR COMFORT AND SAFETY.
PLEASE FAMILIARISE YOURSELF WITH THE LOCATION OR OPERATION OF SAFETY EQUIPMENT

THANK YOU FOR FLYING WITH CELTIC HELICOPTERS

EMBARKING & DISEMBARKING:

WHEN IN MOTION, THE ROTORS ARE DIFFICULT TO SEE AND CAN BE EASILY MISJUDGED. THE PILOT HAS A RESTRICTED FIELD OF VISION AND IS ALWAYS MOST CONCERNED THAT HE IS UNABLE TO SEE THE TAIL ROTOR.

ALWAYS APPROACH FROM AND LEAVE TO POSITION FORWARD OF THE HELICOPTER, IN FULL VIEW OF THE PILOT, AND WITH HIS PRIOR PERMISSION

DOORS:

PLEASE DO NOT SLAM DOORS.
THE PILOT WILL DEMONSTRATE THE METHOD OF CLOSING THEM. ONCE CLOSED, DO NOT OPEN THEM DURING FLIGHT.

SAFETY BELTS:

YOUR SAFETY BELT MUST BE SECURELY FASTENED FOR EVERY TAKE-OFF AND LANDING AND WE ALSO RECOMMEND THAT YOU WEAR IT FOR THE DURATION OF THE FLIGHT.

SMOKING:

ASHTRAYS ARE PROVIDED FOR THOSE WHO WISH TO SMOKE DURING FLIGHT. SMOKING IS NOT PERMITTED WHILST THE AIRCRAFT IS ON THE GROUND, DURING TAKE-OFF AND LANDING OR ANY OTHER TIME ON THE INSTRUCTION OF THE PILOT.

SAFETY EQUIPMENT

LIFE JACKETS ARE POSITIONED ON THE SHELF BEHIND THE REAR SEAT. PLEASE STUDY THE PICTURES SO THAT IF YOUR FLIGHT IS OVER WATER YOU WILL BE FAMILIAR WITH THE PROCEDURE.

THE FIRE EXTINGUISHER IS BETWEEN THE FRONT SEATS.
THE DOORS ARE ALSO TO BE USED AS THE EMERGENCY EXITS.
THE FIRST AID KIT IS ALSO ON THE SHELF BEHIND THE REAR SEATS.
THE LIFE JACKETS: THIS IS WORN BY FOLLOWING THESE STEPS:

(1) PLACE HEAD THROUGH THE COLLAR (FIG 1.(2)) WRAP CORDS AROUND YOUR BACK (FIG 2.(3)) TIE CORDS AT THE FRONT (FIG 3.(4)) DO NOT INFLATE JACKET UNLESS YOU NEED TO LEAVE THE AIR CRAFT

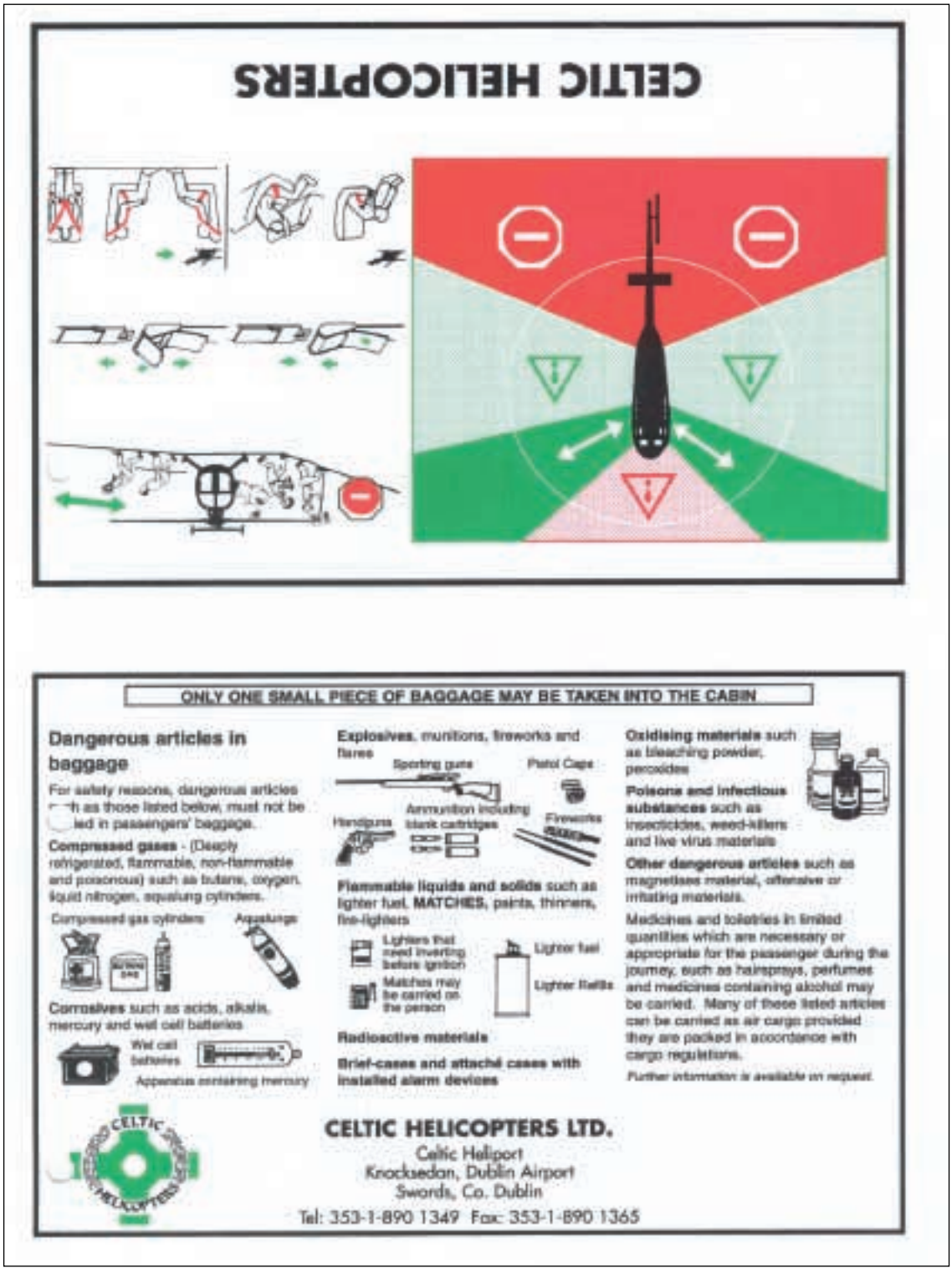
EMERGENCY PROCEDURES

IF THERE IS AN EMERGENCY OF ANY NATURE YOU WILL BE FOREWARNED BY THE PILOT WHENEVER POSSIBLE . CHECK THAT YOUR SEAT BELT IS SECURELY FASTENED. EXTINGUISH ANY CIGARETTES. OBEY ANY INSTRUCTIONS GIVEN BY THE PILOT.
WHEN THE AIRCRAFT HAS LANDED DO-NOT DISEMBARK UNTIL GIVEN PERMISSION TO DO SO BY THE PILOT.
THE AIRCRAFT WILL FLOAT ON THE FLOTATION GEAR, BUT SHOULD IT BE NECESSARY TO LEAVE THE AIRCRAFT DO-NOT INFLATE THE JACKET UNTIL YOU HAVE LEFT THE AIRCRAFT.

BRACE POSITION:

IN THE EVENT OF A WARNING FROM THE PILOT, ADOPT THE BRACE POSITION.

Operator's Safety Card



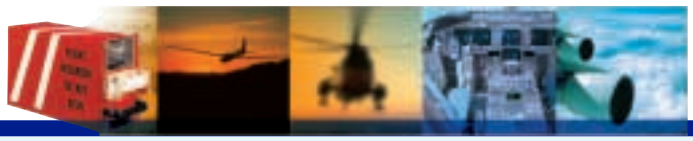
Reverse Side of Safety Card

This side of the card is shown in the format of the original, with the top section inverted.

APPENDIX F

This photo shows the instrument panel as viewed from behind the head of a person seated in the front LH seat. This photograph was taken during the test runs noted in paragraph 1.12 of the main report. It represents what would have been seen by the pilot and front LH seat passenger when one booster pump was uncovered but before the second pump uncovered and the engine failed. The visible red light in the Warning Panel (upper centre) is the "FUEL PUMP" warning light. The main lighting of the warning light is red, while the logo "FUEL PUMP" is yellow. Because of the colour balance of the camera, the yellow is more visible in this digital photo, compared to the actual situation. In this test the low main rotor light was also on, as the rotor was running at idling speed. In this photograph, the warning light is hidden by the headphone cable to the right of centre. The fuel gauge is located on the left of the instrument panel. In this photograph it is hidden by the person seated in the LH seat.

- END -



AAIU Synoptic Report No: 2006-014

AAIU File No: 2005/0039

Published: 7/8/06

In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on 28/6/05, appointed Mr John Hughes as the Investigator-in-Charge to carry out a Field Investigation into this Accident and prepare a Synoptic Report.

Aircraft Type and Registration:	Enstrom F-28A, G-BBHE
No. and Type of Engines:	1 x Lycoming HIO-360-C1A
Aircraft Serial Number:	153
Year of Manufacture:	1973
Date and Time (UTC):	28 June 2005 @ 10.15 hrs
Location:	Fethard, Co. Tipperary
Type of Flight:	Private
Persons on Board:	Crew - One Passengers - One
Injuries:	Crew - Nil Passengers - Nil
Nature of Damage:	Complete tail rotor section torn away. Main blades destroyed on landing. Undercarriage damaged on landing.
Commander's Licence:	UK PPL(H)
Commander's Details:	Male, aged 62 years
Commander's Flying Experience:	1400 hours of which, 400 were on helicopters.
Information Source:	Aircraft Owner. AAIU Field Investigation.

SYNOPSIS

The pilot took off in order to take his passenger friend on an airborne tour of the town of Fethard. At between 900 and 1,100 ft, the pilot heard a bang from the rear of the helicopter. He then realised he had no directional controls using the pedals. The pilot auto-rotated into a grass field and managed to crash land the helicopter. The horizontal stabilizer spar had failed in fatigue, and the departing stabilizer struck the tail rotor resulting in the bang heard by the pilot. There was no fire and both occupants exited the helicopter without injury. The Report makes two Safety Recommendations.

1. FACTUAL INFORMATION

1.1 History of the Flight

At 09.48 hrs the pilot departed his home in G-BBHE from a private airfield near Fethard, 16 miles distant. He arrived at 10.00 hrs and picked up a friend who was a fixed wing pilot. The passenger carried a new video camera with him and the helicopter took off again for a trip around the town of Fethard.

The climb out was uneventful and the helicopter levelled out at between 900 and 1,100 feet. Approaching the town the pilot reduced speed from 80 mph to 60 mph. The helicopter had completed half the circumference of the town when both pilot and passenger heard a bang from the tail section of G-BBHE. At the same instant the helicopter yawed to the right. The pilot lowered the collective and backed off the power throttle. The right yaw stopped and then the helicopter yawed to the left. The pilot controlled direction using the collective and throttle controls. The foot pedals were ineffective in controlling helicopter direction.

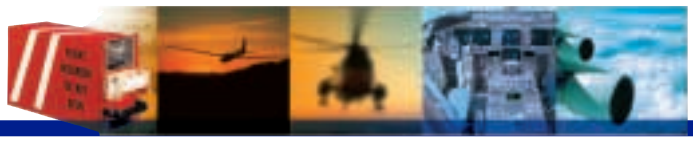
There was a quarry below and some houses followed by four fields some containing boulders and some cattle. The pilot selected the next nearest suitable field about 0.5 miles distant and made a gradual autorotation approach to that field. The landing was heavy and the left front shock absorber lost its charging connection with the force of impact. During the landing the main rotor blades struck the tail boom.

Whilst the main blades were still turning the passenger exited the helicopter. Both he and the pilot were using a four-point harness and there were no reported injuries to either.

1.1.1 Pilots Comments

Afterwards, the pilot commented as follows:

"After the bang and the initial lurch to the right I lowered the collective full, simultaneously backing off the throttle. Pushing down the right pedal then the left had no effect. I increased throttle and some collective to counter torque until I had some directional control. I made throttle and slight collective changes all the way keeping the "auto"(autorotation) at 60 (mph) and the blade RPM within the green arc. The engine RPM would vary commensurate with left or right direction changes. On the way down in autorotation, it was not dissimilar to normal except my method of directional control."



Following a study of the Draft Report on this accident, the pilot made the following comment:

"I had very little cyclic control either directional or lateral. After entering autorotation I had to keep the cyclic stick full back in order to maintain 60 mph and then at the end of autorotation I had no flare and when I tried to level for a run on landing the cyclic gave no response when pushed forward for a run on landing."

He was also of the opinion that the stabiliser spar should be replaced after seven to eight hundred flight hours.

The pilot said that he was aware of the requirement for a pre-flight check on the stabilizer and usually carried it out. However, he could not specifically recall having done so on this occasion (ref. 1.8 below).

1.2 Damage to the Aircraft

Witnesses on the ground heard the bang and saw pieces falling from the helicopter. Several parts of the tail section including three sections of the R.H. stabilizer (**APPENDIX A**) were subsequently found in a quarry 0.5 miles before the final landing area. Tail rotor blade strike marks were found on the underneath surface of the larger of the RH stabiliser sections and on the inner top surface of the smaller section. With the exception of the tail rotor drive shaft and the RH section of the stabilizer spar, which were, despite regular searches, never located, the rest of the tail section including airframe and dynamic parts were all located within 20 metres of the helicopter landing area. The cylindrical stinger tube with part of the tail boom attached was found 18 metres to the right of the helicopter. A large dent, 15 inches from the tube end was compatible with a strike from one of the main blades.

All of the RH tail rotor control cable was found wrapped around the TR gearbox output shaft. It was impossible to rotate the output shaft by hand. It unravelled in two separate lengths of 78 inches and 156 inches. Strands were either broken or damaged at regular intervals. Its anchor point to the pitch change mechanism had broken off. The other end had broken at the thimble Nicropress sleeve (18-2-G), adjoining the cable to the turnbuckle (MS21251-33S), in the lower engine bay. After unravelling, the gearbox shaft was free to rotate by hand. One of the two pitch link retainers had cracked at its root.

The LH cable was found cut 36 inches from its tail rotor pitch change mechanism attachment lug. The remainder of the cable was found intact.

1.3 Aircraft Information

1.3.1 General

Accommodation is for a pilot and two passengers, side by side on a bench seat. The helicopter has a high inertia, three-blade fully articulated rotor head with blades attached by retention pin and drag link. The control rods pass inside the tubular rotor shaft to a swashplate inside the fuselage. It has a two-blade teetering tail rotor. The drive from the horizontally mounted engine to the transmission is through a grooved rubber belt.

Skids are carried on oleo-pneumatic shock-absorbers. The power plant consists of one 208 hp (@ 2,900 RPM) Lycoming HIO-360-C1A flat-four engine. The helicopter had only flown 1.5 hrs since a Star inspection and a renewal of its Certificate of Airworthiness (Cof A) on 7/3/05.

1.3.2 Transmission System

The main transmission unit provides an 8.7871 ratio between the engine and the main rotor. The ratio between the tail rotor and the main rotor is 7.154. The transmission incorporates a free-wheeling unit in the upper pulley assembly, which is mounted on the output pinion shaft. The free-wheeling unit provides a dis-connect from the engine in the event of a power failure and permits the main and tail rotors to rotate in order to accomplish safe autorotation landings.

1.3.3 Tail Rotor (TR) and Transmission

The tail anti-torque rotor counteracts the torque of the main rotor and functions to maintain or change the helicopter heading. The tail rotor is a two-bladed, teetering, delta-hinge type assembly.

The tail rotor transmission, mounted at the aft end of the tail cone, supports and drives the tail rotor. The tail rotor transmission is equipped with a self-contained lubricant supply and level gauge at the rear of the housing and a magnetic plug can be removed to inspect for metal particles. Its capacity is ½ pint of No.10 oil.

1.4 Meteorological Information

The actual weather recorded by the pilot on the day through www.aviationweather.gov was:

Wind: 320/04-06 MPH
Visibility: In excess of 30 miles.

The weather as supplied later by Met Éireann was:

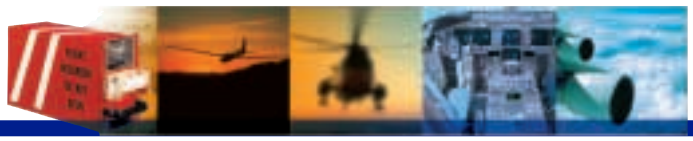
Wind: 050-080/04-07 kts
Visibility: 10 KM

1.5 Audio Recording

A frequency analysis of the audio output of the video camera carried by the passenger is shown in graphical format at **APPENDIX B**. The results are not too clear, due in part to the aerodynamic noise when the camera was pushed out into the slipstream. The noise recorded in the cockpit is a complex signal produced by a number of dynamic sources in flight. These sources can be broadly classified as deterministic or stochastic (random) in nature. In engine noise these occur simultaneously. The engine produces pulses at a rate proportional to engine speed. In this four-cylinder engine, fuel is ignited and two pulses emanate every crankshaft revolution.

Other sources would include the large engine-cooling fan, which produces both deterministic and stochastic (turbulent air flow) components. Sound sources, both random and deterministic are shown and this produces the mottled effect. However, the basic engine deterministic noise both before and after TR control failure can clearly be seen.

The operating speeds of the dynamic components taken from the Flight Manual are shown in the table below. The rotational speed for the engine and TR (two bladed) are multiplied by a factor of 2 giving the frequency of the pressure pulses in each case. Likewise, the MR speed is multiplied by a factor of 3 representing three pressure pulses for each revolution of the main rotor.



Operating Speeds	RPM	Cycles/Sec	X2	X3
Engine (green arc)	2900 max 2750 min	48.33 45.83	96.66 91.66	
Tail rotor (TR)	2365	39.42	78.84	
Main Rotor (MR)	330	5.50		16.50
MR Autorotation Range (Green arc)		313-385	5.22-6.42	15.66 -19.26
Tail rotor Autorotation Range	2243-2759	37.40-46.00	74.80 - 92.00	
Engine Idling (Clutch disengaged)	1400	23.33	46.66	

1.6 Inspection of Airframe

As parts of the L.H. stabilizer were found approximately 0.5 miles from the landing site a detailed examination of the stabilizer system was considered necessary. A section of the stabilizer spar was not recovered with these parts and it was considered necessary to examine the R.H. stabilizer and the remainder of the spar. This component was examined in detail by a metallurgist and a report ensued.

The conclusions of the report are as follows:

1. Failure of the spar (tube) has occurred through fatigue cracking.

2. The cracking appears to have initiated at the inner edges of the boltholes, where burrs were observed.

3. The extent of fatigue cracking, with only a small ligament in which final failure occurred, indicates high cycle fatigue.

There was no indication of any inherent defect in the material of the tube. The spar was held in the fuselage fitting by means of a nut, bolt and washers at its LH side. It was observed that the nut was tightened to the end of the threaded portion of the bolt, and it appeared that the bolt was too long for the assembly (**APPENDIX A**). The fitting appears to have been machined to accommodate the washers so that the assembly could be tightened up with the bolt head, the washers and the nut parallel to one another and perpendicular to the longitudinal axis of the bolt. The fitting of the spar on the RH side was a plain fitting with no bolt. A grease mark on the spar indicates that there had been relative movement between the spar and its RH fuselage fitting. The wall thickness of the spar tube was 0.48 inch. Burrs were observed on the insides of both boltholes. Initiation points for fatigue fracture appear to have been at the inner edges of the boltholes.

1.7 Flight Manual

With a tail rotor drive system failure during cruising flight the Flight Manual instructs the pilot to cut the throttle full off immediately and complete an auto-rotational landing.

The Flight Manual states that on tail rotor control system failure at low airspeed power settings under approximately 18" Hg the helicopter will yaw to the left. With power settings over 18" Hg the helicopter will yaw to the right.

1.8 Technical History

The first recorded instance of failure of a spar was in 1972 with a steel tubular spar having a 0.035 inch wall thickness. The wall thickness was subsequently increased to 0.049 inches and this appeared to correct the problem.

Following an accident in October 1987, involving a spar with the increased wall thickness, the manufacturer issued Service Bulletin SDB0076 in December of that year, followed by the issue of FAA Airworthiness Directive AD 88-11-06 effective May 31 1988. This AD requires that the stabilizers be removed and the spar examined for cracks every 100 hours. It also stipulated pilot checks to be carried out during the pre-flight of the first daily flight. This involved applying slight up and down pressure to the stabilizer during the walk-around inspection.

For G-BBHE the log book entries were as follows:

SDB0076 complied	@ 716.3 hrs	On 30/5/1988 ("out of phase")
AD 88-11-06 complied	@ 737.7 hrs	On 20/5/1989 (Annual)
AD 88-11-06 complied	@ 905.7 hrs	On 20/8/2001 (Annual)
"FAA ADs Complied"	@ 927.0 hrs	On 9/8/2002 (Annual)
"FAA ADs Complied"	@ 948.0 hrs	On 18/10/2003 (Annual)
"No effective ADs present"	@ 964.0 hrs	On 7/3/2005 (Star Annual)

It is noted that SDB0076 requires a specific entry in the logbook in order to verify the inspection. The last verification of AD 88-11-06 was at 905.7 hrs. The next inspection of the spar was not due therefore until 1005.7 flight hours. As the helicopter had a total time of 969.6 flight hours at the time of the accident, the inspection was not due until another 36 flight hours.

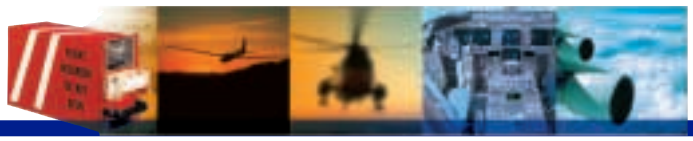
1.9 Manufacturers Comments

The manufacturers said that they would have expected to find the tail rotor drive shaft between 50 and 200 yards back from the landing site along the reciprocal of aircraft heading. From photos it appeared that the tail rotor blade struck the RH stabilizer. A similar incident of a spar failure occurred to a US registered helicopter in 1987 but none had occurred since that time. They were of the opinion that most of the damage they observed in this accident was typical of a hard landing where the tail strikes the ground and the main rotor flexes down and contacts the tail boom. They said that the tail rotor normal operating RPM is 2240 to 2375 with a maximum of 2750 in autorotation.

2. ANALYSIS

Three sections of the R.H. stabilizer were found in a quarry 0.5 miles before the final landing area. The location coincides with that at which the loud bang was heard. A dent in the stabilizer airfoil matches one of the tail rotor blades. The stabilizer departing the helicopter and striking the tail rotor therefore initiated the sequence of events that followed.

In the sonogram, the main rotor blades can be detected at 16.78 c/s prior to the event, corresponding to a speed of 335 Rotor RPM. Following the event, there is a tail rotor blade frequency of 84 c/s, which corresponds to a tail rotor speed of 2520 RPM. This would indicate that there was no disconnect between the main rotor and the tail rotor during autorotation.



APPENDIX C demonstrates the most likely sonograms for engine, main rotor blades and tail rotor blades. The pilot said that he maintained engine RPM at about 2950 prior to the event. This corresponds to a frequency of 98.3 c/s, which is difficult to see on the sonogram. Hearing the bang and loss of pedal control were instantaneous so that one or possibly both cables were severed at that point. The pilot took action immediately following the loud bang and on suddenly discovering that tail rotor control was absent. In auto-rotating on to the chosen field (**APPENDIX D**) he had to traverse a 10 kv electricity line and a boundary hedge before he made the final landing. The severe drop in engine RPM after the event can be clearly seen. The average engine RPM during autorotation is of the order of 1440 RPM. This rises to 2040 RPM and apparently drops to 1800 RPM at impact. The tail rotor blades continued to rotate at a speed of 2520 RPM.

The directional control following the incident was remarkably constant and is an indication that for most of the autorotation sequence the tail rotor blades assumed a nearly neutral pitch condition thus maintaining a certain degree of directional stability.

The reduction of engine RPM to near idling speed during autorotation would indicate that engine RPM had little control over main blade speed and tail rotor blade speed as the freewheeling unit had effectively disconnected the engine.

Near the impact site, the sonogram frequency for the tail rotor blades becomes indeterminate. At this point it is likely that the RH tail rotor control cable started to wrap itself around the perimeter of the gearbox shaft. With a tail rotor speed of 2520 RPM, it would have taken less than a second for the RH control cable to do this. The wound cable squeezed between the rotating pitch link retainers and the fixed bearing housing assembly. The resulting force was sufficient to break one of these retainers before the gearbox seized and the rotating flexible drive shaft broke away.

The pilot intended to carry out a flare and run-on landing. He maintained a speed of about 60 mph down to approximately 4 to 5 ft in height and increased the collective to initiate the flare. Following the flare, the helicopter dropped vertically with the left skid making initial hard contact with the ground.

The main blades struck the tail boom causing the tail rotor to sever from the boom and fall to the ground whilst the rear section of the boom departed the helicopter and was found almost 20 yards from the body of the helicopter. Most of the damage to the helicopter appears to have been done when the main blades struck the boom on landing. The long bolt found in the LH stabilizer assembly, whilst not a contributing factor to this accident, was an indication of poor in-service maintenance at some stage prior to this event.

At the rate at which the helicopter was being flown, SDB0076 or AD 88-11-06 would not have been due for at least 2 years. The Investigation is of the opinion that these Directives should be re-examined in order that stabilizer spars are inspected at least once a year.

The pilot is to be complimented for landing the stricken helicopter, under difficult circumstances, without injury to either himself or his passenger.

3. CONCLUSIONS

(a) Findings

1 The stabilizer spar fractured in high cycle fatigue at the mounting point/bolt hole for the RH stabilizer airfoil.

2 The mating portion of the spar and the RH stabilizer airfoil detached in flight.

3 The RH stabilizer contacted the tail rotor.

(b) Cause

1 Failure of the spar occurred through high cycle fatigue cracking.

2 The cracks initiated at the inner edges of the boltholes holding the RH stabilizer airfoil to the stabilizer spar.

4. SAFETY RECOMMENDATIONS

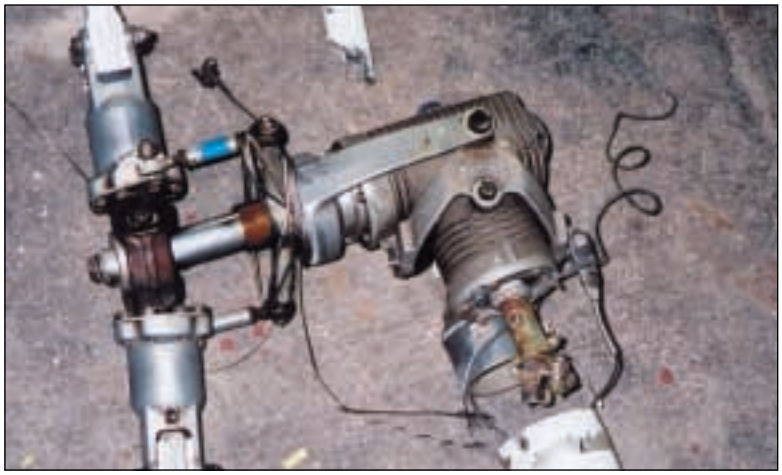
1. The manufacturer should revise SDB0076 with a view to stipulating that the SDB should be carried out at the aircraft annual inspection if it has not been carried out since the previous annual inspection. **(SR 05 of 2006)**

2. The FAA should consider an amendment to AD 88-11-06 with a view to stipulating that the AD should be carried out at the aircraft annual inspection if it has not been carried out since the previous annual inspection. **(SR 06 of 2006)**

APPENDIX A

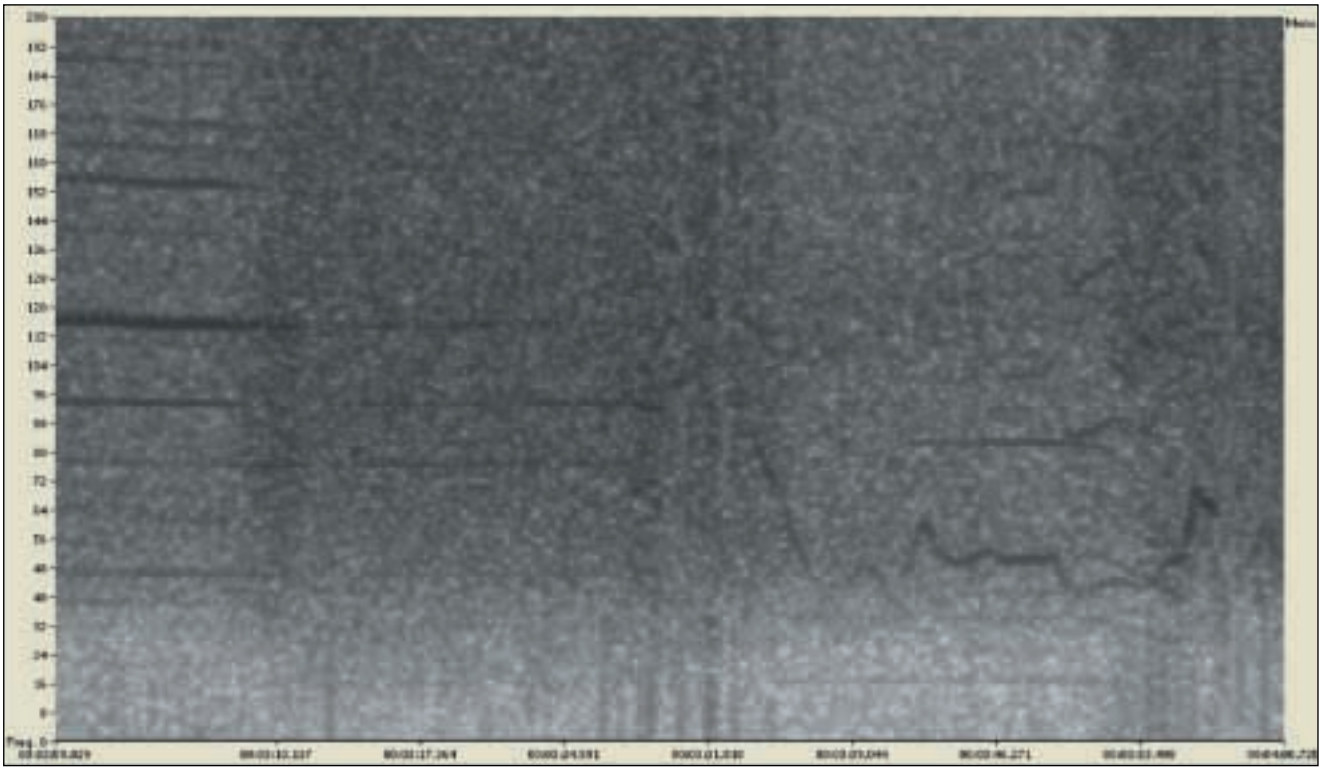
Three sections of the RH stabilizer found 0.5 miles from the landing site

Spar /fuselage attachment bolt, nut and washer.
Note long bolt and space between washer and housing.



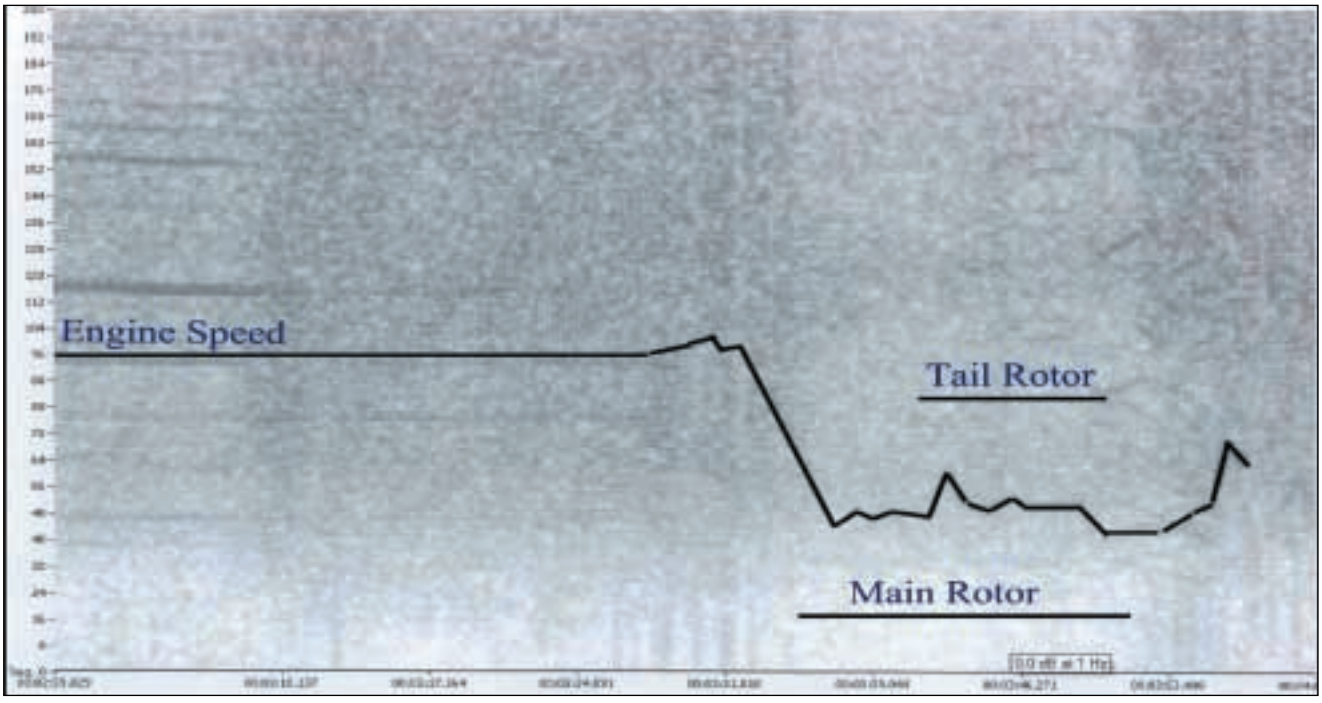
Tail rotor gearbox pitch change mechanism and control cables
as found separated from the tail boom at the helicopter landing site.

APPENDIX B



Frequency analysis of audio output from video camera onboard aircraft

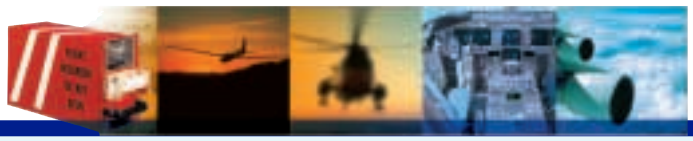
APPENDIX C



Sonogram of engine, main rotor and tail rotor speed

APPENDIX D

Final track of G-BBHE



AAIU Formal Report No: 2006-019

AAIU File No: 2005/0040

Published: 29 Sept 2006

Operator:	Private
Manufacturer:	Robinson
Model:	R44 Raven
Nationality:	Ireland
Registration:	EI-DOC
Location:	Nr Derrybrien, Co. Galway
Date/Time (UTC):	09 July 2005 @ 10.44 hrs

SYNOPSIS

The helicopter was on a Visual Flight Rules (VFR) flight from New Ross, Co. Wexford, to its base near Galway Airport. En route, it entered an area of rising terrain and low cloud base, near Derrybrien, Co Galway. Radar tracking indicates that the helicopter slowed down, and then made a sharp turn before disappearing off the screen. The helicopter then suffered an in-flight collision with terrain directly after the loss of radar contact. A passenger died at the scene and the pilot died later in hospital. Another passenger survived with serious injuries. The probable cause was the pilot's loss of spatial orientation resulting from inadequate visual reference with the ground due to limited visibility. The Report makes two Safety Recommendations.

NOTIFICATION

Shannon ATC notified the AAIU Duty Inspector of the accident at approximately 12.00 hrs UTC. The Inspector then proceeded to the site. In accordance with the provisions of S.I. 205 of 1997, the Chief Inspector of Air Accidents, on 10 July 2005, appointed the Duty Inspector, **Mr Graham Liddy**, as the Investigator-in-Charge (IIC) to conduct a Formal Investigation into this accident.

1. FACTUAL INFORMATION

1.1 History of the Flight

The pilot, accompanied by two friends, had flown the helicopter from its base near Galway Airport, to New Ross, Co Wexford, on the day prior to the accident. The purpose of the flight was to visit the start of the Tall Ships Race in Waterford on the morning of 9 July 2005. The helicopter landed in the grounds of a hotel at New Ross where it remained overnight. The pilot and his companions then proceeded to Wexford by ground transport. They returned to the helicopter by taxi about 09.30 hrs UTC on the morning of 9 July. At 09.52 hrs, the pilot phoned Waterford Airport ATC and requested permission to fly from New Ross to the Hook Head area, South Waterford, in order to view the start of the race from the air.

Waterford ATC refused to approve the flight plan due to poor visibility and low cloud in the Waterford ATC zone. The pilot then told ATC that he would be taking off shortly and heading west without entering the Waterford zone. A VFR flight plan was subsequently submitted giving a departure time from Waterford of 10.30 hrs and a flight time to Galway of 50 minutes, tracking direct at 2000 ft.

The helicopter took off almost immediately, and the pilot contacted Waterford Tower by radio at 09.59 hrs and stated that he *"was airborne, heading west for Galway at an altitude of not above 2000 ft"*. Waterford ATC passed a transponder code of 0235, which the pilot acknowledged. At 10.03 hrs, the pilot signed off with Waterford ATC and transferred to Shannon ATC on 127.50 kHz. He contacted Shannon ATC at 10.08 hrs, stating that he had departed Waterford about 10 minutes previously and was routing to Galway. Shannon advised him that there was no traffic to affect him. He was also instructed to squawk (use) the transponder code 0235, which the pilot acknowledged.

Shannon ATC called the helicopter again at 10.17 hrs, requesting an estimate for Galway. The pilot replied "50", indicating 10.50 hrs.

The helicopter was subsequently observed a number of times on Shannon Secondary Surveillance Radar (SSR), initially SE of Portumna, Co Galway. The radar did not record the altitude as the transponder was set in Alpha Mode (i.e. transponder was returning its identification code but not altitude when interrogated). Radar returns from the helicopter were intermittent in the Portumna area because of terrain masking.

At 10.40 hrs, the pilot called Shannon and reported abeam Woodford (which would locate the helicopter approximately 7 nm from the accident site) and that he was changing to the Galway frequency. Shannon acknowledged this call and sign-off. The pilot then called Galway ATC. There was no response from Galway, as the duty controller had left the tower for a brief break. The call was heard by another helicopter, EI-EMG, who called back EI-DOC, informing EI-DOC that the tower was *"off-air at the moment"* and passing a QNH of 1026 hPa, which EI-DOC acknowledged. At 10.42 hrs, EI-EMG called EI-DOC informing EI-DOC that it was routing in to the Airport and was over Galway City. EI-DOC acknowledged this call. This was the last communication from EI-DOC.

At approx 10.43 hrs, a witness located at the Derrybrien Wind-Farm site heard a helicopter pass in the near vicinity of the site, coming from the SE and then moving NE. He then heard a loud bang followed by silence. At 11.06 hrs, the Galway 999 service received a call from the pilot via a mobile phone, reporting a helicopter accident in the area of the Derrybrien Wind-Farm. The rescue services were alerted and Galway Airport was informed. This resulted in two helicopters from Galway proceeding to Derrybrien to search the area. One of these helicopters located the wreckage in dense forestry on the northern slopes of the Slieve Aughty Mountains, 1 nm NE of the summit. The pilot of this helicopter directed the emergency services, which had arrived in the area, to the accident site. The Coast Guard helicopter arrived on scene shortly afterwards and evacuated the three casualties to hospital in Galway City.

1.1.2 Witness Information

1.1.2.1 Witness A

The surviving front seat passenger did not initially have any recall of the accident sequence. However with the passage of time he was able to recall some details of the events leading to the accident. He stated that himself, the pilot and the other passenger had gone out for the evening after their arrival in the Waterford area the day before the accident. He and the other passenger had a few drinks but the pilot did not. They all retired to bed between 2 and 3 AM. The following morning, as they left Waterford, the weather was clear and the flight was uneventful. Suddenly the helicopter entered cloud. He stated that he had not noticed any clouds in front of them and he was unsure of how long they were in cloud before the crash. He went on to state: *"We seemed to hit something and I saw XXX (the pilot) struggling with the controls, I remember that we went chopping through trees before coming to an abrupt halt"*. At this point he became unconscious. He later regained consciousness but was in a confused state. He recalls asking the pilot what happened and he replied: *"What do you think happened?"*. He later stated that he did not know what the pilot meant by this remark.

1.1.2.2 Witness B

A witness at the Wind-Farm heard the helicopter flying over the site. There was nothing unusual about the noise of the helicopter but the witness said he was unable to see it due to poor visibility. As the noise of the helicopter started to fade in an easterly direction, it suddenly stopped and nothing more was heard. This witness was able to fix the time of the event accurately, as he had just received a call on his mobile phone and he was able to fix the time accurately by means of the phone's memory, which recorded the call at 11.40 hrs local (10.40 hrs UTC).

1.2 Injuries

1.2.1

Injuries	Crew	Passengers	Total in aircraft	Others
Fatal	1	1	2	Nil
Serious	0	1	1	
Minor	0	0	0	
None	0	0	0	
TOTAL	1	2	3	

1.2.2 Injuries To Persons

The passenger in the rear seat suffered major injuries in the accident, and did not respond to the revival efforts of the emergency services when they arrived at the accident scene.

The pilot had suffered internal injuries and underwent an operation in hospital the same day, in an effort to stem internal bleeding, but this was not successful and he died at 22.00 hrs that evening.

The front seat passenger suffered serious impact injuries that precluded the Investigation interviewing him after the accident. He had recovered sufficiently to be interviewed 18 days later.

1.2.3 All three persons in the helicopter were Irish Nationals.

1.3 Damage To Helicopter

1.3.1 The helicopter suffered significant damage when it initially struck the forest trees. It suffered further damage when it struck the ground and when its forward path was stopped by two trees. The helicopter was totally destroyed as a result of these impacts.

1.4 Other Damage

The helicopter damaged and destroyed approximately 30 trees in the forest. It was necessary to cut down a further area of forest, approximately 500 square metres, in order to recover the helicopter.

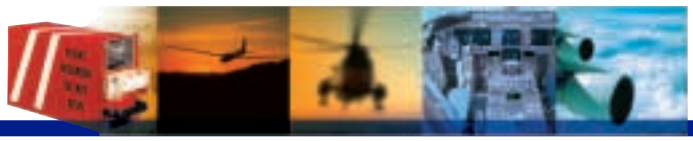
1.5 Personnel Information

1.5.1 Pilot

Personal Details: Male, aged 33 years

Licence: PPL(H) issued by US FAA Issued on 12 April 2005

Medical Certificate: Class 2 Issued 11 April 2005



Flying Experience:

Total all types:	123.3	hours
Total all type P1:	57.5	hours
Total on type:	31.2	hours
Total on type P1:	26.1	hours
Last 90 days:	13.3	hours
Last 24 days:	7.2	hours
Last 24 hours:	1.8	hours

1.5.2 The pilot obtained his Joint Airworthiness Authorities (JAA) PPL(H), issued by the Irish Aviation Authority (IAA) on 22 June 2004. The validity of his medical for this licence had expired on 20 May 2005. However, the pilot obtained his US FAA PPL (H) on 12 April 2005, and had successfully undergone a medical examination for this licence on 11 April 2005. Thus his FAA licence was valid at the time of the accident. The IAA has confirmed that this FAA licence was valid for flying EI-DOC in Ireland. The pilot also possessed a fixed-wing Student's Pilots Licence (SPL) and was in the process of obtaining a fixed–wing PPL, having applied to the IAA for a flight test on 4 May 2005.

1.6 Aircraft Information

1.6.1 Leading Particulars

Aircraft type:	R44 Raven
Manufacturer:	Robinson
Constructor's number:	1400
Year of manufacture:	2004
Certificate of registration:	Issued 3 Sept 2004
Certificate of airworthiness:	Valid to 2 Sept 2005, in aerial work category
Total airframe hours:	462
Engines:	1 x Lycoming O-540-F1B5
Maximum, authorised take-off weight:	2,400 lbs

1.6.2 General Information

The Robinson R44 is a single piston-engined light helicopter. In the case of EI-DOC, the engine was a carburetted six-cylinder Lycoming engine. The helicopter has four seats, two forward and two to the rear. The pilot sits in the forward RH seat. There is a provision to equip the forward LH seat with dual controls for instructional flights. The R44 Flight Manual specifies that these LH controls should be removed when the helicopter is engaged in non-instructional flying. The investigation found that the LH controls (cyclic and collective controls) had been removed from EI-DOC and were stored under the pilot's seat.

The Investigation estimates that the gross weight of the helicopter, on take-off from Galway the day before the accident, (at the start of this trip) was just below the maximum authorised take-off weight. It is further estimated that at the time of the accident the gross weight of the helicopter was approximately 2,200 lbs.

1.6.3 ATC Transponder

EI-DOC was equipped with an ATC transponder, with Mode C (altitude encoding) capability. Examination of the transponder selection showed that it was in the ON position but that Mode C was not selected. The selector is a rotating knob. The first position is ON and the next position, in a clockwise direction, is ON with Mode C selected.

1.6.4 Helicopter Maintenance

The helicopter was fitted with a Datcom Meter which records hours flown on the helicopter. The readings of this meter were used to manage the maintenance of the helicopter. The last inspection on the helicopter was a 50-hour inspection, which was carried out on 16 June 2005 at 410.8 airframe hours. The helicopter was due its next inspection, a 100-hour/Annual Inspection, at 460.8 airframe hours, or on 9 July 2005, whichever came first. The Technical Log (Tech Log) was recovered from the wreckage, and shows that the helicopter had departed from Galway with a Datcom reading of 460.8 hours.

The Tech Log also showed that that there were no recent defects on the helicopter and no maintenance items or defects were being carried forward or deferred at the time of the accident. The Tech Log also contained an Engineering Procedures Variation to Maintenance Periods, which extended the maintenance requirement by 5 hours to a total of 465.8 hours, in order to "align the Inspection with Annual Inspection". This variation was authorised and signed off by a licensed aircraft engineer on 8 July 2005. The Tech Log details for the flight to Waterford were filled in, prior to take-off from Galway.

1.6.5 Fuel

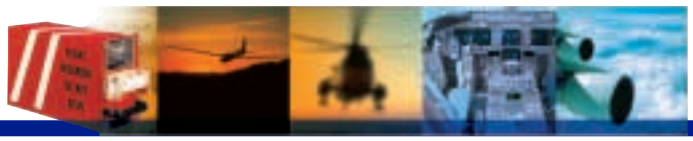
The R44 runs on 100 LL Avgas. Both fuel tanks, with a total capacity of 48 US gallons, were ruptured in the accident impact. A strong smell of fuel was detected at the accident site, indicating the presence of a significant amount of fuel. A small fuel sample was recovered from one tank. Assuming that the helicopter was full of fuel when it departed from Galway, the tanks would have been approximately half full, (approx 24 US gallons) at the time of the accident.

1.6.6 GPS

EI-DOC was equipped with a Bendix King Skymap IIIC GPS. The physical configuration of the display unit is that of a high-resolution 5-inch diagonal active matrix thin film transistor (TFT) liquid crystal display (LCD) screen.

The unit, which was mounted on top of the instrument panel, is sunlight readable with a wide viewing angle. The map display of this unit does not show the terrain contours. **APPENDIX A** shows a series of screen images from a Skymap IIIC display for the Derrybrien area, to give the reader an indication of the display provided by this unit. Elevated terrain is only shown as coarse polygons of varying colour. The rising terrain in the Derrybrien area is only indicated by a variation in the shade of green displayed. This unit suffered some damage in the accident. When subsequent tested, the memory of the unit was found to be blank.

The Manual for the Bendix King Skymap IIIC GPS contains caution regarding the use of this equipment. The Manual particularly cautions against the use of this unit for terrain clearance and stresses: *"it is intended as an aid to VFR navigation only"*. **APPENDIX B** contains relevant extracts from this Manual.



1.7 Meteorological Information

1.7.1 Met Éireann, the Irish Meteorological Service, provided the following information after the accident.

General Situation:	A complex low pressure system in eastern Greenland and a high pressure cell to the southwest of Ireland maintained a general west to northwest airflow over the region. A weak warm front extended down the east coast of Ireland, with a humid airmass over the general area of the accident.
Wind:	Surface: 280/320 03 kt. 2000ft: 330/07 kt
Weather:	BR/DZ (mist or drizzle)
Visibility:	5000m or greater
Cloud:	SCT005 BKN010 (AMSL) (scattered cloud cover (3-4 oktas) at 500 ft above sea level, and broken cloud (5-7 oktas) at 1,000 ft)
Temperature/Dew-Point:	17/16degC
MSL Pressure:	1027 hPa

The available information is that the weather was reasonable at New Ross, from where the return flight to Galway commenced, probably with a cloud base of around 1000 ft. The pilot contacted Waterford Airport, with the intention of flying from New Ross to the Waterford Estuary area in order to view the start of the Tall Ships race. Permission for this flight was refused by Waterford ATC, who stated that, because of poor weather conditions, they were operating Special VFR in the Waterford ATC zone, and only permitted one item of traffic into the zone at a time.

As there was already one helicopter operating within the zone, permission to enter the zone was not given to EI-DOC. In the transcript of Waterford ATC, the pilot appeared to be surprised that the weather was so poor in the Waterford zone, which would indicate that the weather was reasonable in New Ross (where the pilot was located at the time). The pilot also phoned another pilot in Galway, who informed him that the weather was reasonable in the Galway Airport area.

Another pilot who was flying due east of Galway Airport shortly before the accident, told the investigation the weather was reasonable in that area with a visibility of approximately 5 km, but that visibility did appear to be poorer in the area of the high ground SE of Galway Airport (i.e. the Derrybrien area).

Another pilot, who lives out on the Western slopes of the high ground in the Derrybrien area, had booked a helicopter in Galway, with the intention of flying on the morning of the accident. When he assessed the weather at his home location, especially the low cloud base and poor visibility, on the morning of the flight, he considered it to be unsuitable for flying and he cancelled the booking.

A number of witnesses working on the Wind-Farm project close to the accident site reported poor visibility and low cloud in the area at the time of the accident. While standing at one turbine, it was just possible to see the next turbine tower. These towers are spaced approx 225 metres (740 ft.) apart. The same witnesses reported that the tops of the turbine towers, which are 49 metres (approximately 160 ft) above ground level, were barely visible due to low cloud.

The meteorological definition of fog is where the visibility is less than 1000 metres.
The various classifications of fog are:

- Thin fog is a visibility between 1000 and 1500 metres
- Moderate fog is a visibility between 500 and 1000 metres
- Fog is a visibility between 200 and 500 metres
- Thick fog is a visibility between 50 and 200 metres
- Dense fog is a visibility less than 50 metres

1.8 Aids to Navigation

The only navigation equipment on the helicopter was a magnetic compass, a gyrocompass, an artificial horizon and the GPS unit already noted. Prior to crossing the River Shannon, the helicopter intermittently appeared on Shannon SSR. This intermittent return was caused by the helicopter being obscured by high ground between the helicopter and the radar transmitter. However, consistent returns were recorded after the helicopter crossed the east bank of the Shannon, until contact was finally lost. The radar plot for the final segment of the flight is shown in **APPENDIX C**. This Appendix also includes an aerial photograph of the Wind Farm area.

1.9 Communications

ATC Communications were not a factor in this accident

1.10 Aerodrome Information

EI-DOC was routing to a small heliport adjacent to Galway Airport. Galway Airport is not radar equipped.

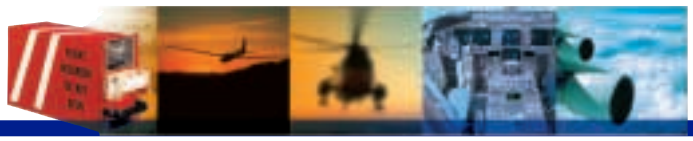
1.11 Flight Recorders

EI-DOC was not carrying any flight recorders. It was not required to carry such equipment.

1.12 Wreckage and Impact Information

The helicopter impacted on the northern slopes of the Slieve Aughty Mountains. The crest line of the high ground runs approximately E - W in this area. The helicopter had passed close to the summit, which is 1,174 ft (358 metres) above sea level. This figure does not include the height of the wind turbines located in this area. The helicopter impacted the trees of a dense plantation. At the impact point the terrain is approximately 1,000 ft (305 metres) above sea level, and the taller trees are approx 33 ft (10 metres) high. An aerial view of the accident site is shown in **APPENDIX D**.

The helicopter made initial contact with the trees on a heading of approx 080˚ at steep angle descent and possibly a high nose down angle. The main rotor blades made progressively heavier contact with the trees, initially with the light tops, but then with the thicker trunks of the trees as it came closer to the ground at this point of major impact. The undercarriage skids separated at this point and the tail rotor assembly departed. Both main rotor blades suffered major damage during this descent through the trees. One main blade spar remained intact, while suffering major distortion. The other blade spar failed approx 0.5 metres from the tip. The separated segment of this blade was not recovered, notwithstanding an extensive air and ground search. The forward momentum of the helicopter carried the fuselage through a tree. It then struck the ground and was brought to a stop as a result of impact with two more trees.



The tail boom was severed forward of the tail rotor gearbox. This was caused by main rotor blade contact with the boom, as evidenced by witness marks on the boom containing the yellow paint of the main rotor blade tips. The separated assembly, consisting of the end of the tail boom, the vertical and horizontal stabilisers, the tail rotor gear box and the tail rotor head and blades, landed in the forest very close to the point where the main rotor blades made initial contact with the tree tops.

Examination of the damaged carburettor heat (Carb Heat) valve on the engine showed that full carburettor heat was selected at some point prior to impact.

The engine driven cooling fan, mounted on the rear of the engine showed positive evidence of rotational damage, consistent with the fan and, consequently, the engine, rotating during the impact sequence. Examination of the engine's air inlet manifold showed considerable quantities of soil/peat, consistent with the soil at the accident site. Normally the ingestion of such debris is prevented by the engine air filter and associated ducting. The presence of such debris indicates that there was normal engine air suction in the manifold when the air intake system was disrupted by ground impact. Pine needles were found on the spark plug electrodes within the engine's cylinders. This evidence indicates that the engine was operating at normal RPM at the time of ground impact.

1.13 Medical and Pathological Information

Post Mortem examinations were conducted on the pilot and fatally injured passenger the day after the accident, at University College Hospital, Galway. The post mortem of the pilot showed that the cause of death was consistent with the numerous injuries he suffered in the accident. No pre-existing medical conditions, which could have had an adverse effect on the pilot's performance, were found. Toxicology tests did not find any traces of alcohol or drugs in the pilot's system. There was no evidence that physiological factors or incapacitation affected the performance of the pilot. The Post Mortem of the rear seat passenger showed the cause of death was due to respiratory failure, chest injuries and head injuries. No pre-existing medical conditions, which could have contributed to his death, were found.

1.14 Fire

There was no fire.

1.15 Survival Aspects

1.15.1 General

Given the speed of impact, the high deceleration caused by the final impact with tree trunks, and the light construction of the cabin of the helicopter, survival was unlikely. The compaction of the rear seat area, in particular, made survival in this area improbable.

The investigation noted that the seat belts were in use at the time of impact, and remained intact throughout the crash sequence. Emergency service personnel cut them, in order to free the occupants. The helicopter was not fitted with a crash-activated emergency locator transmitter (ELT). There is no requirement that it be fitted with this equipment.

1.15.2 Search and Rescue

The ground based emergency services responded quickly and arrived in the area in a timely manner. They were hampered in their efforts to locate the accident site by the absence of an accurate position fix, the mountainous terrain and the dense plantation. The latter made it impossible to see the helicopter until one was within a few metres of it. The Galway based helicopters also arrived quickly on the scene. As the first aerial asset to reach the area, one of them was able to locate the wreckage reasonably quickly. This helicopter then landed on the roadway about 100 metres from the accident site and the pilot gave location directions to the ground rescue services. The weather improvement, between the time of the accident and the arrival of this helicopter on scene, was critical in the location of the accident site. At this time, approximately 11.15 hrs, the cloud base was approx 1,500 ft above sea level or about 300 ft above the high ground.

The Coast Guard S61 helicopter arrived shortly after the accident site was located and took over aerial command of the scene. The S61 crew also assisted in the removal of the casualties from the wreckage and their removal to hospital in Galway City.

1.16 Tests and Research

1.16.1 A small sample of fuel was found in one of the ruptured fuel tanks. The sample was analysed and found to be uncontaminated AVGAS.

1.16.2 The Bendix GPS unit was found lying on the ground beside the helicopter. It had been forcibly ejected during the impact sequence and had suffered extensive damage to the screen display and some damage to the casing. Otherwise the unit was intact. However, on examination, the memory was found to be blank.

1.16.3 The fracture surface of the main rotor blade, where the unfound tip had broken off, was examined. The failure was found to be consistent with a single event overload and no evidence was found of pre-impact damage.

1.17 Organizational and Management Information

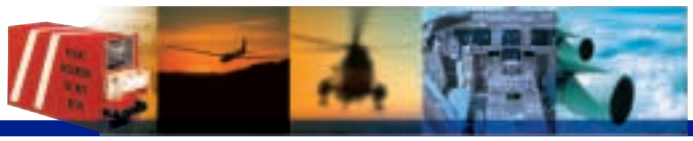
The helicopter was owned by a private company. The owners of this company made the helicopter available to a helicopter operator located at the heliport near Galway Airport. This operator used the helicopter for instructional and other aerial work activities. He also made the helicopter available to qualified pilots for personal flying purposes, such as the flight that is the subject of this Report.

1.18 Additional Information

1.18.1 Radar Plot

The plot of the Shannon SSR shows that the helicopter maintained a steady track of 308° from the time it first showed on Shannon Radar, until it reached the Derrybrien area. The speed was steady at just above 100 kts ground speed. This track took the helicopter over varying, and frequently featureless terrain.

The track did not follow any ground feature, such as a road, railway, river, etc. The terrain for the final 15 nm of the flight was particularly featureless. During this phase the helicopter crossed only one road of any significance, and this road ran at approx. 45° to the flight track.



The final sections of the radar plot are shown in **APPENDIX C**. This shows an initial track change to 295˚ followed by a speed reduction to 30 kts and somewhat erratic track, followed by a northerly track, then another turn back to the track of 307˚ and an increase of speed up to 95 kts. The track then veered to a northerly heading, followed by a sharp right turn of nearly 180˚ and a rapid reduction of ground speed to 16 kts. The helicopter then turned left onto a track of 100˚ and ground speed increased to 62 kts before contact was lost. While viewing **APPENDIX C**, the reader's attention is drawn to the note in that appendix concerning the lack of accuracy in the geo-referencing of this plot with respect to the position of the wind turbines.

1.18.2 Missing Item

The outer section of one main blade was not found. This piece is approx 0.5 m long, and contains the blade spar and tip balance weights.

1.18.3 The Wind-Farm

The Derrybrien Wind-Farm project consists of 71 wind turbines located around the summit of the Slieve Aughty Mountains. The turbines are located in a grid pattern. The spacing between the turbines is not constant but varies from 200 to 250 metres apart. They are laid out is a roughly rectangular pattern, as shown in **APPENDIX C**. The area of the Wind-Farm, as measured in the direction of flight of EI-DOC, is 3.2 km wide and 1.4 km deep. Each wind turbine consists of a substantial tower 50 meters high. At the top of this tower, the actual turbine is mounted. The turbine consists of a 3-blade rotor, 52 meters in diameter. Consequently the maximum height reached by the blades is 76 metres above ground level. At the time of the accident virtually all the towers had been erected and half of them were fitted with the blade assemblies.

Inspection of the turbine towers and blades of the Wind-Farm, after the accident, did not show any sign of contact damage, such as would be produced if they were struck by a helicopter.

1.18.4 Rules of the Air

The Irish Aviation Authority (Rules of the Air) Order, 2004 (S.I. No 72 of 2004), in Part III (Visual Flight Rules), Section 34, lays down the general rules for VFR flight. Subsection (2) deals with helicopter operations and states: *If the aircraft is a helicopter operating in class F or G airspace (the accident occurred in class G airspace) it may, unless otherwise prescribed, be flown below 300 metres (1,000 ft), but not below 150 metres (500 ft), above terrain or water in a flight visibility of not less than 1,000 metres, or such lesser visibility as may be prescribed by the Authority, and in such case shall remain clear of cloud and in sight of the surface and shall be manoeuvred at a speed which would give the pilot-in-command adequate opportunity to observe other traffic or any obstruction in good time to avoid collision."*

1.18.5 Mobile Phone Coverage

The Investigation noted that mobile phone coverage provided by some networks was extremely problematical in the area of the accident.

1.18.6 Use of GPS

The IAA has issued Aeronautical Notice NR O.22 (Issue 2 dated 02.10.03) that gives guidance on the use of GPS. However, this guidance is mostly of a legal nature, and gives little advice on the practical issues, and dangers of using GPS in a low level VFR environment. In particular, there is no reference to the pitfalls of an over-reliance on GPS in deteriorating weather conditions.

1.18.7 NTSB Study

In the United States, the NTSB has conducted a safety study titled "Risk Factors Associated with Weather-Related General Aviation Accidents". This study can be found at http://www.ntsb.gov/publictn/2005/ss0501.pdf. The findings on page 47 of this study are noteworthy.

1.18.8 Irish Fatal Accidents in 2005

There were three fatal accidents in Ireland in 2005. In all these accidents, weather was a significant factor, and they occurred in the summer or early autumn (one in July and two in September). It is also noted that all three accidents occurred on the return leg of multi-day trips. It has been confirmed that the aircraft were GPS-equipped in two of these accidents.

1.19 Useful or Effective Investigation Techniques

Nil

2. ANALYSIS

2.1 Examination of the helicopter shows no indications of pre-impact damage or malfunction. The aircraft documentation indicates that the helicopter was serviceable when it departed from Galway

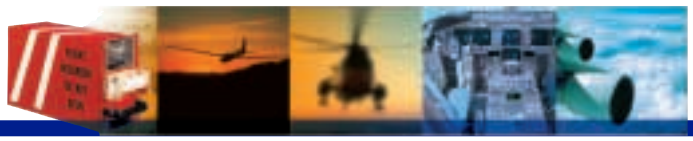
2.2 The evidence of rotation at impact on engine components, and the presence of tree debris inside the engine cylinders, indicates that the engine was run at a normal power setting at the point of impact with the trees. The presence of soil in the intake manifold indicates that the engine was still rotating at ground impact.

There was no evidence of the helicopter having struck any obstacle prior to the final impact with the trees at the accident site. In particular, any contact of the helicopter's main rotor blades and the wind turbines would have caused the helicopter to crash before it could have reached the actual accident site.

2.4 The failure to locate the missing tip section of one main rotor blade is not seen as significant. This blade had suffered significantly more disruption than the other blade, indicating that it made the initial heavy contact with the trees, and probably with the tail boom, and therefore suffered heavier damage than the other blade. This caused the tip to fail, and to be flung away due to the high centrifugal forces acting on it. Previous experience has shown that the helicopter blade tip elements can be found up to 500 metres from hard impact accident sites. Given the large possible area, the dense forestry and the fact that much of the forest floor was covered with impenetrable peat-stained water up to 0.5 m deep, the probability of finding the tip was low. Calculations showed that if 0.5 metres of tip departed in flight the ensuing imbalance would have been of the order of 6 tonnes. Such imbalance would have caused the main gearbox to immediately depart the airframe in flight. This did not occur, which indicates that the blade tip was present when initial tree contact was made.

2.5 The fact that the helicopter maintained a constant track, even over featureless terrain, particularly in conditions of rising ground, declining visibility and increasing cloud cover, indicates that the pilot was probably following a GPS-derived course.

2.6 Approximately 12 nm before the accident site, the helicopter crossed a significant road, the R352. Had the pilot followed this road north, and then the R351 (the Woodford/Loughrea road), the helicopter would have flown to Loughrea, and hence to Galway by the N6. This route would have avoided high ground and would have increased the flight distance by approx 10 nm.



2.7 The reports of various witnesses indicated that the cloud was sitting on the high ground in the Derrybrien area at the time of the accident and that visibility was poor. Because of the NW airflow, the cloud base on the north facing slopes of the high ground would probably have been lower than that on the south slopes. Thus, if the helicopter maintained constant altitude as it passed over the crest of the high ground, it would have encountered conditions of further reduced visibility, which may have obscured the pilot's view of the ground, as it flew over the descending slope on the north side of the mountain.

2.8 The evidence of the radar plot showed that the helicopter slowed down and started to alter course just as it approached the Wind-Farm. The plotted track goes through the Wind-Farm with significant track and speed changes. This would indicate that the pilot saw the wind turbines and manoeuvred his way through the turbines at reduced speed. Having passed through the turbines and the crest of the high ground, the ground fell away underneath, and the helicopter had now entered the area of the northern slopes and the associated lower cloud level. At this point the pilot probably would have had little or no visible contact with the ground. In such circumstances, the loss of spatial awareness can be expected. The final right turn to the east that the helicopter performed prior to impact, which has no obvious explanation, may well be indicative of spatial disorientation, which quickly led to an unintentional loss of height and consequent contact with the trees at the accident site. In this regard it is noted that this turn was immediately after a sharp right turn of 180˚. Sharp turns in conditions of poor/no horizon reference are a frequent cause of spatial disorientation.

It should be noted that the radar plot speed is only the horizontal ground speed component of the helicopter's total speed vector. If the final descent rate was high, which was probably the case, then the airspeed in the final moments of the flight would have been significantly more than the 62 kts plotted ground speed. This is consistent with the damage suffered by the helicopter.

2.9 The fact that carburettor heat was selected to full ON at some stage prior to the accident indicates that the pilot was concerned that the ambient conditions were conducive to the formation of carburettor icing. The ambient temperature of 17˚ C would not normally warrant the use of carburettor heat, while operating at cruise power in dry, clear air. Furthermore, because the selection of full carburettor heat has an adverse effect on fuel consumption and available power, and can lead to "coking" of the spark plugs and cylinders, a pilot would not select full carburettor heating for long periods as a matter of precautionary routine. The forgoing indicates that prior to the accident, the pilot was concerned with the humidity/moisture levels in the area. Poor visibility, precipitation or proximity to fog or cloud would cause such concern.

2.10 The Rules of the Air show that the helicopter, while flying VFR in the area of the accident site, was required to fly at least 500 ft above ground, clear of cloud and in a minimum flight visibility of 1000 metres. The evidence of witnesses on the Wind-Farm at the time of the accident indicated cloud was approximately 160 ft above ground level and that the horizontal visibility was of the order of approximately 225 metres. Therefore the helicopter was operating well below the required minimum visibility conditions at the time of the accident.

2.11 The en-route weather conditions for this trip were sufficient to maintain VFR, except in the Derrybrien area where local conditions were demonstrably poor. In order to maintain VFR, the pilot had the option, as noted in para 2.6 above, to avoid the high ground on his direct track in the Derrybrien area and to route more northerly and follow relatively lower ground and well-defined geographic features. This is a judgement call which frequently has to be made by pilots and is based, to a large extent, on previous flying experience.

2.12 The pilot had a total of 123 hrs flying experience of which 26 hrs were as PIC on type. In aviation terms the pilot was not experienced. Generally the en-route weather was within VFR limits. However the weather, in terms of visibility and the height of cloud base above ground, deteriorated significantly and progressively as the helicopter approached the high ground in the Derrybrien area. This high ground resulted in the helicopter flying at an increased elevation, where visibility reduced significantly. With the comfort of GPS-derived heading information for Galway, the pilot elected to continue in weather that was below VFR limits. The likelihood is that the pilot, while manoeuvring in poor visibility, inadvertently entered Instrument Meteorological Conditions (IMC), where control was lost and the helicopter impacted the ground.

2.13 The Investigation notes that a reduction of speed by a helicopter in misty, damp or raining conditions has the consequential effect of reducing the clearance of water droplets or rain off the windscreen. This is caused by the reduced speed of the airflow over the windscreen. Furthermore the speed reduction can cause a build-up of mist on the inside of the windscreen, due to a reduction of the ram air effect through the windscreen demisting vents. Thus, when declining external visibility dictates a speed reduction, the pilot's visibility through the windscreen is further reduced by these effects. This is particularly a problem on helicopters that are not fitted with windscreen wipers, such as the R44.

2.14 The helicopter was due its next maintenance check on the day of the accident, or, (including the authorised extension) at 465.8 hrs, whichever came first. Given the Hobbs meter reading of 462.7 hrs at impact, and because the helicopter would have been expected to land in Galway within 15 minutes additional flying, the flight would, in normal circumstances, have been completed before the 100 hr/Annual Inspection was due.

2.15 Given the absence of an ELT on the helicopter, the poor mobile phone coverage of some networks in the accident area, and the remoteness of the accident area, it was fortunate that the pilot was able to contact the emergency services. It is an unfortunate fact that terrain collision accidents are more likely to occur in remote mountainous countryside where mobile phone coverage is more likely to be poor. While there is no legal requirement to fit an ELT, the potential benefits of such equipment is demonstrated by this accident.

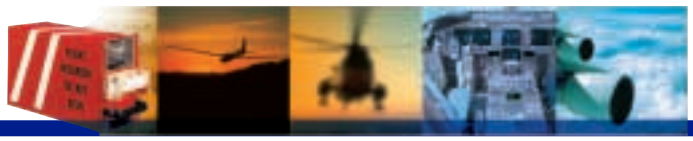
2.16 If the pilot had not been able to raise the alarm, the alarm would have been raised when the helicopter was ½ hr. overdue at Galway, i.e. at approx 11.20 hours UTC.

2.17 The inability to contact Galway ATC was not a factor in this accident. The pilot's call to the emergency services initiated the rescue response before the overdue limit was reached.

2.18 A prompt reaction to the pilot's phone call resulted in a timely response by the Galway based helicopters, and the emergency services, including the Coast Guard helicopter.

2.19 The absence of retained memory data in the GPS unit deprived the Investigation of a valuable source of information with regard to the operation of this flight. A possible cause of the absence of such data was that the memory unit was never initialised.

2.20 There were two fatal air accidents within Ireland in 2005, and another flight, which took off from Ireland, crashed into the Irish Sea, in UK airspace. A total of six people were fatally injured in these accidents. The Investigation notes that continued flight into bad weather was a common and significant factor in all three accidents. Furthermore, at least two of the aircraft were carrying GPS at the time of the accident.



2.21 This accident, and the other two fatal accidents that occurred/originated in Ireland in 2005, indicate factors which show significant correlation with the findings of the NTSB study, noted in para 1.18.7 above, particularly with regard to pilots' age at qualification.

2.22 In this accident, and other fatal accidents that occurred/originated in Ireland in 2005, adverse weather was a factor. It is also noteworthy that all three accidents occurred on the return leg of a multi-day trip.

3. CONCLUSIONS

3.1 Findings

1. The helicopter was fully operational prior to impact with the trees in the plantation.

2. The pilot continued the flight into an area of featureless rising terrain, probably navigating by GPS, where there was a significant deterioration of visibility.

3. Approaching the site of the accident, the pilot continued to fly into conditions of visibility significantly below the minima laid down in the Rules of the Air for VFR flight.

4. The pilot probably lost ground reference in the final stages of the flight and became spatially disorientated. This resulted in unintentional loss of height and ultimately to in-flight collision with terrain.

5. The probability of surviving the accident was low.

6. The pilot elected to follow a direct course, probably using GPS, to his destination, over higher ground, in reducing visibility. An alternative low-level route, to the north, was available.

7. Some significant factors in this accident, and other recent fatal accidents, are consistent with the findings of an NTSB study into the causes of General Aviation weather related accidents.

3.2 Causes

The pilot entered conditions of poor visibility/cloud that probably led to spatial disorientation. This resulted in loss of control and, ultimately, in-flight collision with terrain.

3.3 Contributory Factors

The pilot's decision to continue the flight along a GPS derived track, over rising terrain, in conditions of reducing visibility, which were significantly below VFR minima.

4. SAFETY RECOMMENDATIONS

1. The IAA should revise Aeronautical Notice NR O.22 to give guidance on the practical use of GPS in low-level VFR operations, with particular emphasis on the pitfalls arising from an over-reliance on this equipment in conditions of declining visibility. This guidance material should also stress that pilots of General Aviation aircraft, equipped with GPS systems, should ensure that the tracking facility memory function is initialised. **(SR 7 of 2006)**

2. The IAA should review the NTSB study into General Aviation Weather Related Accidents to determine if a programme of possible action can be initiated to reduce such accidents. **(SR 8 of 2006)**

APPENDIX A

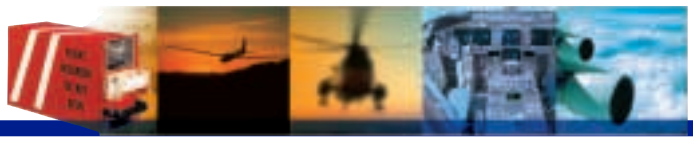
The following images are digital pictures taken of a Skymap III display. The images were taken in a Bell 206 inside an aircraft hangar and hence a "NO FIX POSSIBLE" message was displayed in the centre screen. The two images were taken at varying range settings and show the Derrybrien area. It was not possible to determine what range setting was selected in EI-DOC at the time of the accident due to the damage suffered by the unit. The images are shown here at approximately full size and the display in EI-DOC was located approximately 60 cm (arm's length) from the pilot's eyes.

Image 1

This image was taken at an 8nm setting (ref lower left of display). This setting is probably the maximum range setting that the pilot would have used. The high ground in the general Derrybrien area is shown by the light green area surrounding Derrybrien. The summit area is shown by the darker green rectangle immediately north of Derrybrien. The accident site is approximately in the centre of this darker green rectangle. It may be noted that none of the local roads in the area are displayed. The two "rivers" shown (blue) starting near the summit area are, in fact, just mountain streams and are virtually invisible from the air in this area. The pink lines are the boundaries of Air Traffic Control areas.

Image 2

This image again shows the Derrybrien area, but at a range setting of 2nm. This setting is probably the minimum range setting that the pilot would have used. The accident site is just above the centre of "NO FIX POSSIBLE" message. Again the lack of local terrain features in the display is noticeable.



APPENDIX B

Extract from Manual for Bendix King Sky Map III Global Positioning System

Warnings

The Global Positioning System (GPS) satellite constellation is operated by the Department of Defence (DoD) of the United States, which is solely responsible for its accuracy and maintenance. Although declared fully operational on July 17th 1995, the system is still under development and subject to changes, which could affect the accuracy and performance of all GPS equipment.

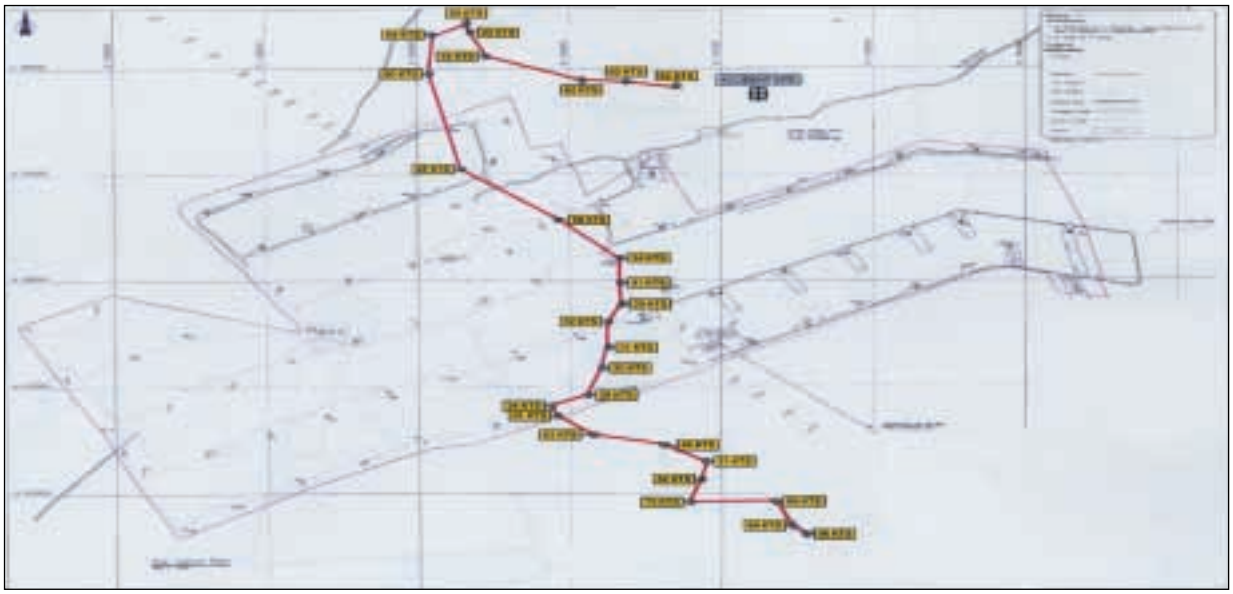
Use this equipment at your own risk. Your new Bendix/King equipment is a precision navigation aid but like any navigation aid it can be misused or misinterpreted and so become unsafe. You are strongly advised to read and fully understand this Manual before using it. Your unit has a DEMO MODE or simulation facility that allows you to practice with it before you begin using it for actual navigation.

Whenever you are using the unit for navigation in the air you should treat it as a **supplemental navigation system**. You should always carefully compare indications from your Bendix/King equipment with the information available from all other navigation sources including NDB's, VOR's, DME's, visual sightings, charts, etc. For safety, any discrepancies observed should be resolved immediately.

The altitude calculated by GPS equipment is geometric height above a theoretical mean sea level of a mathematically calculated ellipsoid that approximates to the shape of the earth. This altitude can differ significantly from that displayed by your pressure altimeter. You must therefore **NEVER USE GPS ALTITUDE FOR VERTICAL NAVIGATION OR TERRAIN CLEARANCE**.

This equipment is not a replacement for your chart. It is intended as an **aid to VFR navigation only**. The database within the equipment has been compiled from the latest official information available, and although every care has been taken in the compilation, the manufacturers will not be held responsible for any inaccuracy or omissions therein.

APPENDIX C



This map shows an overlay of the Shannon radar record onto a site-map of the Derrybrien Wind-Farm project, which includes the accident site. The speeds shown are the instantaneous speeds calculated by the radar at the points in question. While the shape of the plot is reasonably accurate, the plot can't be accurately geo-referenced onto the map, due to the (relatively) poor resolution of the radar. The placement of the plot was achieved by estimating the probable vertical flight path from the last recorder point (at 62 kts ground-speed) to the accident site. Between these two points the radar was unable to detect the helicopter, because it had descended below the crest of the high ground between itself and the radar transmitter. Because of the foregoing, no inference should be drawn as to the proximity of the flight path to any of the turbine towers of the Wind-Farm.

This aerial photo of the Derrybrien Wind Farm was taken some time after the accident, when construction of the farm was complete. The flight path of EI-DOC was from left to right.

APPENDIX D

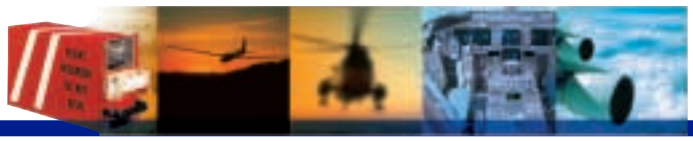
Aerial Photo of Accident Site

Note: the white line streaming back from the helicopter is a survey tape being used by the Investigation.

AAIU Synoptic Report No: 2006-022
AAIU File No: 2005/0062
Published: 9/10/06

In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on 4/10/05, appointed Mr John Hughes as the Investigator-in-Charge to carry out a Field Investigation into this Accident and prepare a Synoptic Report.

Aircraft Type and Registration:	Piper Pacer PA 20/22, G-APYI
No. and Type of Engines:	1 x Lycoming O-290-D2
Aircraft Serial Number:	22-2218
Year of Manufacture:	1954
Date and Time (UTC):	21 August 2005 @ 17.45 hrs
Location:	Ballyboy, Athboy, Co.Meath
Type of Flight:	Ferry Flight
Persons on Board:	Crew - 1 Passengers - Nil
Injuries:	Crew - Nil Passengers - Nil
Nature of Damage:	Propeller tip damage, starboard main wheel spat and damage to wing surfaces
Commander's Licence:	Commercial Pilots Licence
Commander's Details:	Male, aged 50 years
Commander's Flying Experience:	2,000 hours of which 500 were on type (tail dragger)
Information Source:	AAIU accident report form submitted by Pilot.



SYNOPSIS

The tail wheeled aircraft took off from a private airfield in Navan for a ferry flight to a neighbouring airfield at Athboy, a few miles distant. On climb out, the pilot attempted to correct a tendency to swing left with application of right rudder. However, even full right rudder input failed to fully correct this tendency. On landing at Athboy a crosswind weathercocked the aircraft to the left and with insufficient right rudder available to the pilot, the aircraft impacted a ditch and came to rest. Subsequent investigation showed considerable play between the right pedal bolt and its attachment to the torque tube.

1. FACTUAL INFORMATION

1.1 History of the Flight

The pilot agreed to ferry the aircraft from his private airfield in Navan to a neighbouring airfield in Athboy owned by the owner of the aircraft. He started the aircraft and initiated a 90˚ ground turn to the right in order to backtrack up RWY 27 for departure. The pilot said that the aircraft controls were functioning properly and in the correct sense at this stage. Another 180˚ turn to the right was executed at the runway threshold prior to take-off. On application of full power during take off, a tendency to swing left was corrected using right rudder.

The pilot said that further right rudder was applied in the climb out and at 500ft QNH he retracted the flaps. He then noticed that his right foot was more forward than was normal in the climb and that the rudder ball was indicating that insufficient right rudder was being applied. His foot came to the end of right rudder pedal travel but the aircraft was still yawing to the left.

For a number of reasons the pilot decided to continue the flight and to land at Ballyboy rather than return to his own airfield. He made his approach to RWY 29, went over its threshold at about 50 mph and touched on at low speed. He was some distance up the runway when a small crosswind from the left weathercocked the aircraft towards a wire fence in spite of right rudder input by the pilot. The aircraft went through the fence, finally coming to rest with the left wing in a hedge, which ran perpendicular to the runway. He shut down the engine and completed the aircraft shut down checks before exiting the aircraft uninjured in the normal way. Later he examined the rudder pedals with the owner of the aircraft and stated that movement of the pedals was not being impeded.

1.2 Damage to the Aircraft

Damage was done to the starboard wheel spat, the underside of that wing and the top surface fabric and leading edge of the port wing. Both propeller blade tips were found deflected forward and the spinner back plate had two areas of damage. The port front wing strut was also damaged, as was the front tube of the undercarriage. The aircraft outer fabric was damaged in numerous places necessitating repair. The engine will require removal for shock loading test.

1.3 Aircraft Information

1.3.1 History

This aircraft was originally manufactured as a Piper PA-22-135, called a Tri-Pacer. It had a nose wheel and nose-wheel/rudder ground steering system. The Tri-Pacer was a special version of the original Piper PA-20 Pacer, which had a 135 HP engine and a full swivelling tail-wheel. The control system of the Tri-Pacer differs from that of the Pacer in that the rudder pedals are connected directly to the nose wheel for ground steering instead of to the tail, and the aileron cables are connected with the rudder cables to provide automatically coordinated aileron and rudder controls for simplified handling in the air.

The aircraft did not fly between 1986 and April 1990 and during that time the aircraft was converted back to a tail wheel configuration using an approved kit under Supplemental Type Certificate (STC) SA45RM. As part of the STC the left side pilots pedal and brake system were also modified. The aircraft has a total of 3011 hrs flying time.

The Certificate of Registration was issued in February 1995 and the Certificate of Airworthiness in May 2004. The stall speed of this aircraft with flaps out (dirty) is 42 kts (48 mph) and the landing roll is 650 ft.

1.3.2 Aircraft Servicing

An Annual Check was completed on 29/4/05 when the aircraft had a total of 3010.45 hrs flight time. The check was completed satisfactorily in accordance with Maintenance Schedule CAA/LAMS/A/1999 issue 1, and its worksheets signed by the aircraft inspector. Although task 89 – *"Control cables for correct tension. Control neutrals and travels"* was signed for the results of the check were not actually recorded on the worksheet.

1.4 Aircraft Inspection

1.4.1 Inspection by Aircraft Inspector

Following the incident, the Aircraft Inspector who had completed the Annual Check in April 2005 carried out a full and thorough examination of the aircraft. In his report he stated that when he examined the aircraft he found the separated components of the fire extinguisher lying on the cabin floor on the co-pilots side. He also had removed the bolt from the pilots right hand rudder pedal to investigate the movement between the pedal and the rudder bar. He removed all parts of the fire extinguisher from the aircraft.

1.4.2 Inspection by the Investigation.

The aircraft was inspected by the Investigation in the owner's hangar following the incident. It was found that the pilot's right pedal did not give full and free movement of the rudder cable or rudder. However, a check of the co-pilot's right seat pedal system gave an adequate deflection of the rudder.

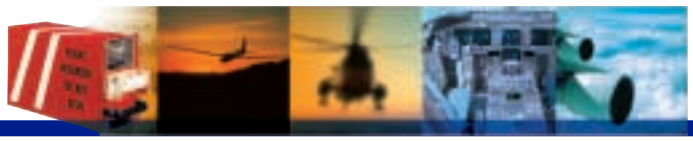
The Investigation found that the bolt and nut fixing the pilots right pedal to the rudder bar had been removed and left on the floor of the cockpit. This bolt (AN4-13A) was re-installed in the pedal system.

Further investigation revealed that although the bolt was of the correct size, the hole into which it fitted in the torque tube had become elongated and oversize, resulting in considerable play in the pilots right rudder pedal system.

The aircraft fire extinguisher was not in situ in the footwell but was found on a nearby bench. It was fully discharged with its Bakelite head broken in half and separated from the body. There was a considerable amount of corrosion between the aluminium bottle and the Bakelite head. Some of the same corrosive substance was also noted on the cockpit carpet where the bottle would normally be installed by a clasp.

1.5 Operator Statement

The owner stated that, to the best of his knowledge, the fire extinguisher was in its mounting bracket after the incident. The pilot confirmed that the extinguisher had not been located in the footwell at the end of his flight.



2. ANALYSIS

Pilot pre-flight checks prior to the first flight of the day would ensure that all loose equipment is correctly stowed and that the aircraft is free of all extraneous items. Examination of the clasp following the incident would indicate that it was serviceable at the time of flight. If the 10" extinguisher bottle was loose on the floor of the cockpit, it is possible that it might roll forward but it would then have to roll over the rudder bar between the pedals, which are 5.5" apart, and lodge behind the co-pilots RH pedal.

However, both the pilot and the owner confirm that the fire extinguisher was not in the footwell after the incident. The owner also confirmed that the fire extinguisher was in its proper place after the incident. It is also possible that the extinguisher was inadvertently broken and removed from its clasp sometime after the incident and prior to the Aircraft Inspectors visit.

The aircraft is over 50 years old. Whilst other bolts and nuts were replaced due to service wear there is no record of any work being carried out on the pedal system apart from the conversion in 1989. The original manufacturers bolt type and torque tube were retained.

It is of interest to note that in 1992 the FAA issued approval for modification kits STC SA8334SW and STC SA45RM, both to include dual brake system, new linkages and new torque tubes. This would have been a better option than the modification carried out previously. Due to the time gap between the incident date, the aircraft inspectors visit and the commencement of the Investigation it is not possible to ascertain with certainty the reason for the deterioration in play between the pedal bolt and the torque tube.

3. CONCLUSIONS

(a) Findings

On landing the Pilot had insufficient right rudder available to keep the aircraft on the runway.

(b) Cause

There was excessive play between the pilot's right pedal and the torque tube due to elongation of the bolthole in the tube.

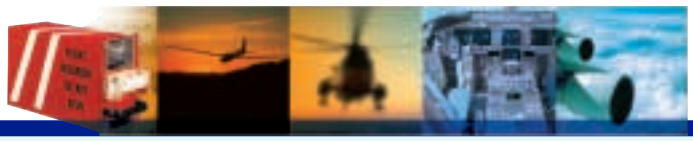
4. SAFETY RECOMMENDATIONS

This Report does not sustain any Safety Recommendations.

APPENDIX A

A view of the pilot's RH pedal showing the elongated hole with the bolt removed

- END -



AAIU Formal Report No: 2006-023

AAIU File No: 2005/0060

Published: 12/10/2006

Operator:	Private
Manufacturer:	Avions Robin
Model:	Jodel DR 250 - 160
Nationality:	Belgian
Registration:	OO-TYP
Location:	Lydican, Oranmore, Galway, Ireland
Date/Time:	19 September 2005 @ approximately 12.38 hrs (Local Time)

SYNOPSIS

Approximately 5 minutes after OO-TYP took-off from Galway Airport, for a VFR[3] flight to Saint-Ghislan, in Belgium, a member of the public reported to An Garda Síochána (Irish Police Force) that an aircraft had crashed in the Galway Cricket Grounds at Lydican, Oranmore, Galway. The aircraft was later identified as OO-TYP. The aircraft's two occupants, Belgian Nationals, suffered fatal injuries.

Eyewitness reports, and analysis of the wreckage distribution, determined that the aircraft had spun out of cloud with a significant portion of its starboard wing missing.

The Investigation concluded that a possible attempted recovery manoeuvre by the Pilot, following loss of control due to disorientation from an intentional or inadvertent flight in Instrument Meteorological Conditions (IMC)[4], sufficient to overload the wing structure, was most likely the cause of the wing failure. Once the wing section had separated from the main body of the aircraft, the aircraft was unflyable and it spun to earth.

NOTIFICATION

At approximately 13.00 hrs (Local), the Station Manager, Shannon Air Traffic Control (ATC), reported to the AAIU that an aircraft (OO-TYP) had crashed near Oranmore, Galway. An AAIU go-team, consisting of Jurgen Whyte and Graham Liddy, Inspectors of Air Accidents, arrived at the accident site at approximately 16.00 hrs and commenced the Investigation.

In accordance with the provisions of S.I. 205 of 1997, the Chief Inspector of Air Accidents, on 19 September 2005, appointed **Mr Jurgen Whyte** as the Investigator-in-Charge (IIC) to conduct a Formal Investigation into this occurrence.

As the aircraft was registered in Belgium and both persons onboard were Belgian Nationals, the Belgian Air Accident Investigation Authority, Bureau Enquêtes – Accidents (BEA) appointed Mr Richard Taverniers, Chief Inspector of Air Accidents, as an Accredited Representative to the Irish Investigation, in compliance with the provisions of the International Civil Aviation Organisation (ICAO), Annex 13.

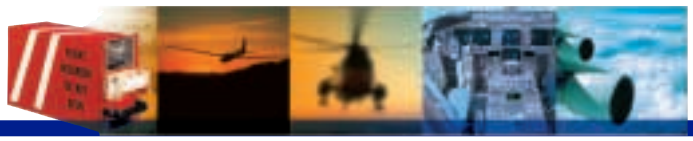
1. FACTUAL INFORMATION

1.1 Background

On the 17 September 2005, OO-TYP took-off from Saint-Ghislan (EBSG), in Belgium, at 12.15 hrs with 2 persons onboard for a VFR flight to Galway (EICM). At approximately 12.40 hrs OO-TYP landed back on at EBSG. Information from the airport staff at EBSG, indicated that this return was due to a malfunction of the Global Positioning System (GPS) which was carried onboard OO-TYP. A re-connection of the antenna cable resolved the problem.

3 VFR flight. Flight conducted in accordance with the Visual Flight Rules (APPENDIX A).

4 (IMC) Instrument Meteorological Conditions expressed in terms of visibility, the distance from clouds, and the ceiling, less than the minimums specified for visual meteorological conditions.



The Pilot refuelled[5] the aircraft, reactivated the original flight plan and departed again from EBSG at approximately 13.58 hrs for EICM. The flight plan estimated elapse time (EET) was 4 hrs 30 min with endurance filed as 5 hrs 30 min. There was nothing to suggest that the en-route segment of the flight was anything other than uneventful. At 18.35 hrs, OO-TYP first reported on Galway Tower frequency that he was approaching overhead. While a flight plan had been filed with Shannon ATC, the flight plan details had not been forwarded by Shannon to EICM. In addition, while EICM is classified as a Prior Permission Required (PPR)[6] airfield, no prior permission was sought by the Pilot of OO-TYP. As a result, OO-TYP's arrival over EICM was unexpected.

A review of the full EICM ATC Transcript for the 17 September 2005 revealed that OO-TYP did not respond correctly to ATC instructions with regard to downwind positioning and runway in use. ATC assisted OO-TYP to position for the correct runway, diverting other traffic in the process. At 18.41 hrs OO-TYP reported to ATC, *"O-YP I need to land, short of fuel."* ATC replied, *"O-YP Runway 26 in use, are you requesting priority landing."* No response was forthcoming from OO-TYP. At 18.43 hrs OO-TYP reported, *"Galway Tower, Runway 26, finals O-YP."* OO-TYP was clear to land RWY 26 and was recorded landing at 18.45 hrs. Further difficulties were experienced by OO-TYP in following ATC instructions to the parking area. Eventually, OO-TYP was told by ATC to hold his position and the aircraft was then ground marshalled to the correct parking stand. On shutdown, the Pilot of OO-TYP was requested to report to the Control Tower. When challenged by the Tower Controller, re his non-compliance with ATC instructions, the pilot apologised, stating that he was unfamiliar with the airport and that he had concern for his low fuel, which he stated was 10 litres remaining (16 minutes approximately).

In general conversation, the pilot informed the Controller that, they were going fishing for the weekend and that they would be flying back out on Monday morning the 19 September 2005. The ATC Controller subsequently remarked to the Investigation that the Pilot's English was poor.

1.1.1 History of the Flight

At approximately 10.30 hrs on the morning of the accident, the Pilot and passenger arrived at EICM and went about refuelling the aircraft. When the refueller truck arrived, the Pilot asked to refuel the aircraft himself (**See Section 1.1.5**). The Pilot then went to the terminal building and paid for his fuel and landing charges (11.07 hrs). At approximately 11.20 hrs, the Pilot arrived at the control tower with a prepared flight plan for filing.

The Controller advised the Pilot that it would require at least 1 hour for the flight plan to go through the system. In addition, as no en-route height/flight level was entered on the flight plan, the Controller asked the pilot what level he would be returning to Belgium. The Pilot replied, "FL 065" (6,500 ft). The flight plan was thus amended and filed for a departure out of EICM at 12.30 hrs (Local) for a VFR flight at FL 065 to EBSG, in Belgium.

The Pilot then requested and was given the Local Area Forecast (LAF) for Galway and the Controller also downloaded weather for Dublin, Cork and Cardiff. The Controller asked the Pilot if he required weather for Belgium and the Pilot replied, *"Belgium is CAVOK."* [7] The Controller was of the opinion that the Pilot had no hard copy written weather as he entered the control tower. A follow-up enquiry to the Irish Meteorological Service determined that no record was found of the Pilot seeking a weather forecast for the flight on the day of the accident.

5 Aircraft initially uploaded 97 litres and then after the diversion uploaded a further 37 litres. Total fuel onboard for flight to Ireland could not be determined.

6 Prior Permission Required (PPR). Irrespective of submitting a Flight Plan through the ATC System, a Pilot is required to seek permission to use/land at a PPR airport prior to commencing the flight.

7 CAVOK is a generic term for Ceiling and Visibility OK. The term is used if the visibility is 10 km or more and the cloud base is above 5,000 ft.

At 12.27:15 hrs, OO-TYP requested taxi information for the VFR flight to EBSG. An extract of the ATC audiotape transcript of OO-TYP's communications with the Control Tower on the day of the accident is presented as **APPENDIX B** to this Report. OO-TYP was cleared to Bravo holding point for departure from RWY 26. A QNH[8] of 1017 hPa and a Squawk[9] of 0234 was given by the Tower Controller and this was acknowledged by the Pilot. On arrival at Bravo holding point, the Pilot carried out power checks on the aircraft. OO-TYP was then cleared for take-off RWY 26, left turn out (For Birr), wind 210 degrees 15 kts. Birr is located approximately 40 nm east-south-east of Galway on a heading of approximately 115°M.

OO-TYP was advised airborne at 12.35 hrs and, as the Tower Controller observed that the aircraft was nearing the cloud base that was reducing to between 700 and 800 ft southwest of the field, he instructed OO-TYP to continue Special VFR[10] and report 10 miles (The Galway Control Zone Boundary). This was acknowledged by the Pilot with a request to repeat the QNH, which was provided again by the Tower Controller. The Tower Controller then lost sight of OO-TYP. OO-TYP's last transmission was recorded at 12.35:18 hrs, *"Continue Special VFR."* The estimate for OO-TYP to reach the 10 nm southeast Boundary for Birr was approximately 12.45 hrs.

When the Boundary was not called, the Tower Controller initiated calls to OO-TYP at 12.45:15 hrs, 12.45:28 hrs and 12.45:32 hrs respectively, but with no response. The Tower Controller then called Shannon Low Level, in the event that OO-TYP was working them, however, this proved not to be the case.

A final call was made to OO-TYP at 12.49 hrs, with no response. The Watch Manager at Shannon contacted the Tower Controller (Galway) at 13.00 hrs and said that they had received a report that an aircraft had crashed at the Galway Cricket Grounds. This was subsequently confirmed in a telephone conversation between the Tower Controller and An Garda Síochána at Mill Street, Galway. The Tower Controller immediately initiated the callout procedures for an aircraft accident.

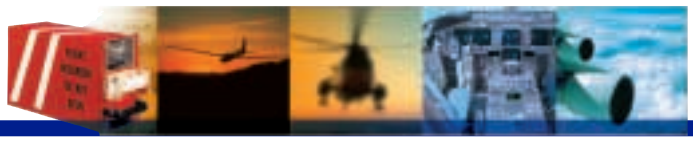
1.1.2 Witness Report No 1.

This witness was standing in her kitchen with another person who was measuring the window for blinds. Without any prior warning they both heard a very loud bang followed by white bits flying past the window. After a short while, they went out to the back garden, looked over towards the cricket grounds and saw that something had crashed in the field. Two men, one of whom she recognised as a local, were standing by the wreckage. The lady ran back into the house and made a 999 call (12.43 hrs) to An Garda Síochána reporting that something had crashed into the Cricket Grounds. Prior to the loud bang the lady had not heard or seen anything relating to the crashed aircraft. She described the weather conditions at the time of the accident as, *"Bad, very very grey and misty, with drizzle."* When ask about the cloud conditions she replied, *"Lots of cloud, the sky was full of cloud."*

8 QNH - Term used for atmospheric pressure reduced to sea level pressure as calculated.

9 Squawk number. Term used to set a designated code/number on the radar beacon transponder.

10 Special VFR. A VFR Flight cleared by Air Traffic Control to operate within Class B, C, D and E surface areas in meteorological conditions below Visual Meteorological Conditions (VMC)



1.1.3 Witness Report No 2.

Both these witnesses were Electricity Supply Board (ESB) line contractors who were working on an electricity pole approximately one-quarter mile south of the accident site. Initially they heard the sound of an aircraft engine above cloud, but they could not see the aircraft. The engine revved up, then down, then up again. In their opinion they believed that the engine sounded OK, like it was responding to power changes. It did not sound like it was in trouble. Moments later they saw the aircraft, *"Spin nose down out of the cloud, like a drill, very fast."* They noticed that one wing was missing, but they did not see the missing wing fall to earth. The aircraft continued to spin down until it went out of view below a hill. This was followed by a loud bang. Both individuals got into their company jeep and raced in the direction of the accident site. Eventually they came across some people standing in the middle of the road who believed that they were part of the emergency services due to the flashing yellow lights on their vehicle. They were directed to the main gate of the Cricket Grounds which was pad locked. The ESB crew cut the lock and entered the grounds. At the far end of the cricket pitch they saw some people standing by the aircraft wreckage. They decided not to go over to the impact site, as it was obvious to them that there was nothing further they could do. They reported hearing no other aircraft in the area at the time.

1.1.4 Witness Report No 3

A local and a friend ran in the direction of a loud bang and eventually found the accident site within the Cricket Grounds. On arrival it was obvious that the impact was such that nothing further could be done for the two individuals onboard.

1.1.5 Witness Report No 4

A local man, whose house was located approximately 400 metres east of the accident site, heard a very loud bang and then a couple of seconds later saw what appeared to be part of a wing fly past his window. He went outside and found an aviation map in his garden. Part of a wing had landed in a field, fenced-off for horses, which was located behind a large farm shed near the end of his garden.

1.1.6 Witness Report No 5

Both these witnesses were handling ground operations at Galway Airport, which included ramp duties and aircraft refuelling. On the morning of the accident, they received a request at approximately 10.40 hrs to go out and refuel a light aircraft.

They both went to the hangar where the AVGAS (aviation fuel) refueller truck was located, they checked the fuel[11], and then brought the fuel truck out to OO-TYP. On arrival the Pilot asked to refuel the aircraft himself. Both individuals watched the Pilot refuel four separate tanks on the aircraft. He first refuelled both wing tanks and then two tanks in the fuselage. He spent time ensuring that each tank was full. The Pilot then signed for the 176 Litres of fuel and then went across with one of the Ground Operations Personnel to pay for the fuel and landing charges. This individual observed, in general chat with the Pilot, that he was in good spirits, he had staggered English, but appeared to understand what was being said. When making a general comment that the weather was not that good, the Pilot responded, *"Weather good around here."*

11 A sample of fuel is taken and tested to ensure that no water/moisture is present in the fuel.

1.2 Injuries To Persons

Both the pilot flying and the passenger were fatally injured in this accident.

Injuries	Crew	Passengers	Total in aircraft	Others
Fatal	1	1	2	0
Serious	0	0	0	0
Minor	0	0	0	
None	0	0	0	

1.3 Damage To Aircraft

The aircraft was destroyed on impact. A section of the starboard wing was located 422 metres due east of the main wreckage site.

1.4 Other Damage

The vertical impact forces were such that a significant portion of the aircraft penetrated the ground/earth to a depth of approximately 5 feet. A JCB digger was brought to the site in order to assist in the recovery of the wreckage. Following the recovery, the impact site was filled in and levelled. Whilst every effort was made to prevent further damage, areas of the cricket grounds did suffer tyre-rutting damage due to vehicular traffic transiting to and from the impact site.

During the actual impact, all four fuel tanks, containing approximately 198 Litres of AVGAS, ruptured and the resultant fuel spray was wind blown across the grass surface in a northeasterly direction. A significant area of the prepared grass surface was damaged as a result of fuel contamination.

1.5 Personnel Information

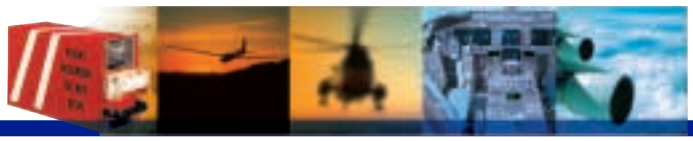
1.5.1 (Commander/Pilot Flying)

Personal Details: Male, aged 56 years
Licence: PPL Single engine (Land) VFR
Last Periodic Check: 20 September 2004
Medical Certificate: Class 2 -Valid until 1 February 2006

1.5.2 Flying Experience:

The Pilot was first issued with a PPL (Land) by the Belgian Civil Aviation Authorities on the 5 August 1985.

The Pilot's logbook No. 2 was recovered from the accident site and it was found to cover the period 13 Jan 1992 to 20 June 2005. The last entry recorded in the logbook was on the 20 June 2005, the nature of which was an engine run-up by the PF after a 100 hr inspection. The total flying hours recorded up to the 7 June 2005 (last recorded entry in Pilot's logbook) was 882 hours. The nature of the flights logged was mainly local and navigational flying. Virtually all the recorded time was as PF on the accident aircraft type. No record was found that the PF had engaged in actual or simulated instrument flying.



A request was made by the Investigation to the Belgian BEA to source any flying logbooks belonging to the Pilot that covered the period 5 August 1985 to 13 Jan 1992. No flying logbooks were found. It was determined that the Pilot had flown a total of 5 flights between the period 7 June 2005 and the 17 September 2005. These flight were conducted as follows:

Date	Flight	Time	Total
19 July 2005	Local Flight EBSG	40 min	
03 Sept 2005	Local Flight EBSG	30 min	
06 Sept 2005	NAVEX EBSG/EBKT	30 min	
06 Sept 2005	NAVEX EBKT/EBSG	30 min	
17 Sept 2005	NAVEX EBSG/EICM	4 hours 30 min	6 hrs 40 min

Therefore, the total flying experience for the Pilot up to the day of the accident was approximately 888 hours.

1.6 Aircraft Information

1.6.1 Leading Particulars

Aircraft type: Jodel DR 250-160

Manufacturer: Avions Robin.

Constructor's Number: 81.

Year of Manufacture: 1966.

Certificate of Registration: Valid and issued by the Kingdom of Belgian CAA on 30 December 1991.

Certificate of Airworthiness (COA): Valid and issued by the Kingdom of Belgian CAA on 9 June 2005

Last Inspection: Renewal COA/100 hr 07 June 2005

Total Airframe Hours: On 9 June 2005 recorded as 1,888.28 hours.

Maximum authorised take-off weight: 960 kg

Estimated take-off weight: 881 kg

Estimated weight at time of accident: 879 kg

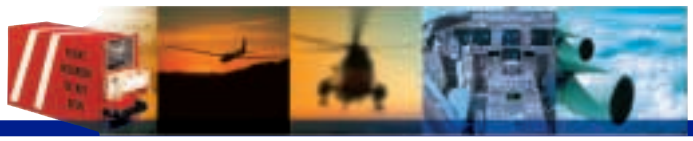
Centre of Gravity limits: Within Limits

1.6.2 General Information

The DR 250 was first flown in April 1965 and it entered production later the same year. It was available with either a 150 hp or 160 hp Lycoming O-320-D2A four-cylinder horizontally opposed air-cooled engine. OO-TYP was equipped with a 160 hp engine. The aircraft is primarily constructed of wood. The standard fuel capacity of 150 litres is contained in two wing-root leading-edge tanks. However, the installation of auxiliary tanks in the fuselage increases the capacity to 200 litres, as was the case with OO-TYP. The aircraft has a large cabin, accommodating up to 4 persons. The instrument panel is large enough to accommodate full equipment for Instrument Flight Rules (IFR)[12] flight.

Robin DR 250-160

12 IMC - Instrument Flight Rules – flight conducted according to instrument flight rules in or near cloud



1.6.3 General Aircraft Specification

DIMENSIONS, EXTERNAL:	
Wing span	8.72 m
Length overall	6.98 m
Height overall	1.86 m
Wheel track	2.59 m

AREA:	
Wing, gross	14.15 m^2

WEIGHTS AND LOADING:	
Empty weight	552 kg
Max T/O weight	960 kg
Max wing loading	68 kg/m^2
"G" Limits	+ 3.8g – 1.52g

PERFORMANCE (AT MAX T/O WEIGHT):	
Max level speed at Sea Level (S/L)	171 mph (148 kts)
Max cruising speed (75% power) at S/L	152 mph (132 kts)
Economy cruising (66% power) 10,000 ft	155 mph (135 kts)
Rate of climb at S/L	780 ft/min
Fuel capacity (4 tanks)	200 litres
Service ceiling	16,400 ft
Endurance	5 hours 30 minutes
Range	1,000 miles

Stalling Speed:	
Flaps up	59 mph (51 kts)
Flaps down	54 mph (47 kts)

1.6.4 Equipment/Instrumentation

The aircraft was fitted with the following equipment:

4 x Fuel Gauge Indicators, Suction Indicator, Airspeed Indicator, Turn and Bank Indicator, Artificial Horizon, Climb and Descent Indicator, Altimeter, Compass, Hobbs (Jaeger) Meter, RPM Gauge, Oil Temperature Gauge, Amp Meter.

The aircraft was fitted with the following Radio/Navigation Instrumentation:
Audio KING KMA 20 TSO, NARCO MK 12 D TSO NAV/COM with VOR/ILS, KING NAV/COM KX 175 B TSO with VOR Indent, NARCO Transponder AT 150 TSO, ADF, Blind Encoder, Intercom Telex PC 4. A Skyforce Skymap II Global Positioning System (GPS) was found within the wreckage.

1.6.5 State of Manufacture

Following a query by the AAIU to the State of Manufacture, France, regarding previous similar events on type, it was determined that there was no record of a Jodel DR250-160 suffering a catastrophic wing failure such as that which occurred to OO-TYP.

1.7 Meteorological Information

1.7.1 Met Éireann, the Irish Meteorological Service, Aviation Services Division, Shannon, provided the following meteorological information after the accident.

1.7.2

General Situation:	A depression east of Iceland maintained a moist south-westerly flow over the area. A cold front with waves was moving slowly eastwards at the time of the accident. The frontal line, as indicated by the wind veer, was approximately 40 nautical miles west of Galway.	
Wind:	2000 ft Surface wind	240° 35 kts (True) 210° 15-18 kts
Weather:	Occasional rain/drizzle	
Visibility:	Generally 5000m but occasionally 1500-3000m	
Cloud:	Scattered (SCT) 500 ft, Broken (BKN) 1,000 ft - Occasionally BKN 700 ft, BKN 1,000ft.	
Temperature/Dew-Point:	15/15 deg Celsius	
MSL Pressure:	1017 hPa[13]	

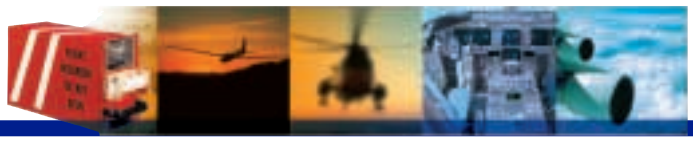
1.7.3 Met Report Galway Airport

A Met Report for Galway Airport at 12.35 hrs (Local) on the day of the accident was as follows:

Surface Wind:	200 degrees 15 kts
Visibility:	4500 m
Weather:	RA (Rain showers)
Cloud:	BKN 700 ft BKN 1200 ft
QNH/QFE[14]:	1017 hPa/1014 hPa

13 hPa. Hectopascal – A unit of measurement of atmospheric pressure equall to one millibar.

14 QFE - Term used for the atmospheric pressure at the aerodrome elevation or the runway threshold



1.7.4 General Route Conditions Galway to Belgium

At the time of the accident, the associated warm front was located between 65 and 68 degrees North. The rain band from the cold front extended into the Irish Sea, but cloud and visibility conditions would have improved to visual meteorological conditions (VMC) in the east midlands of Ireland. There would have been a risk of some fog in the Irish Sea, but apart from that, conditions would remain good for visual flight rules (VFR). Conditions between Galway and the midlands of Ireland would have been generally below VMC.

1.7.5 General Comment on Weather Conditions

- Gusts in excess of 25 kts at surface would not have been expected.
- The gradient wind speed was insufficient to produce severe mechanical turbulence.
- The radar imagery did not suggest any significant CB activity in the area at the time.
- Upper air and satellite analysis did not suggest the presence of severe mountain waves.
- There was no indication of any other extreme weather conditions in the area at the time of the accident.

1.8 Aids to Navigation

1.8.1 General

A Non-directional radio beacon (NDB) and Distance measuring equipment (DME) were available and serviceable at Galway airport at the time of the accident.

The aircraft was equipped with VHF omni-directional radio range (VOR), Instrument landing system (ILS) and Automatic direction-finding equipment (ADF).

A Skymap II Global Positioning System (GPS) was found within the wreckage site.

Shannon International Airport, located approximately 35 nm south of Galway Airport, is a 24 hour airport with all associated facilities, including, ILS, Surveillance Radar Element of precision approach radar system (SRE) and Secondary Surveillance Radar (SSR).

1.8.2 Radar Information

The Shannon SSR tapes were impounded by the AAIU on the day of the accident and were viewed some days later by the IIC. The most likely "track made good" and the aircraft ground speed, as depicted by the radar returns, are reconstructed with map overlay and presented as **APPENDIX C** to this Report.

Prior to departure, OO-TYP was issued with a transponder Squawk of 0234, which was acknowledged by the Pilot. By setting a squawk number on the aircraft transponder, the same number will appear on the radar operator's screen thereby identifying the specific aircraft to the controller.

Two modes are generally associated with the transponder. Standard Mode A (Alpha) is primarily a pulse format for an identification code interrogator (gives identification/position). Mode C (Charlie), if selected, will provide a pulse format for an altitude information interrogator (gives identification/position and altitude).

A review of the radar type showed that OO-TYP was Squawking A0000, indicating that the Pilot had not selected the Squawk of 0234. Mode Charlie was not present on the radar return. Therefore no radar height/altitude information for the aircraft was available to the Investigation.

Factors such as the distance between Galway and the radar head position at Shannon and the effects of terrain masking, will normally determine the minimum heights at which the radar returns first appear flying out of Galway and those that disappear when flying into Galway.

A flight test was conducted in the vicinity of Galway Airport and the accident site, in order to determine at what height radar contact would be acquired and lost. The test concluded that radar contact was acquired at Galway Airport (climb out) at approximately 500 ft and was lost over the accident site at approximately 600 ft.

1.8.3 Radar Data

The radar initially depicted OO-TYP at 12.35:30 hrs (Local) in a climbing turnout as cleared, onto an east south easterly heading for Birr. The ground speed as derived by radar, is a measurement of the time that the aircraft takes to go from one radar return to the next. The recorded ground speed can have a vertical element associated with it.

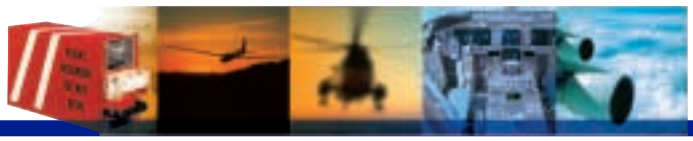
The aircraft continued in a gentle climbing turn towards the northeast and onwards towards the north. The horizontal speed, (ground speed with possible +/- vertical element) remains relatively constant in a shallow climb. The heading continues to turn through north and onward to the northwest, followed by an orbital turn back towards the east. In this particular turn the ground speed reduces significantly from 106 kts down to 42 kts and increases to 91 kts and then 106 kts as the heading increases to the northeast and north-northeast. The radar then depicts a sudden direction change to the northwest with the horizontal speed reducing from 94 kts to 32 kts. This is followed by a heading reversal with the horizontal speed reducing further to 24 kts. Horizontal speed increases from 24 kts to 46 kts and onward to 65 kts with the aircraft on a near easterly heading. The final radar return is recorded over the accident site at time 12.38 hrs (Local) on a near easterly heading, approximately 1.5 nm northeast of Galway Airport. The last radar return disappeared off screen virtually over the accident site.

1.8.4 Height Information

The approximate height in which the aircraft first appeared out of Galway Airport was 500 ft. While not an exact science, a calculation of the ground speeds from the first radar contact to the point just prior to where the aircraft commenced its excessive manoeuvring indicates that the additional height gained would have been in the region of 800 ft. Total height reached just prior to excessive manoeuvring was approximately 1,300 ft. The maximum height achieved during the following upset cannot be determined but would have been in excess of 1,300 ft.

1.9 Communications

Normal two-way communications existed between the Galway ATC and OO-TYP on Freq 122.5 Mhz. Only one other aircraft (Helicopter EI-IHL) was working the frequency at the time, clearing the zone south abeam of Craughwell, enroute to Shannon. No MAYDAY call, transmission, or carrier wave was heard or recorded on the ATC tape.



1.10 Aerodrome Information

Galway Airport (531805N 0085621W), which is a Licensed Public PPR airport, is located 4 nm east north east of Galway City. Its runway (RWY) 08/26 is 1,350 m in length and 30 m in width. Radio Navigation and Landing Aids consist of a Non-directional radio beacon (NDB) and Distance measuring equipment (DME) to each end of RWY 08/26.

The Galway Control Zone is a circle radius out to 10 nm from the airport. During promulgated hours of operation, Galway Control Zone is classified as Class C airspace. Outside promulgated hours of operation of Galway Control Zone, the airspace coterminous with Galway Control Zone is classified as Class G airspace. Category (CAT) 4 Rescue and Fire Fighting Services are available for scheduled flights, otherwise CAT 2 pertains.

1.11 Flight Recorders

1.11.1 Cockpit Voice Recorder

Not fitted, nor was it required to be.

1.11.2 Flight Data Recorder

Not fitted, nor was it required to be.

1.12 Wreckage and Impact Information

1.12.1 General

A general aerial view of the accident site is presented as **APPENDIX D** and a general layout of the wreckage is presented as **APPENDIX E** to this Report.

The aircraft impacted into the Cricket Grounds in a near vertical attitude on a heading of approximately 103° magnetic.

The impact force was such that the rotating propeller, the entire engine assembly, the firewall and the instrument panel penetrated the soft earth to a depth of approximately 5 feet. The propeller was severely damaged by the ground impact. It suffered rotational damage and markings, which indicates that the propeller was rotating at impact.

The mainplane (excluding the starboard wing outboard of the undercarriage structure), the tail plane and the main undercarriage assembly remained on the surface, but in an extremely disrupted condition. A number of items, separate to the aircraft structure, such as overnight bags, a *"Coke"* can a fire extinguisher were found in close proximity to the main impact site. These items penetrated the earth vertically, indicating that they had been expelled from the aircraft at some height, as it spiralled in its vertical descent. Continuity of control cable runs to the LH aileron and to the elevator and rudder controls were established. The cable to the RH aileron failed where the right wing outer section had separated. Some of the engine and flight instruments were punched through the instrument panel and were imbedded in soil between the rear of the panel and the engine firewall. Some other instruments were found loose within the wreckage. The destruction of these instruments was such that none could be tested for functionality. However, certain observations could be made on some of the instruments (**See below**).

The four fuel tanks carrying approximately 198 litres of AVGAS ruptured on impact sending a wind blown spray across the cricket grounds. Fuel traces were found in the fuel filter.

The starboard wing section was recovered virtually intact and was subsequently brought to the AAIU facility at Gormanston, Co. Meath for examination (**See Section 1.16 Test and Research**)

1.12.2 Engine RPM/Tachometer

The Engine RPM/Tachometer was found lodged in a reversed position between the rear of the instrument panel and the engine firewall. Its glass face had shattered and the instrument was caked in soil. The RPM needle showed that at the time of impact the engine RPM was registering 1,850 RPM. This is an indication that the engine was running, albeit at a reduced speed setting, at the time of impact.

The Jaeger engine hour's meter provides a time count on engine usage. It was recovered from the wreckage, however, the damage to the instrument, in particular the drum counter, was such that it could not be used for engine usage analysis.

1.12.3 Altimeters

1.12.3.1 General

Maintenance records and statements received through the Belgian BEA confirm that only one altimeter was fitted to the aircraft. However, two altimeters were found within the wreckage at the accident site.

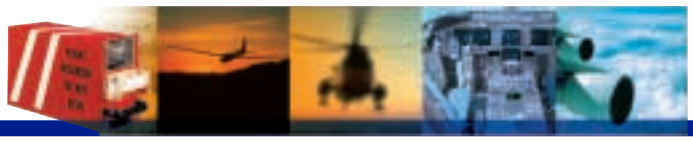
1.12.3.2 Altimeter No 1.

This altimeter (No. 1) was found loose within the wreckage. It was noted that a cardboard blanking cover had been placed over the face of the altimeter and secured by the mounting screws that would have held it in place on the instrument panel. Two of the three mounting screws were found on the altimeter. However, these had sheared at the back plate of the mounting attachment. The casing was broken at the static line attachment port and the altimeter had significant deposits of soil on it. The pressure sub scale was set at 1013 hPa.

Further research on the altimeter determined the following:

The altimeter was identified as a Kollsman 671RK-010 Type C-12 AF43-178206. It had been overhauled by an American Company and documentation confirms that it had received an Authorised Release Certificate on the 27 July 2002. The altimeter had subsequently been released by the Belgian CAA, under an Authorised Release Certificate (Form 1), on the 10 June 2003.

In correspondence with the Belgian Authorities and the Maintenance Company who serviced OO-TYP, it was determined that, when altimeter (No. 2) was deemed unserviceable, it was replaced with the overhauled altimeter (No. 1) and then fitted to OO-TYP. The last person to work on the aircraft confirmed the installation of a serviceable altimeter (No. 1) without the cardboard cover over its face. He was not aware of the whereabouts of the unserviceable altimeter (No. 2). Other persons familiar with the aircraft at EBSG were also not aware of the cardboard cover on the altimeter.



1.12.3.3 Altimeter No 2.

This altimeter (No. 2) was found loose within the wreckage. The glass face had shattered and the casing was broken at the static line attachment port. The pressure sub scale was set at 1019 hPa. No Part or Serial Number was found.

The altimeter was free of soil deposits and the four front face attachment screw holes showed no signs of damage. No attachment screws were found on the altimeter.

A red unserviceable label had partially detached itself from the altimeter and was lying on the ground within the wreckage. The other part of this label was still attached to the altimeter casing (**APPENDIX G**). No Part or Serial Number was found on this label. However, it did reveal a Work Order No 01030603 and a note on the label identifying that it was, *"Out of Tolerance"* and therefore unserviceable. It was later identified as a Kollsman, however, the part number and serial number were missing. Further research on the Work Order Number determined the following:

In June 2003, a 2-yearly bench check (Examination) had been carried out on the altimeter and on a Blind Encoder (NARCO AR-850 No 33553). The bench check revealed that the part and serial number was missing and that the altimeter was, *"Out of Tolerance"* at the higher altitudes and therefore unserviceable. It was noted by the Investigation that out of tolerance errors were recorded at altitudes in excess of 10,000 ft and up to 20,000 ft with virtually no errors recorded below these altitudes. The Blind Encoder was found to be serviceable.

1.12.4 Global Positioning System (GPS)

A Skyforce Skymap II Global Positioning System (GPS) Unit (Version 1.00 Jan 1996) with monochrome screen was found separate within the wreckage site. The Unit was extensively damaged and the internal battery for the memory source had been disconnected. As a result of this, no data could be retrieved from the Unit.

The Sky data module (Data Chip V3.02) contained within the GPS Unit was marked EUR 07/98.

The Unit was powered by internal batteries and not powered by the aircraft electrical system. Additional batteries and a carrying case were found in the pilot's navigational bag.

An aluminium bracket with spring loaded retaining clips was found loose in the wreckage. The makeup and dimensions of this bracket indicated that the bracket was mounted somewhere on or in the area of the instrument panel and that the GPS Unit had been clipped/secured on this mounting bracket during flight.

1.13 Medical Information

1.13.1 Pilot

The Post Mortem Report recorded that the cause of death of the Pilot was multiple injuries, consistent with extremely violent impact sustained in an aviation accident. Toxicology results revealed that there were no drugs or ethanol (alcohol) detected in the Pilot's system.

1.13.2 Passenger

The Post Mortem Report recorded that the cause of death of the Passenger was multiple injuries, consistent with extremely violent impact sustained in an aviation accident. Insufficient samples were available to conduct toxicology tests on the passenger.

1.14 Fire

There was no fire.

1.15 Survival Aspects

A 12.43 hrs, a 999 call was received from a woman in Lydican, Oranmore, Galway, reporting that an aircraft had just crashed in the Galway Cricket Grounds. This call was immediately transferred to An Garda Síochána at Mill Street in Galway City. At 12.50 hrs An Garda Síochana arrived on scene, followed by 1 ambulance and 2 fire engines. Additional rescue personnel and equipment arrived from Galway Airport. The impact forces were such that the accident was un-survivable.

1.16 Tests and Research

1.16.1 Wooden Structure Examination

The services of a certified aircraft maintenance engineer (AME) with specialist knowledge and experience in the construction and maintenance of wooden aircraft was secured by the AAIU to examine the wreckage of OO-TYP. The aircraft was inspected at the AAIU facility at Gormanston, Co. Meath on the 28 September 2005.

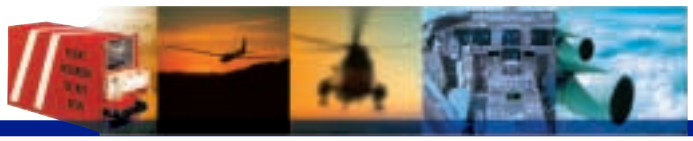
The centre wing box section had the LH wing still attached to the fuselage when the main body of the aircraft struck the ground. The nose and engine penetrated the ground. The LH wing and the remaining inner section of the RH wing halted further ground penetration. Consequently, these wing sections experienced severe impact when the aircraft hit the ground. This impact shattered much of the wing, particularly the LH wing. Thus, a detailed examination of the LH wing, as a complete structure, was not possible. However, an inspection of the fragments revealed no material or glue defects.

The outer RH wing section had separated in flight (**APPENDIX F**). Because of its bulky but light construction, it floated somewhat gently to ground. It struck a fence, but remained largely intact with its aileron still attached.

Examination of this wing section showed it to be well constructed and the materials used as per the approved materials and practices in force today. No evidence was found of any significant repairs or water penetration, which might have weakened any part of the wing.

The materials used in the wing were British Colombian Sitka Spruce, Birch Plywood and Gaboon Plywood. Gaboon Plywood is normally the plywood used in French built aircraft. The glue used was Resorcinol-Phenol Resin possibly Aerodux Resin 500+ Hardener 501 made by Ciba Geigy or Dynochem, which is an approved aircraft wood adhesive. All wood components were sealed with a Rhodius varnish and the entire structure looked fresh and did not show any signs of ageing. The fabric used was a synthetic material possibly Ceconite or Diatex.

A comparison on the dimensions of the wood used, with drawings of a similar Jodel spar, found no significant differences. The moisture content of the wood was tested in various places and it ranged from 12.25% to 15.5%. The accepted range is 10% to 15 %. The plywood moisture content ranged from 10.5% to 14% with the accepted range being 8% to 14%.



A rough fibre test was carried out on the spar boom material and it was comparable with a recent certified piece of Sitka Spruce. There was no sign of disease or brittleness. The wing suffered severe impact, yet most of the breakages in the boom were splits with ratios of up to 20 to 1 and there was no evidence found of glue failure. In conclusion, the wing was well constructed and maintained. There was no evidence to suggest that any pre-existing defects existed within the wing structure prior to its failure. Therefore it is likely that the wing failed in upload following a gross overload of the wing.

The Investigation did receive a communication from the Belgian BEA indicating that they had heard that the pilot might have experienced a bird strike on the aircraft a few weeks prior to the accident.

A follow up by the Belgian BEA did not provide any further details of this possible event. However, this was taken into account during the examination of the wreckage. No evidence was found that the aircraft suffered a recent bird strike, nor was there any evidence to suggest that a recent repair had been made that could be associated with a bird strike.

1.17 Organizational and Management Information

Nil

1.18 Additional Information

Acceleration of Gravity ("G").

"G" is used as a unit of stress measurement for bodies undergoing acceleration. This acceleration can be acting along any of the aircraft's axes, but usually it refers to the one acting along the normal vertical axis, or from head to toe (top to bottom). Positive (+) "G" acts from head to toe and negative (-) "G" acts from toe towards the head. In this usage, "G" is the centrifugal force experienced by a body or aircraft and is expressed as a number, which is that number times the actual weight of the body or the aircraft. If the body or aircraft is said to be experiencing 4 g, then the pilot and aircraft are experiencing a force that is 4 times their weight. Excessive "G" pulled by an individual who is not tolerant to high "G" loading, may cause that individual to "grey out" or "black out".

1.18.2 Load Factor

The load factor is the ratio of a specified load to the total weight of the aircraft. The specified load is expressed in terms of aerodynamic forces. Aerodynamically, it is the ratio of the total lift to the weight. The load factor is generally referred to as "G". In the case of manoeuvres, the load imposed on the aircraft leads to an increase in the lift and since the weight remains the same, the load factor, or "G" increases. The amount of "G" application decides the tightness of the manoeuvre. The higher the "G" loading, the tighter the manoeuvre.

The Limit Load Factor (LLF) is the maximum load factor authorized for flight on a particular aircraft and the specified load below which structural members or parts are designed not to fail. If the load factor is higher than the design load factor, either permanent distortion or failure may occur. In the case of OO-TYP this was +3.8G and –1.52G.

The ultimate load safety factor (ULF), or safety margin above the LLF, is the ratio of the ultimate load at which the structure is likely to fail to the loads imposed under normal operating conditions. Normally, the ultimate load is higher than 1.5 to 1.7 times the normal load in flight. In the case of OO-TYP, the ratio was 1.5 (See Table below).

Gross Weight	Limit -G	Structural Limit Load	Ultimate -G	Structural Failure Load
960 kg/2112 lbs	+3.8 G/-1.52G	3648 kg/8025 lbs	+5.7G/-2.28G	5472 kg/12038 lbs

1.18.3 Instrument Flying

1.18.3.1 General

When flying in cloud or in reduced visibility such as mist, smog, rain or snow, the natural horizon and ground/terrain features are difficult, if not impossible, to see.

In general, humans use their vision to orientate themselves with surroundings, supported by other bodily senses such as feel and balance, which can sense gravity. Even with one's eyes closed, a human can sit, stand and walk on steady ground without losing control. This obviously becomes more difficult if the ground becomes unsteady or if the body is subjected to some acceleration, for example being spun around.

In an aircraft, which can be accelerated in three dimensions, the task becomes almost impossible without the use of the eyes. The eyes gather information from the external ground/terrain features, including the horizon, or in cloud or poor visibility, gather substitute information from the flight instruments. By scanning the instruments, the pilot builds up a picture of the outside world, in relation to flight path, attitude and speed of the aircraft. However, without the assistance of an autopilot, the task of maintaining control in cloud or in limited visibility is constant and challenging and such a skill requires both training and practice.

1.18.3.2 Unusual Attitudes

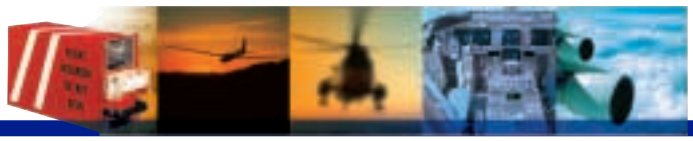
An unusual attitude in instrument flying is any attitude not normally used during flight solely on instruments, including, among other things:

- Bank angles in excess of 30°;
- Nose-high attitudes with decreasing airspeed;
- Nose-low attitudes with increasing speed; and,
- Spinning

An unusual attitude may result from some external influence, such as turbulence or wake turbulence, or it can be self-induced as a result of;

- Disorientation;
- Distraction;
- Becoming pre-occupied with other cockpit duties;
- An over-react or under-react on the flight controls;
- Misinterpretation of instruments;
- Following a failed instrument; or,
- Loss of a primary instrument.

Whatever the cause of an unusual attitude, the immediate problem is to recognize exactly what the aircraft is actually doing and to return it safely back to normal straight and level or controlled flight.



1.18.3.3 Recovery

For non-instrument rated pilots or for pilots inexperienced in flying under IMC, there can be a tendency to over-react to an unusual attitude, by applying rapid and excessive control movement. Over-reaction can worsen the situation and, possibly, overstress the airframe. For this reason, part of any instrument training syllabus will include recovery from an unusual attitude. The purpose of this is to develop recovery techniques, for different scenarios, in order to allow the pilot, having recognized the nature of the unusual attitude, to return the aircraft to normal flight, calmly, quickly and safely. In particular, as there is a danger of overstressing the airframe at high speeds with large and sudden elevator/aileron control movements, the pilot is taught to "ease" the aircraft out of the dive with firm control pressure, rather then with sudden and large movements of the controls.

1.19 Useful or Effective Investigation Techniques

Nil.

2. ANALYSIS

2.1 Weather

The airspace classification for the Galway Control Zone on the day of the accident was Class C airspace. The General Rules for VFR Flights for Class C airspace requires a distance from cloud (horizontally) of 1500m (5000 ft), vertically 300m (1,000 ft), and a flight visibility of 5000m below (flight level) FL100 (10,000 ft).

The prevailing conditions on departure from Galway were: visibility 4500m with broken cloud at 700 ft and 1,200 ft respectively. In addition, the aftercast for the weather conditions between Galway and the midlands were reported as generally below VFR, while the weather conditions east of the midlands of Ireland were expected to improve and remain good for VFR.

The weather conditions at the time of departure were below VFR. This is confirmed by the fact that Tower Controller, observed OO-TYP nearing the cloud base, towards the south of the field and as he considered that VFR could not be maintained, he instructed OO-TYP to continue Special VFR.

It is also clear that the intended flight plan en-route level of FL065 (6,500 ft) would not have been achievable under the prevailing conditions without entering into cloud or flying through cloud.

No formal weather forecast was sought by the Pilot from the Irish Meteorological Service. However, the Pilot was aware (through a phone call home) that the weather at the destination airport was clear, and from weather provided by the Galway Tower Controller, that the weather was generally clearing east of the Irish midlands.

A final weather decision regarding an intended flight is the responsibility of the pilot and him alone. However, a route forecast from a qualified forecaster will greatly assist the pilot in coming to a final decision as to whether a flight is achievable under the laid down weather limits.

While an aviation forecaster was available (by phone) at Shannon Airport, the Pilot of OO-TYP did not avail of this service. The Investigation acknowledges that the Galway Tower Controller did have access to electronically generated weather data and this was provided to the Pilot, on request.

2.2 Technical Aspects

A review of the aircraft's technical documentation indicates that OO-TYP was well maintained and all work required under the maintenance schedule had been completed. The aircraft had a valid Certificate of Airworthiness (COA) and had completed a 100 hr inspection on the 7 June 2005.

The aircraft was primarily of wooden construction and as a result of severe vertical impact forces, the aircraft virtually disintegrated on impact. However, rotational damage and markings were found on the propeller, indicating that the propeller was rotating on impact. This is supported by the fact that the engine RPM needle had frozen at 1,850 RPM (maximum continuous is 2,700 RPM), indicating that the engine was running on impact, albeit at a reduced speed setting.

The extent of the damage to the instrument panel was such that the Investigation could not determine the functionality of the different instruments.

Continuity of control cable runs to the left hand aileron and to the elevator and rudder controls were established. The cable to the right-hand aileron failed at the point were the right wing outer section had separated from the aircraft.

An examination of the failed right hand (starboard) wing section, found no evidence to suggest that any pre-existing defects were present within the structure, prior to its failure. The likely cause of the wing failure, which occurred just outboard of the right hand fuel tank and undercarriage attachment point was that, the wing section failed in upload, following a gross single event overload of the wing in flight.

2.3 Altimeters

The Investigation had great difficulty in reconciling the altimeter configuration on OO-TYP.

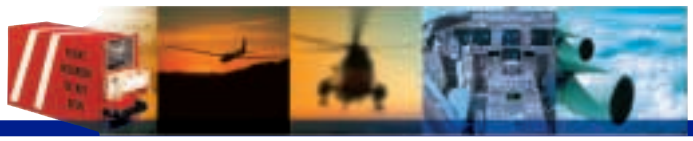
Altimeter No. 2 was found loose in the wreckage with a red unserviceable label, which had detached from the altimeter, lying in close proximity to the instrument. The altimeter was certified out of tolerance, unserviceable, and therefore not suitable for use.

A post accident examination of the instrument provides a strong indication to the Investigation that the altimeter was not secured to the instrument panel prior to the final impact.

Altimeter No. 1 was also found loose within the wreckage. However, this particular altimeter had a cardboard blanking cover secured to its face, by means of the mounting screws. Following post accident examination, the general overall condition of the instrument indicated that this altimeter was secured to the instrument panel. This is supported by the fact that the mounting screws, which were still attached to the instrument, had sheared.

While not a general practice, experience has shown that when a mounted instrument goes unserviceable, and where a second similar instrument is available on the instrument panel, a cover is placed over the face of the instrument in order to ensure that the pilot does not mistakenly read the unserviceable instrument.

It is considered highly unlikely that the pilot flew the aircraft without altimeter reference. Therefore the only plausible conclusion that can be reached by the Investigation is that Altimeter No 1, which was overhauled and fitted to the aircraft without a blanking cover, went unserviceable at some date prior to the flight to Ireland. In order to put this altimeter out of use, without removing it from the instrument panel, a cardboard cover was placed over the face of the instrument and secured through the instrument mounting screws. The Investigation was unable to determine whom or when the cardboard cover had been secured to the altimeter.



Altimeter No 2, was out of tolerance and unserviceable. However, as the errors were recorded at altitudes in excess of 10,000 ft, and bearing in mind that the majority of VFR flights are flown at altitudes well below 10,000 ft, it is considered possible that the pilot reinstated this altimeter somewhere within the cockpit area as a temporary measure. The location of Altimeter No 2 within the cockpit area could not be ascertained.

For VFR flights, the temporary location of an altimeter (while not good practice) would not be a particularly critical issue, as outside visual references and occasional monitoring of the altimeter would be sufficient to maintain height.

However, for IFR flight, controlled flight is maintained through sole reference to instruments, with no external references available.
The location of the altimeter, or any of the other primary instruments, such as the artificial horizon, the airspeed indicator, the climb and descent, the turn and slip, and the compass, is crucial. Instrument flight requires a constant scan by the pilot on the primary instruments, in order to maintain flight path and attitude.

To reduce this scan area (distance between the instruments), the primary instruments are grouped together. If one of the primary instruments is not within the primary group, the scan distance will increase, as will the rate of scan to that particular instrument. The further the instrument is away from the primary group, the more difficult it is for the pilot to maintain a constant scan of the primary instruments and this would undoubtedly increase the workload on the pilot. In addition, if the isolated instrument is not, in general, along the same line scan as the primary instruments, for example, located above, below or to the side of the instrument panel, the pilots head movement could be such as to induce physiological sensations associated with inner ear balance.

2.4 The Accident Flight

Prior to departure, ATC gave OO-TYP a QNH of 1017 hPa and a transponder squawk of 0234. This was acknowledged by the pilot. The take-off clearance, of a left turnout from RWY 26, was as per flight plan for a routing via Birr. Following an advised airborne time of 35 (12.35 hrs), ATC instructed OO-TYP to continue Special VFR and next report 10 nm (Control Zone Boundary). The Pilot acknowledged, *"Report 10 nm"* and then asked for the QNH to be repeated, which it was.

Radar analysis determined that the transponder return on the radar screen at Shannon was showing A0000 for OO-TYP. This indicates that the aircraft's transponder was switched on, in Mode A (identification code interrogator), but that the ATC issued squawk number of 0234, which had been acknowledged by the Pilot, had not been entered or selected on the transponder box. In addition, the non-selection of Mode C (altitude encoding) on the transponder, by the Pilot, meant that no altitude information was available on the radar returns for OO-TYP. The request to repeat the QNH shortly after take-off and the non-selection of Mode C with the issued squawk of 0234 could be an indication that the Pilot was under some degree of pressure or distraction.

The radar returns show OO-TYP initially turning towards Birr, following a left turnout off RWY 26. However, the gentle left hand climbing turn is continued around the general area of the airport and onwards towards the north. The Tower Controller told the Investigation that when he saw OO-TYP nearing the cloud base, he amended the clearance to Special VFR in the Zone as he considered that under the prevailing weather conditions VFR was not sustainable. The Controller then lost sight of OO-TYP just south of the field.

The gradual climbing left turn towards the north, as recorded on the radar plot, does give the appearance that the aircraft was under control. Therefore it is possible that the Pilot was flying close to the cloud base with poor horizontal visibility, but with some visual reference with the ground. Failure to maintain the heading for Birr (115°M) could have resulted from the Pilot concentrating on maintaining visual references and therefore not being aware of the changing heading.

As OO-TYP passes north over the R339 road, the aircraft continues its turn to the left towards the northwest. Over the N18 road, the aircraft commences a tight left turn back towards the general direction of the east. Ground speed reduces significantly during this particular manoeuvre.

With groundspeeds recorded down as low as 42 kt, 32 kt, 24 kt, and 46 kt respectively, near the end of the radar plot, it is considered likely that the aircraft was engaged in significant vertical (ascent/descent) flight. The turn back towards the general direction of the east and the vertical elements of flight as recorded through the low groundspeeds are indications that the pilot was experiencing difficulty in maintaining control. The sudden 90° left-hand turn towards the northwest and the heading reversal, with groundspeeds down as low as 32 kt and 24 kt are not representative of controlled flight. The final radar return is recorded over the accident site at approximately 12.38 hrs (Local) on a near easterly heading, approximately 1.5 nm northeast of Galway Airport.

The report of two eyewitnesses hearing an aircraft above cloud with its engine revving, prior to seeing an aircraft spin out of cloud with a portion of its right wing missing, supports the Investigation's belief that the aircraft was flying in cloud around the time that the radar plot shows the aircraft flying erratically. The revving of the engine, as reported by the eyewitnesses, is not considered to be associated with an engine problem, but rather that the throttle was being "worked" (moved forward and back) by the Pilot during an attempt to maintain or regain control of the aircraft. Wreckage analysis determined that the engine was running at 1,850 RPM on impact and that the propeller suffered rotational damage.

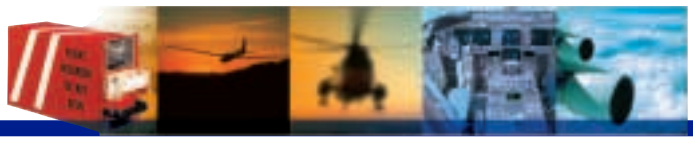
In addition, no radio communications or MAYDAY call was made by the Pilot indicating that he was experiencing an engine problem.

The cockpit of OO-TYP was equipped with flight instruments that would allow for IMC flight. Therefore, the possibility exists that the Pilot may have engaged in instrument flying in the past. The weather for departure from Galway was marginal VFR, with cloud base recorded as broken at 700 ft and 1200 ft respectively. While aware of the prevailing weather conditions, the Pilot confirmed to the Tower Controller and on the submitted flight plan that it was his intention to return to Belgium at FL065 (6,500 ft). The Pilot was also aware that the weather for his destination in Belgium was clear and that the weather was improving as one flew east. Therefore the possibility exists that the Pilot may have attempted to penetrate the broken cloud layer in the belief that he may become VMC on top (visual flying conditions above the broken cloud layer). The possibility also exists that the Pilot, while attempting to navigate in marginal VFR conditions, inadvertently entered cloud.

Whether the pilot intentionally or inadvertently entered cloud cannot be determined by the Investigation and therefore this must remain a matter for conjecture.

However, what is clear to the Investigation is that the aircraft was heard flying in or above cloud and, moments later, it was seen spinning down out of the cloud, with a portion of its right hand wing missing.

The Pilot was licensed to fly VFR only. He was not Instrument Rated, he had never held an Instrument Rating, and a review of the Pilot's available logbooks, did not reveal any entries associated with either official or unofficial Instrument flying.



Flight in IMC is by sole reference to instruments, with no external visual references for flight path or attitude guidance. A pilot requires training, practice and currency to master the skills of instrument flight. To officially fly in IMC, a pilot requires an IFR Rating, which is granted by the State Licensing Authority on completion of a successful flight test. To retain an IFR Rating, a pilot needs to maintain proficiency throughout the year by flying in actual or simulated flight conditions, followed by an annual renewal test.

For an instrument rated pilot, flight in IMC and identification/recovery from an unusual attitude is generally well practiced, tested, and relatively easy to accomplish. A non-instrument rated pilot, on the other hand, would experience extreme difficulties in maintaining controlled flight in IMC, identifying the initial onset of an unusual attitude and recovering from an unusual attitude, as recovery is generally achieved through sole reference to instruments.

If, as believed in this case, the altimeter was not co-located with the primary instruments, the pilot would have been severely challenged to maintain an appropriate rate of scan to maintain controlled flight while in IMC.

The possibility that the altimeter in use on the day of the accident became dislodged from its stored position cannot be ruled out.

If this happened, the lack of altimeter information would have seriously impeded the Pilot's ability to maintain flight path and attitude while in cloud and more importantly to recover from an unusual attitude.

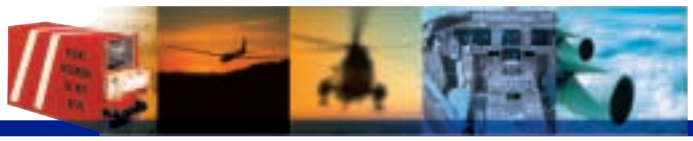
The technical examination of the recovered wing section, shows that the wing failed in upload as a result of a single event gross over-load. The aircraft was heard flying in cloud and was seen spinning out of cloud. No other aircraft was recorded in the area around the time of the accident and no weather phenomena, such as turbulence, was present to influence the aircraft. In considering all the available evidence, the Investigation is satisfied that following entry, either intentionally or inadvertently into cloud, the Pilot became disorientated, and while attempting to recover from a high speed vertically descending/spinning dive, he overloaded the aircraft to such a degree that the starboard wing failed and it separated from the aircraft. Once the wing had failed, total control of the aircraft was lost and the aircraft plummeted to earth.

Due to the aerodynamics of a falling wing and the fact that no height information was available from the radar returns, the Investigation cannot accurately determine the height at which the wing failed. A calculation of the maximum rate of climb and the total time of the event would give an absolute achievable height of approximately 2,400 ft. With a cloud base of approximately 1,000 ft in the general area of the accident site, it is likely that wing separation occurred somewhere between 1,500 ft and 2,000 ft.

3. CONCLUSIONS

3.1 (a) Findings

1. The Pilot had a valid Belgian licence and was medically fit to fly.
2. The Pilot was licensed to fly VFR only.
3. The aircraft had been well maintained and had a valid Certificate of Registration and a Certificate of Airworthiness.
4. The pilot and passenger took off from Galway Airport in OO-TYP at approximately 2.35 hrs for a VFR flight at 6,500 ft for Saint-Ghislan, in Belgium.
5. The weather conditions at the time of take-off were marginal for VFR flight.
6. The Galway Tower Controller cleared OO-TYP for Special VFR through the zone, as in his opinion, the prevailing weather conditions were less than that required to maintain VFR.
7. Two eyewitnesses located in the vicinity of the accident site, heard the aircraft flying above cloud, shortly before seeing the aircraft spin out of cloud with a significant portion of its starboard wing missing.
8. An examination of the main body of the wreckage and in particular the recovered wing, determined that no pre-existing defects were identified in the structure of the wing or the flying control system.
9. There was no evidence found to support the possibility of a technical malfunction prior to the pilot losing control of the aircraft.
10. There was no evidence found of atmospheric turbulence or any factor requiring the Pilot to carry out an evasive manoeuvre.
11. The starboard wing section, just outboard of the wing fuel tank and undercarriage attachment point, failed as a result of a gross overload of the wing section in upload.
12. No record was found of a Jodel DR 250-160 suffering a catastrophic wing failure such as that which occurred to OO-TYP.
13. The likely cause of the gross overload was the Pilot's failed attempt to recover.
14. The aircraft from an unusual attitude while in IMC.
15. Two altimeters were recovered from the wreckage. Altimeter No 1 was recovered from the wreckage and found to have a cardboard cover secured to its face. The Investigation is satisfied that this particular altimeter was fixed to the instrument panel but was not in use by the Pilot. Altimeter No 2 was found to be marked "Out of tolerance" and therefore unserviceable. The investigation considers that this particular altimeter was not fixed to the instrument panel, but it is likely that the Pilot was using the altimeter for height reference.



16. The Investigation cannot rule out the possibility that the position and use of this altimeter may have in some way contributed to the onset of loss of control.

17. Whether the Pilot entered IMC intentionally or inadvertently cannot be determined by the Investigation and must remain a matter for conjecture.

3.2 (b) Cause

1. Failure of the starboard wing was as a result of a gross overload of the wing section in upload, following an attempted recovery from an unusual attitude in instrument meteorological conditions.

3.3 (c) Contributory Factors

1. Spatial disorientation during instrument meteorological conditions, which resulted in the pilot being unable to maintain control of the aircraft, and control of the aircraft was lost.

2. Intentional or inadvertent entry into instrument meteorological conditions, without having the appropriate rating or experience.

3. Possible use of a stand-alone altimeter that was "Out of Tolerance" and therefore unserviceable.

4. SAFETY RECOMMENDATIONS

This Report does not sustain any Safety Recommendations.

APPENDIX A

PART III VISUAL FLIGHT RULES

34. ***General Rules for VFR Flights (Appropriate extracts)***

(I) Except when operating as a special VFR flight, VFR flights shall be conducted so that the aircraft is flown in conditions of visibility and distance from clouds equal to or greater than those specified in the following table:-

*Airspace class	**A**BCDE**	FG Above 900 metres (3,000 ft) AMSL or 300 metres (1,000 ft) above terrain whichever is the higher	**FG** At and below 900 metres (3,000 ft) AMSL or 300 metres (1,000 ft) above terrain whichever is higher
Distance from Cloud	1,500 metres horizontally (1,000 ft) vertically	300 metres	Clear of cloud and in sight of the surface
Flight Visibility	8 Kilometres at or above	Flight Level 100 or 10,000 ft AMSL	**5 Kilometres ***** (See below)
	5 Kilometres below Flight	Level 100 or 10,000 ft AMSL	

* Note: See Rule 26 of these Rules.

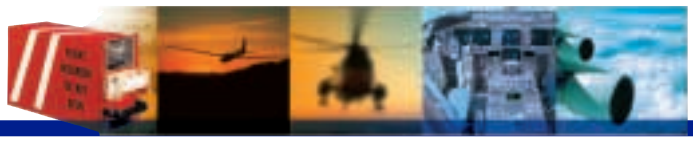
** Note: VMC minima in Class A airspace are included for guidance to pilots but do not imply the acceptance by the ATS Unit responsible of a VFR flight in Class A airspace in a particular instance;

*** **Note:** (a) 3 kms. Flight Visibility for aircraft operated at an indicated airspeed of 140 kts or less;

(b) lower flight visibilities to a minimum of 1500m may be permitted for aircraft operating:

(1) at speeds that, in the prevailing visibility, will give adequate opportunity to observe other traffic or any obstacles in time to avoid collision, or

(2) in circumstances in which the probability of encounters with other traffic would normally be, low, e.g. in areas of low volume traffic and for aerial work at low level;



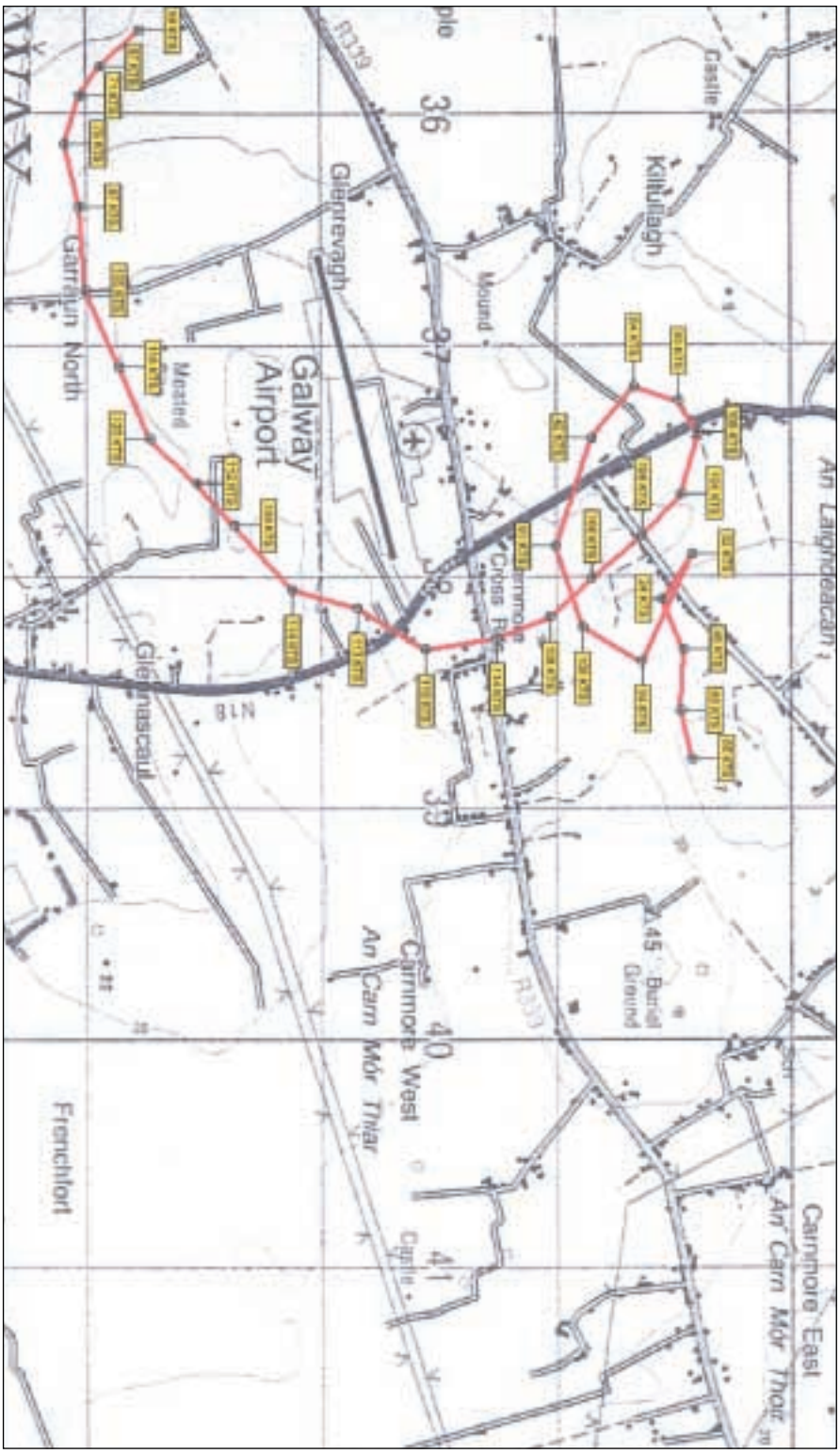
APPENDIX B

Audio Tape Transcript Galway Airport

Date: 19 September 2005
Time Period covered: 12.26:57 to 12.49:10.

Time	TX From	Transcript
12.26:57	OO-TYP	Galway Tower from OO-TYP, how do you read? Over.
12.26:59	TWR	OO-TYP, getting you strength four.
12.27:15	OO-TYP	Ah, eh, I request to taxi information for VFR flight to EBSG.
12.27:18	TWR	O-TB (OO-TYP) and when ready taxi holding position Bravo, hold short Runway 26, QNH 1017.
12.27:30	OO-TYP	Runway in use, 26, 1017 for QNH and I will eh, go to the taxi bravo
12.29:06	TWR	O-TB (OO-TYP) Squalk 0234
12.29:11	OO-TYP	0234, O-YP (OO-TYP)
12.30:00	EI-IHL	And Tower helicopter HL. I'm clear of your zone now south abeam of Craughwell, en-route to Shannon.
12.30:08	TWR	HL that's copied and continue with Shannon 127.5 no traffic to effect. See you Colm.
12.30:15	EI-IHL	Shannon 127.5 Talk to you Mike.
12.31:21	OO-TYP	Galway Tower from OO-TYP, ready for departure.
12.31:25	TWR	O-YP (OO-TYP) enter backtrack and line up Runway 26, report ready.
12.31:35	OO-TYP	I will report ready
12.32:53	OO-TYP	Galway Tower, from OO-TYP ready for departure
12.33:05	TWR	O-YP (OO-TYP) clear take-off runway 26, left turn out, 210 degrees 15 kts.
12.33:15	OO-TYP	Taking-off O-YT (OO-TYP)
12.35:00	TWR	O-YP (OO-TYP) airborne at time 35, continue Special VFR, and next report 10 miles.
12.35:10	OO-TYP	Next report 10 miles and could you, please repeat the QNH please.
12.35:15	TWR	QNH 1017, and continue Special VFR.
12.35:18	OO-TYP	Continue Special VFR.
12.45:15	TWR	OO-TYP Galway Tower.
12.45:28	TWR	OO-TYP Galway Tower.
12.45:32	TWR	OO-TYP Galway Tower.
12.49:10	TWR	OO-TYP Galway Tower.

APPENDIX C



Most likely "Track Made Good" as depicted by Shannon Radar

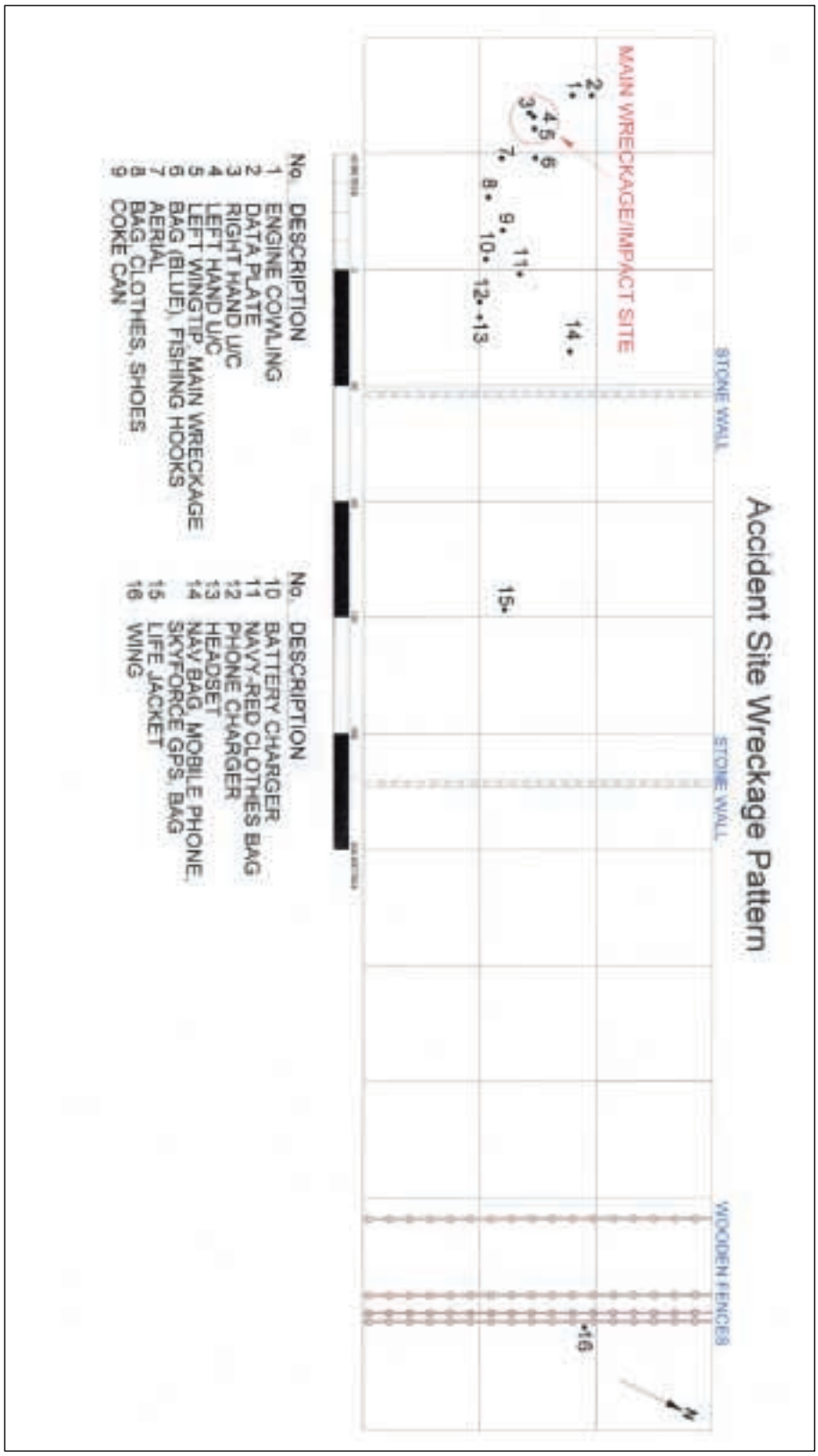
APPENDIX D

General Aerial View Of Accident Site

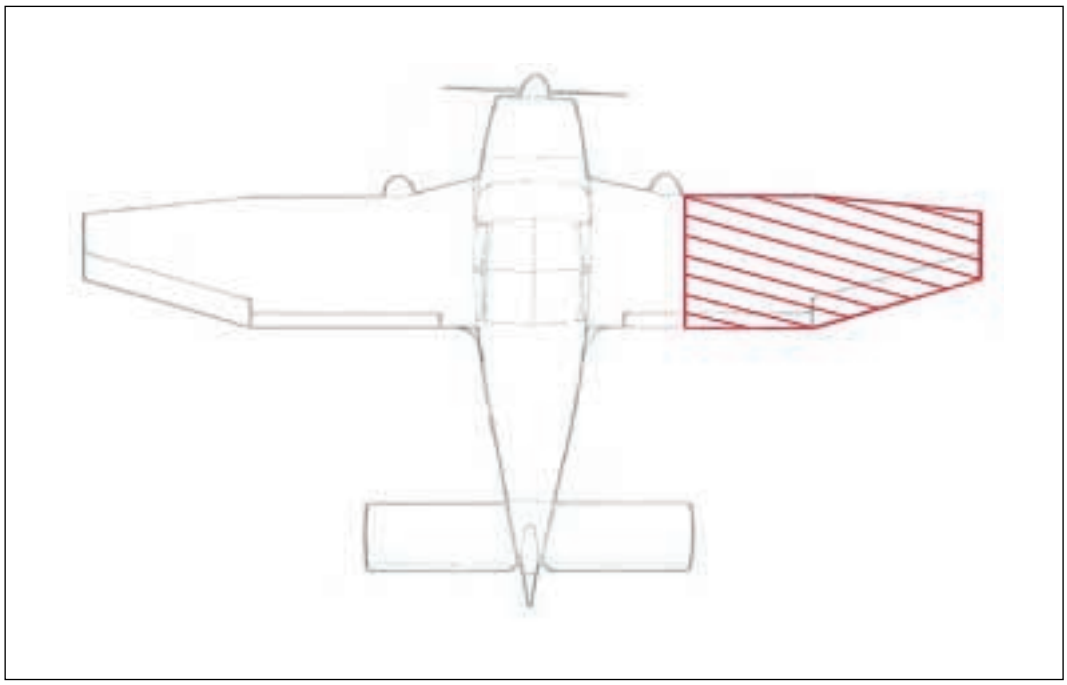
Primary Impact Site

Secondary Site:
Where wing section was located.

APPENDIX E


Accident Site Wreckage Pattern
MAIN WRECKAGE/IMPACT SITE
STONE WALL
STONE WALL
WOODEN FENCES
No. DESCRIPTION
1 ENGINE COWLING
2 DATA PLATE
3 RIGHT HAND U/C
4 LEFT HAND U/C
5 LEFT WINGTIP, MAIN WRECKAGE
6 BAG (BLUE), FISHING HOOKS
7 AERIAL
8 BAG, CLOTHES, SHOES
9 COKE CAN
No. DESCRIPTION
10 BATTERY CHARGER
11 NAVY-RED CLOTHES BAG
12 PHONE CHARGER
13 HEADSET
14 NAV BAG, MOBILE PHONE, SKYFORCE GPS, BAG
15 LIFE JACKET
16 WING

APPENDIX F



Profile of Aircraft

Section of wing that separated from aircraft

APPENDIX G

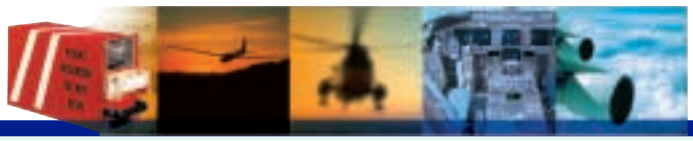
Altimeters No. 1 and No. 2

Altimeter No. 1 with face covered

Altimeter No. 1 with broken mounting screw

Altimeter No. 2 with unserviceable label

- END -



AAIU Synoptic Report No: 2006-025

AAIU File No: 2006/0029

Published: 06/11/2006

In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, Mr Jurgen Whyte, appointed himself on 14 April 2006, as the Investigator-in-Charge to carry out a Field Investigation into this Accident and prepare a Synoptic Report.

Aircraft Type and Registration:	Jodel D 120[15], G-CCBR.
No. and Type of Engines:	1 x Continental C90-14F.
Aircraft Serial Number:	59.
Year of Manufacture:	1957.
Date and Time (UTC):	14 April 2006 @ 17.40 hrs.
Location:	Runway (RWY) 19 Kilrush Airfield, Co. Kildare.
Type of Flight:	Private.
Persons on Board:	Crew - 1 Passenger - 1
Injuries:	Crew - Nil Passengers - Nil
Nature of Damage:	Undercarriage collapsed, propeller, lower cowling, air intake and filter box damaged.
Commander's Licence:	Irish PPL.
Commander's Details:	Male, aged 46 years.
Commander's Flying Experience:	148 hours (of which 4 hours were on type).
Information Source:	Pilot Accident Report Form submitted by Pilot. AAIU Field Investigation.

15 The Jodel D120 is a tail wheel aircraft.

SYNOPSIS

Following touchdown on RWY 19 at Kilrush, directional control was lost, the aircraft departed the right side of the tarmac runway and entered soft ground. The undercarriage collapsed and other associated low speed impact damage was caused to the aircraft. Both the Pilot and the passenger exited the aircraft unaided. There was no fire or injuries.

1. FACTUAL INFORMATION

1.1 History of the Flight

Returning from a navigation exercise to Carlow, the Pilot, who was relatively new on the Jodel aircraft, planned for an approach to and "touch and go" on RWY 19, followed by a landing on RWY 29. The weather conditions were sunny with few cloud and light winds (<3 kts) from the south.

As the Pilot positioned for a left downwind for RWY 19, he observed another aircraft taxiing on the taxi strip for RWY 19 and a tractor moving on the grass area on the left-hand side of the runway. Following a soft main wheel touchdown, the aircraft proceeded down the runway and then drifted slightly to the left. The Pilot applied right rudder but the aircraft continued to drift left on the runway. He then decided that he would carry out the planned go-around. However, the tractor had now positioned closer to the side of the runway and the pilot felt that he would be on a collision course with the tractor if he applied full power and initiated the go-around.

The Pilot decided to abort the idea of a go-around and concentrate on keeping the aircraft on the runway. Following a number of rudder corrections to the right and left, the aircraft ground looped right 90 degrees and departed the right hand side of the runway surface. The aircraft entered soft grassy ground and the undercarriage collapsed gently as the main wheels dug into the ground. There was no impact as the aircraft stopped in a tail high position. The Pilot switched off the magnetos, the master switch and fuel and evacuated the aircraft with his passenger. There was no fire or injuries.

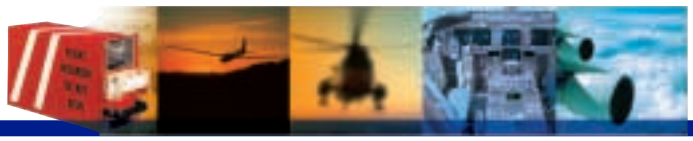
2. Damage

The main undercarriage collapsed following entry into soft grassy ground. Associated damage included impact damage to the propeller, the lower engine cowling, the air intake manifold, the air filter box and some fabric damage on the port wing.

3. Comment

The main difference between a nosewheel and tailwheeled aircraft is that the centre of gravity (CG) is forward of the main gear on the tricycle gear aircraft and behind the main gear of the tailwheeled aircraft. Since the CG is behind the main wheels on the tailwheeled aircraft, the aircraft is not directionally stable while manoeuvring on the ground. The tendency is for the aircraft to yaw as the CG is pushing from behind.

During taxiing, take-off and landing of a tailwheeled aircraft, constant rudder corrections are necessary to keep it rolling straight. On or after landing, if the aircraft is not straight (no drift or crab), the CG will be offset and will try to swing the tail around. If the drift is slight, it can normally be corrected through opposite rudder. If the drift is significant or if there is a strong crosswind, there may not be sufficient rudder control or differential braking action available to re-establish directional control.



In this particular event, the wind conditions were calm and the runway surface was dry. Following a two-wheel touchdown, as the aircraft proceeded down the runway, a slight drift to the left occurred and the corrective action was insufficient to arrest the drift. Subsequent corrections caused the aircraft to ground loop and depart the runway.

The presence of an aircraft manoeuvring on the RWY 19 taxiway and a tractor operating in relatively close proximity to the left side of RWY 19, may have distracted the Pilot from ensuring that the aircraft remained straight (through constant and appropriate rudder corrections) on the runway, following touchdown.

The skill of maintaining directional control of a tailwheeled aircraft requires practice and currency. In that regard, it is noted that the Pilot was relatively new on type and only had a total of 29 hours tail wheel experience.

4. SAFETY RECOMMENDATIONS

This Report does not sustain any Safety Recommendations.

- END -

PRELIMINARY ACCIDENT REPORT

This is preliminary information, subject to change, and may contain errors.
Any errors in this Report will be corrected when the Final Report has been completed.

Report No:	2006-015
1. AIRCRAFT MANUFACTURER:	Cessna Aircraft Corporation
Model:	F150M
State of Registry:	Ireland
Registration:	EI-CHM
Serial Number:	150-79288
Year of Manufacture:	1977
2. OPERATOR:	National Flight Centre
3. TYPE OF OPERATION:	Training
4. DATE / TIME:	25 May 2006 @ approximately 09.55 hrs Local
5. POSITION OF OCCURRENCE:	Raharney, Co. Westmeath, Ireland
6. PERSONS ON BOARD:	Crew: Two
7. INJURIES:	Crew: Two (Fatal)
8. DAMAGE:	Aircraft destroyed
9. INVESTIGATOR-IN-CHARGE:	Mr John Hughes

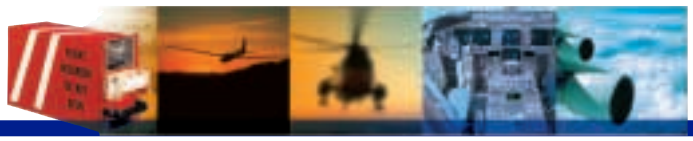
The aircraft departed Weston Aerodrome at approximately 09.20 hrs local time on an instructional detail to the West. A qualified flight instructor was seated in the left hand seat and a pupil, who was on a flight instructor's course, was seated in the right hand seat. The purpose of the flight was a revision detail for a pre-instructors rating test of the right hand seat occupant. It was intended that the flight would take about one hour, and sufficient fuel was on board.

At approximately 09.55 hrs, witnesses who were working on a house close to Raharney, Co. Westmeath, heard the sound of a revving engine and on looking towards the West saw an aircraft spiralling vertically down to earth.

A survey of the accident site determined that the aircraft impacted vertically. There was no wreckage path and all components of the aircraft were located at the site. To date, no evidence of pre-impact aircraft failure has been found An initial inspection of the engine did not reveal any abnormalities that would have prevented normal operation and production of rated horsepower.

The Investigation is ongoing and a Final Report will be published in due course.

- END -



PRELIMINARY ACCIDENT REPORT

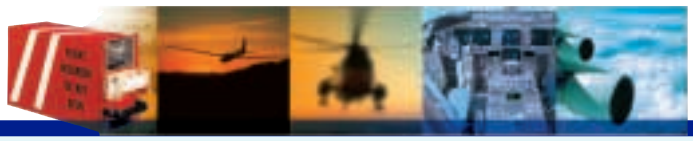
This is preliminary information, subject to change, and may contain errors.
Any errors in this Report will be corrected when the Final Report has been completed.

Report No:	2006-018
1. AIRCRAFT MANUFACTURER:	Pilatus Aircraft Ltd
Model:	B4-PC11 AF
State of Registry:	Ireland
Registration:	EI-121
Serial Number:	199
Year of Manufacture:	1976
2. OPERATOR:	Kilkenny Flying and Gliding Club.
3. TYPE OF OPERATION:	Private Flight.
4. DATE / TIME:	07 August 2006 @ 17:35 hrs
5. POSITION OF OCCURRENCE:	Adjacent Kilkenny Airfield.
6. PERSONS ON BOARD:	Crew: 1 Passengers: None
7. INJURIES:	Crew: 1 (Fatal) Passengers: None.
8. DAMAGE:	Aircraft destroyed.
9. INVESTIGATOR-IN-CHARGE:	Frank Russell.

The weather in the Kilkenny area was good, unrestricted visibility and little cloud. Some pilots reported strong thermal activity in the vicinity of the airfield. The members of the local Flying Club were taking full advantage of the good flying conditions on this August Bank Holiday Monday. The pilot, who was very experienced in both power and glider aircraft, had earlier that afternoon flown an MS 893 Rallye aircraft, which is the Club's glider towing aircraft. This was a routine towing flight. On his return, he had arranged to fly the Pilatus B4, a single seat glider, which had recently been issued with a Temporary Certificate of Airworthiness by the Irish Gliding and Soaring Association.

Again, the MS 893 was the towing aircraft and EI-121 was released, as briefed, at 2000 feet. The pilot had two-way communications with other airborne members of the Club in the Kilkenny area, and his well being was evidenced by an upbeat mobile phone call to his home. At the Airfield, his flight was observed by two Club members on the ground. Both recall his approaching the Airfield in a Southerly direction, at 90° to the 09 Runway. Having crossed the Airfield boundary, at approx 400 feet, both witnesses recall the glider adopting a sudden nose down attitude with wings level, as it continued down to impact the ground. The pilot received fatal injuries and the aircraft was destroyed. The Investigation is ongoing and a Final Report will be published in due course.

- END -



AAIU Synoptic Report No: 2006-029

AAIU File No: 2005/0048

Published: 14/8/06

In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on 9/08/05, appointed Mr John Hughes as the Investigator-in-Charge to carry out a Field Investigation into this Serious Incident and prepare a Synoptic Report.

Aircraft Type and Registration:	ATR 42-300, EI-BYO
No. and Type of Engines:	2 x Pratt & Whitney PW100-120
Aircraft Serial Number:	161
Year of Manufacture:	1989
Date and Time (UTC):	5 August 2005 @ 13.28hrs
Location:	Enroute to Cork Airport
Type of Flight:	Public Transport
Persons on Board:	Crew - 3 Passengers - 45
Injuries:	Crew - Nil Passengers - Nil
Nature of Damage:	No Damage to Aircraft
Commander's Licence:	JAA ATPL
Commander's Details:	Male, aged 31 years
Commander's Flying Experience:	5,000 of which 570 were on type.
Information Source:	Operator and Irish Aviation Authority.

SYNOPSIS

The aircraft was enroute to Cork Airport when the crew observed that No. 1 engine was producing progressively less power. The landing at Cork was routine and the passengers disembarked via the normal stairs. The crew discovered that No. 1 engine nacelle was leaking fuel. Further investigation revealed that the fuel was leaking from a pipe connection, which had become loose.

1. FACTUAL INFORMATION

History of the Flight

During climb enroute to Cork the crew noticed a discrepancy in parameters between engine No1 and engine No.2. This got progressively worse with increasing altitude. Since the aircraft was almost halfway at that stage the crew decided to continue to Cork Airport. Engine No.1 was not producing the normal amount of torque and all it's other parameters were also unusual. The cabin attendant was then informed of the situation. During approach the crew had a large split throttle between the two engines but otherwise the landing was normal. After touch down the crew feathered No.1 engine and 20 seconds later shut it down.

On arrival at the parking position the cabin attendant informed the crew that fuel was leaking from engine No.1 nacelle. The crew shut down No.2 engine and pulled the fire handle for No.1 engine. The Airport Fire Service was requested and after discussion with the Fire Chief the Captain decided to allow the passengers to disembark. They did so in the normal way and there were no reported injuries.

1.2 Aircraft Information.

The leak was traced to a nut on the fuel flow divider union. The nut was discovered to be incorrectly wire locked and had backed off the divider. The union was re-torqued in accordance with the Maintenance Manual (MM) and leak tested. An engine run was carried out which was satisfactory. The nut was then wire locked correctly.

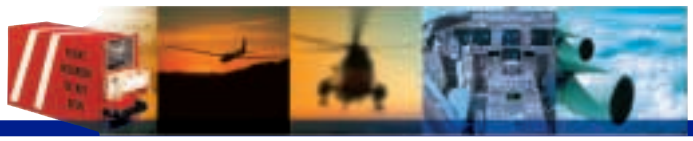
1.3 Aircraft History.

The aircraft had completed 303 flight hours since the last A-Check on 5 June 2005. No work had been carried out on the engine fuel pipe since that date when the fuel nozzles were replaced. It is reasonable to assume that the nut was incorrectly wire-locked at that time.

1.4 Manufacturers Instructions

APPENDIX A shows a photograph and drawing of the fuel flow divider assembly installation. The Maintenance Manual requires that items to be wire locked together are the tube coupling nut to its thrust pin, and the coupling nut to the adjacent dump valve bolts.

The sole function of the thrust pin is to retain the nut on the pipe. Without the thrust pin installed the nut could slide over the flared end of the pipe. The pin facilitates replacement of a worn or damaged nut on a pipe assembly without having to replace the pipe. Disconnecting the coupling nut from the flow divider does not involve removal of the thrust pin.



1.5 Operator Actions

In August 2005, days after this incident, the Operator issued Engineering Notice No. 28/2005 instructing it's technical personnel that the instructions detailed in the engine manufacturers Maintenance Manual should be followed during the removal/installation of the flow divider delivery tube nut. The Operator also found that an incorrect thrust pin configuration may be found due to an error in the engine shop Cleaning Inspection and Repair Manual (CIR). An Operators Quality Assurance Notice (ENO705) was issued on 10 August 2005 requiring that a duplicate inspection be carried out anytime part of the fuel system downstream of the fuel booster pumps is disturbed.

A fleet inspection was initiated following this incident and one further instance of incorrect wire locking was revealed. The above CIR Manual 72-09-20 page 901/902 was amended by the engine manufacturer on 25 November 2005.

2. ANALYSIS

Correct wire-locking procedure will ensure that this nut is held tight against the threads during in service vibration of the pipe assembly. In this case the incorrect method of wire locking had significant safety implications.

The method of wire locking used did not prevent the nut from backing off due to normal engine vibration. This allowed the nut to loosen with a consequent leakage of fuel on to the engine nacelle. The fuel flow to the engine was progressively less and a reduction in available power followed. Had the flight time been longer the engine could have suffered complete fuel starvation, necessitating a descent and approach with only No.2 engine operating. On landing, the Captain took the correct action in pulling the No.1 fire handle and calling the Fire Services. Operator actions, in issuing the Engineering Notice and the QA Notice, following the event were adequate. The preliminary amendment of the manufacturers CIR manual was also timely. The Investigation does not, therefore, intend to make any Safety Recommendations.

3. CONCLUSIONS

(a) Findings

1. Fuel leaked from the fuel flow divider of No. 1 engine during flight causing a loss of engine power.

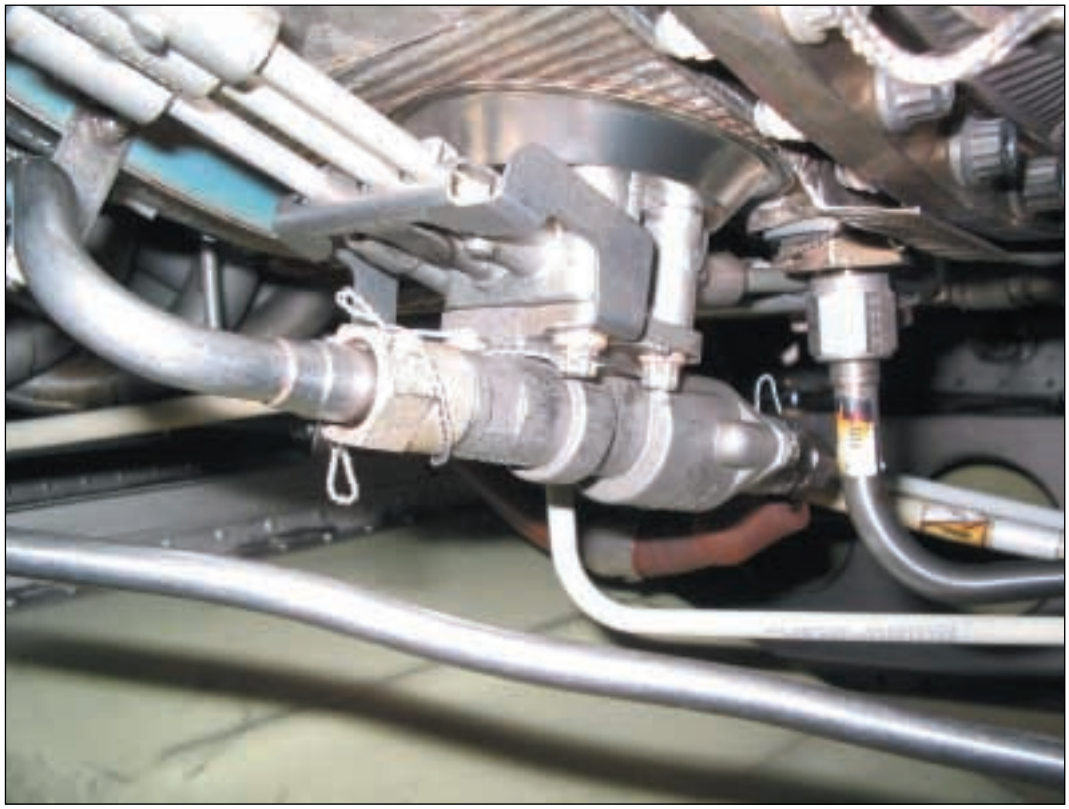
(b) Cause

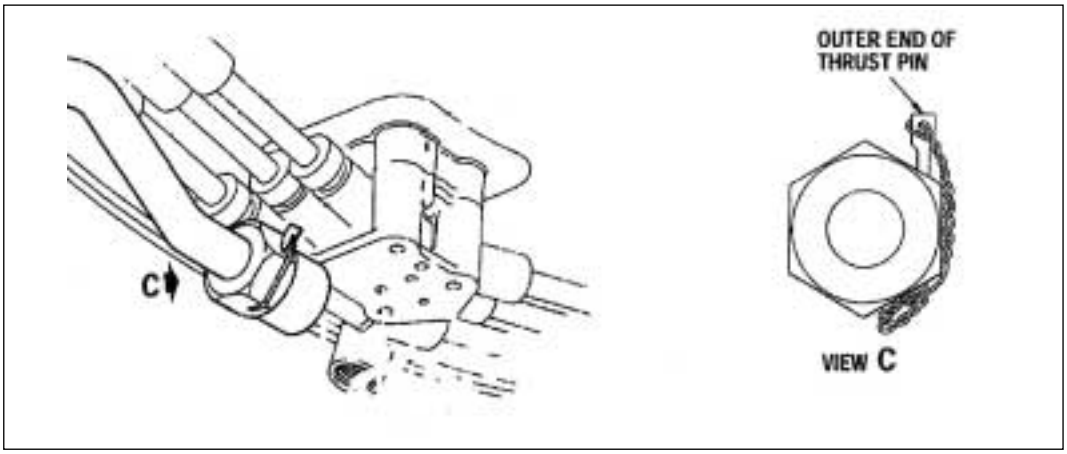
2. A nut on the fuel flow divider was incorrectly wire-locked and allowed the nut to back off, thereby causing the fuel leakage.

4. SAFETY RECOMMENDATIONS

This Report does not sustain any Safety Recommendations.

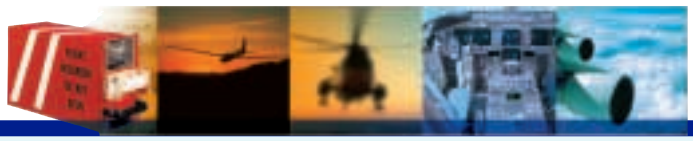
APPENDIX A





The tube coupling nut is wire locked to adjacent bolts on the dump valve in such a way that tension in the wire prevents the nut from backing off. The wire locking of the thrust pin to the coupling nut keeps the thrust pin in place.

- END -



AAIU Synoptic Report No: 2006-0020

AAIU File No: 2006/0003

Published: 25/09/06

In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on 11/01/06, appointed Mr Jurgen Whyte as the Investigator-in-Charge to carry out a Field Investigation into this Serious Incident and prepare a Synoptic Report.

Aircraft Type and Registration:	Sikorsky S 61 N, EI-SAR.
No. and Type of Engines:	2 x General Electric CT58-140-2.
Aircraft Serial Number:	61143.
Year of Manufacture:	1962.
Date and Time (UTC):	17 January 2006 @ 11.10 hrs.
Location:	Conningbeg Lightship, 5 nm south south west of the Saltee Islands, Co Wexford.
Type of Flight:	Training.
Persons on Board:	Crew - 5 Passengers - Nil
Injuries:	Crew - 1 (Minor) Passengers - Nil
Nature of Damage:	Extensive to two main rotor blades and cockpit canopy.
Commander's Licence:	Irish ATPL(H).
Commander's Details:	Male, aged 36 years.
Commander's Flying Experience:	3,980 hours of which 2,225 hours were on type.
Information Source:	Pilot Report Form and Reports submitted by SAR crew.

SYNOPSIS

While conducting a routine winching training exercise on the Conningbeg Lightship, the hoist cable snagged, then sheared and recoiled under load back up towards the helicopter, where damage was inflicted to the main rotor blades and the cockpit canopy. The helicopter recovered back to Waterford Airport (EIWF) without further incident. The Winch Operator suffered a laceration injury to his hand.

1. FACTUAL INFORMATION

1.1 History of the Flight

1.1.1 General

The Search and Rescue (SAR) helicopter took off on a training sortie from its SAR base at Waterford Airport (EIWF) at 09.30 hrs with a total of 5 crew onboard. The crew was made up the Commander, Co-Pilot, a Winch Operator, a Winchman and a Winchman (female) under instruction. The weather was benign.

Following a number of circuits to various targets over the water, the decision was made (as briefed) to conduct transfers to the Conningbeg Lightship that was anchored approximately 5 nm south south west of the Saltee Islands. On carrying out a reconnaissance of the lightship, it was decided that the bow section was the most suitable area available for transfer under the prevailing conditions. On completion of a briefing and dummy approach to hover, the transfer commenced.

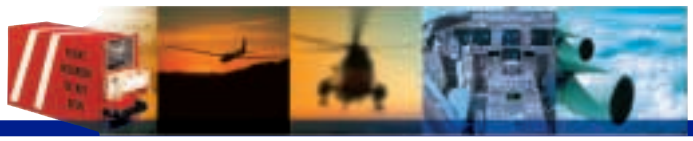
The Winchman was lowered to the deck and landed facing the foot of a steel ladder in the very bow of the ship where the sides are raised to provide a sheltered deck. The vessel was rising on a 2-metre swell and, as the Winchman attempted to release from the hoist hook, he was thrown off balance by the falling bow. To steady himself, the Winchman had to grasp the ladder with one hand, while at the same time trying to release from the hoist hook. During this process, a coil of cable looped around a small steel protrusion welded to the side of the ladder (**Photo No 1**).

On seeing that the Winchman had disconnected, the Winch Operator started to winch in the cable. At the same time, the bow of the ship pitched down, load was put on the unseen snagged cable and the cable sheared just above the hook attachment point.

A loud bang was heard and a heavy vertical jolt was felt through the helicopter. Simultaneously, the front and upper cockpit Plexiglas was struck by the recoiled cable, with the outside air temperature (OAT) probe falling inwards and a hole appearing above the heads of the two pilot's.

The Winch Operator, who had received a laceration to his hand following the recoil of the cable, reported that the cable had sheared, but that the Winchman was secure on the deck. The helicopter cleared away from the lightship, turned towards the coastline and transitioned slowly forward.

The decision was made by the Commander to recover the helicopter directly back to their SAR base at Waterford Airport (approximately 18 nm distance). This decision was based on the facts that, there were no abnormal vibrations or cockpit indications, the Winch Operator required medical attention, the Winchman was secure on the deck, and a run-on landing at Waterford Airport, with minimum attitude change was preferable.



The co-pilot made a PAN call on VHF (Waterford Tower) and FM (Rosslare Coastguard) for cover during the helicopters transit (at minimum power speed of 60 kts) to the Airport, where at 11.28 hrs it carried out an uneventful landing.

The Winchman remained on the deck of the lightship and was later recovered back to Dunmore East Harbour on a rubber inflatable boat (RIB) from the Naval Vessel, Le Orla, which was operating in the area at the time.

1.2 Damage

A visual inspection of the helicopter at Waterford determined that following the cable shear, the cable apparently travelled directly upwards striking both the black and white main rotor blades[16]. Following the initial blade strike, the cable whipped the upper section of the cockpit canopy, breaking a 4-inch hole into the pilot's overhead observation window. The centre windscreen window was also broken around the OAT probe. The probe was left hanging into the cockpit, causing a 6 to 8 inch hole. The cable then came to rest on top of the cockpit section forward of the UHF and FM antennas, and trailed down the left side of the forward fuselage, along the hull and left hand undercarriage sponson. The co-pilot's wiper/washer tube was found to be missing.

The white blade (S. No 61-M-3886-3355) had extensive damage to pocket 17 and 18. Scoring was found to the leading edge spar forward of pocket 17 and 18. A tear was also found in the pocket up to the rear of the blade spar (**Photo No. 2**).

The black blade (S. No 61-M-3860-3637) had a hole/tear on its upper surface at pocket 21 up to the rear of the blade spar. There was some scoring at the leading edge of the spar and on the upper surface of the spar in the same area (**Photo No. 3**).

Due to the extent of the damage, the blades were returned to an overhaul facility for further examination and repair.

The overhead pilot's observation (eye-brow) window was broken beyond repair.

An examination of the rescue hoist determined that the only damage suffered was to the stop plate (lower surface distorted) as a result of the sheared cable passing through the hole. The hoist was returned to the manufacturer for further examination and repair.

The hoist cable sheared just above the hook attachment point.

The onboard Health and Usage Monitoring System (HUMS) was downloaded and analyses carried out on all parameters were found to be satisfactory. A slight rise in main rotor head lateral vibration (due blade damage) was observed in the analysis but the reading remained well below the threshold.

No fault was found with any other part of the aircraft.

1.3 Winch Hook Assembly

The winch hook is made up of a stainless steel hook, a keeper plate with safety locks on either side, a hoist ring, and an end of travel hoist spring/weight (**Photo No. 4**).

16 The rotar assembly contains a total of 5 main rotar blades.

The keeper plate, in the secured position, ensures that the winchman does not become detached while on the hoist hook. When the winchman requires to detach from the hook, he/she has to depress the safety locks on either side of the keeper plate and then pull the plate back to create and open hook. The hook is then tilted to drop the 'D' ring (winchman attachment point) off the hook while it is held open.

The hoist ring is located above the hoist hook and is primarily used as a handgrip. However, it does also add additional weight to the hoist hook assembly, thereby reducing the tendency for the hook to drift when free.

2. COMMENT

The winchman recalled that because of the need to stabilise himself against the ladder with his left hand, he had to open the hoist hook and disengage from it with his right hand. He considered that this created a delay in getting off the hook and thus giving time to ensure the safe passage of the hook and cable over the side and clear of the vessel.

The inclusion of a ring on the hoist hook is generally optional on purchase of the hoist. No commonality exists among SAR Units world wide with regard to the inclusion or non-inclusion of the ring on the hoist hook. The SAR operator associated with this particular occurrence has some helicopters fitted with hoists rings and others without. EI-SAR at Waterford is one of the helicopters fitted with a ring on the hook.

One factor that can hinder quick single-handed operation of the hoist hook is the obstruction caused by the hoist ring. The ring can impede easy access to the hook as the hook can only be grasped from below the ring. This spoils the natural grip on the hook and latches, and although appearing as a minor matter, it may be critical in a situation where fractions of seconds count. The ring also increases the profile of the hook assembly, creating a larger snagging hazard in confined areas.

In discussions with the Operator, it has been confirmed that the Company has reviewed the matter of the hoist ring and have decided to standardise all hoists (to a ring-less hook) within their fleet. The Investigation is supportive of this initiative.

The helicopter SAR Crews provide a vital and effective life saving service to the State. Whether engaged in operational or training exercises, there will always be risks associated with winching operations.

Training exercises such as this one carried out on the Conningbeg Lightship, form an integral element of maintaining SAR Crews proficiency. The benefit of such training far outweighs the associated risks, and while this particular incident was serious, it is not a common occurrence and must be viewed as part and parcel of the unpredictable helicopter SAR environment.

3. SAFETY RECOMMENDATIONS

This Report does not sustain any Safety Recommendations.

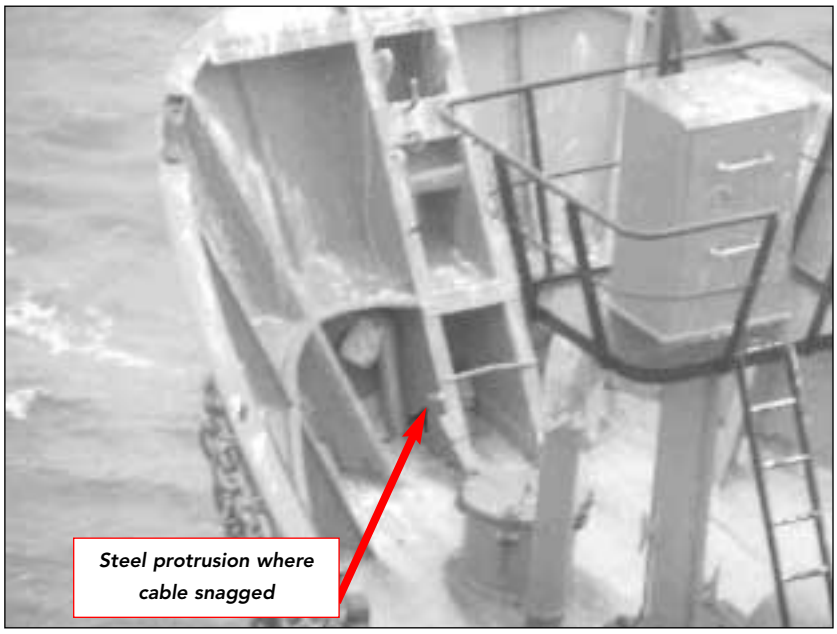
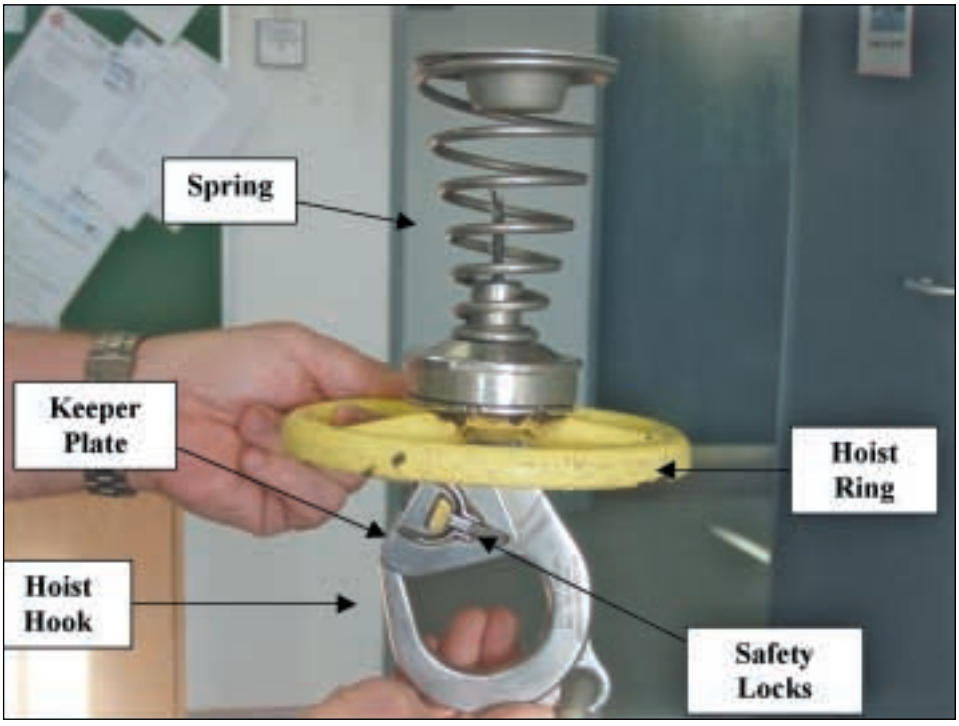


Photo No. 1

Photo No. 2 - Damage to White Blade

Photo No. 3 - Damage to Black Blade



Photograph No 4 - Hoist Hook Assembly

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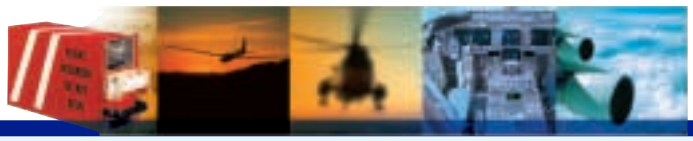


AAIU Synoptic Report No: 2006-027

AAIU File No: 2005/0010

Published: No: 23/11/06

In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on 21/2/05, appointed Mr John Hughes as the Investigator-in-Charge to carry out a Field Investigation into this Incident and prepare a Synoptic Report.

Aircraft Type and Registration:	BAe 146-200, EI-CWA
Aircraft Serial Number:	E2058
Year of Manufacture:	1986
Date and Time (UTC):	21 February 2005 @ 15.30 hrs
Location:	Dublin Airport
Type of Flight:	Ferry Flight
Persons on Board:	Crew - 2 Passengers - Nil
Injuries:	Crew - Nil Passengers - Nil
Nature of Damage:	Broken LH undercarriage door hinge
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Details:	Male, aged 42 years
Commander's Flying Experience:	10,200 hours, of which 5,700 were on type
Information Source:	ATS Dublin (Report No. DA 031/05)

SYNOPSIS

The aircraft was on a positioning flight to Paris CDG following maintenance for a suspected Main Landing Gear indication problem at Dublin. On retraction of the gear following the take-off, a red "gear unlocked" and "gear in transit" warning light, was observed by the crew. The "abnormal" checklist detail was then carried out and the gear activated in an effort to clear the problem. The crew requested a quick return (QRF) to Dublin. On the approach the warning indications cleared and the aircraft landed on RWY 28. No airport services were required. An inspection of the aircraft revealed that a Left Hand (LH) undercarriage door hinge had broken.

1. FACTUAL INFORMATION

1.1 History of the Flight

The aircraft was scheduled for a ferry flight after an undercarriage gear repair and the Captain and his First Officer (FO) had been briefed by Engineering. After take-off the gear was retracted. A red "Gear Unlocked" and at the same time an undercarriage "In-transit" light stayed on showing that the gear was not up-locked. During climb the abnormal checklist was completed and maintenance contacted who requested that a gear swing should be carried out. This was completed but with no improvement. The crew requested a quick return (QRF) to Dublin. During approach the warning disappeared, which suggested an indication problem. The undercarriage gear was cycled again and no fault indication occurred. At no time were there any vibration or unusual noise levels noticed and a normal landing was carried out. The aircraft taxied normally to the stand.

No emergency call was made in this instance, but the Airport Fire Services (AFS) had been alerted by the Airport Authorities. At the stand, it became apparent that one of the LH gear door hinges had failed.

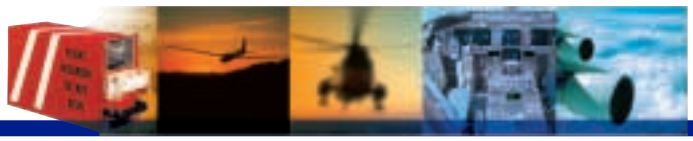
1.2 Aircraft Information

The main gear doors are mechanically linked to the landing gear and close only when the undercarriage gear is retracted, to enclose the gear and fairing within the fuselage. The door is also attached to the main gear bay through two upper door hinges. A side stay is installed between the main landing gear and the airframe to provide a mechanically locked support when the gear is in the extended position.

Proximity switches mounted on the side stay give a remote indication that the unit is in the locked or unlocked condition. The door up-lock electrical circuit is integrated into the main undercarriage indicating system through a printed circuit board (PCB) in order to confirm to the crew that both the undercarriage and the door are in the up-locked position.

1.3 Maintenance History

On a flight the previous day, the LH main gear unsafe indication appeared after the gear had been selected up. The crew carried out the emergency check list drill and concluded that the indication was due to a fault in the indicating circuitry. Maintenance trouble-shooting failed to find a fault. The gear was cycled without any erroneous indications.



1.4 Manufacturers Action

On 22 December 2004, the aircraft manufacturer issued an "All Operator Message" indicating that there had been three reported instances of main landing gear door hinge failures. This had been attributed to corrosion, which had gone undetected due to corrosion emanating from the surface between the bracket and the bearing housing. Only extensive corrosion of this type would have been visible due to the inspection regime then in place.

The action they proposed was to replace hinges, where corrosion was found, with a modified hinge. Where no corrosion was found, a specific protection treatment was required. The message referred to a previous Service Bulletin (ISB 52-113) issued in February 2001, with a "Recommended" compliance. The manufacturers now recommended that the SB be carried out with focus being placed on older aircraft first. They intended to raise the SB classification in consultation with the UK CAA.

1.5 Fleet Status

At the time of this incident, the SB had been complied with, in the case of 10 out of the Operator's fleet of 16 aircraft. The remainder, including EI-CWA had been scheduled for this maintenance. All of the 10 aircraft had been modified prior to the issue of the "All Operator Message".

2. ANALYSIS

The corrosion evidenced in the attached photographs at **APPENDIX A** was very severe but might not have been readily visible in situ. There was obviously a problem with the door during the previous flight. Maintenance could not find the fault probably due to the fact that in the hangar there were no aerodynamic forces acting on the door pulling it in a lateral direction. The hinge may have been fractured at that stage.

On the incident flight, the aerodynamic forces on the door were sufficient to finally break the door hinge. The door was then only supported through the rear hinge. When the door closed the aerodynamic forces prevented the door roller from engaging in the door up-lock.

3. CONCLUSIONS

(a) Findings

1. The LH undercarriage door failed to engage in the door up-lock.

(b) Cause

1. The failure of the door forward hinge was due to corrosion. Failure of the hinge, in turn, prevented the up-lock from engaging due to lateral aerodynamic forces on the door.

4. SAFETY RECOMMENDATIONS

This Report does not sustain any Safety Recommendations.

Note: *SB (52-113) was mandated on 6 July 2005 under EASA AD G-2005-0017. It has since been incorporated on all the Operator's aircraft except for G-MIMA and G-OZRH, which are on Annex 6 arrangements.*

APPENDIX A

Photo No. 1: The broken half-hinge attached to the undercarriage door.

Photo No. 2: The corresponding half fixed to the undercarriage strut showing the corrosion on the bearing housing.

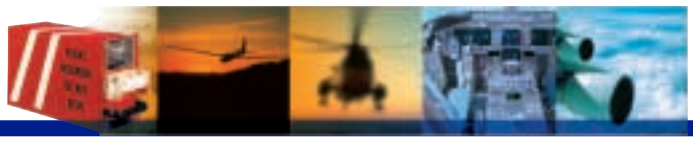
Photo No. 3: General view of the LH undercarriage and door.

- END -

AAIU Synoptic Report No: 2006-013
AAIU File No: 2005/0028
Published: 31/7/06

In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on 24/05/05, appointed Mr John Hughes as the Investigator-in-Charge to carry out a Field Investigation into this occurrence and prepare a Synoptic Report.

Aircraft Type and Registration:	Cessna 172 M, EI-BUA
No. and Type of Engines:	Lycoming L-36760-27A
Aircraft Serial Number:	17265451
Year of Manufacture:	1975
Date and Time (UTC):	23 May 2005 @ 10.30 hrs
Location:	RWY 25 at Weston Airport, Leixlip, Co. Kildare
Type of Flight:	Training
Persons on Board:	Crew - one Passengers - one
Injuries:	Crew - Nil Passengers - Nil
Nature of Damage:	Propeller sustained damage to both tips. Engine removal for shock test.
Commander's Licence:	UK CPL
Commander's Details:	Male, aged 28 years
Commander's Flying Experience:	750 hours of which 97 were on type
Information Source:	Airport Manager AAIU Field Investigation.



SYNOPSIS

The aircraft was hired out from the owner for a practice circuit detail. After a normal approach and touchdown on RWY 25, a gust of wind caused the nose of the aircraft to drop. The propeller struck the runway surface and both blade tips were damaged. There were no reported injuries and the pilot and his passenger exited the aircraft in the normal way.

1. FACTUAL INFORMATION

1.1 History of the Flight

The pupil, who was flying the aircraft (PF), was a PPL holder with a total of 120 flying hours and 5 hrs flying experience on the Cessna 150. He was being checked out to fly a Cessna 172 aircraft.

The pupil and his instructor took off on a "circuits" detail. The weather was gusty when the aircraft took off at 10.21 hrs. At 10.30 hrs the pupil made a normal approach to RWY 25, which was followed by a touchdown, which was also considered normal. On the roll out a gust of wind caused the left wing to rise and the nose of the aircraft to drop. The instructor took control and took immediate corrective action. Despite this, the propeller struck the runway surface. No one was injured and the runway surface was slightly damaged with propeller indentations along the centreline.

1.2 Meteorological Conditions

The forecast conditions given to the pilot by Met Eireann were as follows:

Wind:	225/20 G 30kt.
Visibility:	10 Km.
Significant Weather:	NIL.
Cloud:	SCT 1,600 ft
Temperature/Dew Point:	12/06

The actual conditions were:

Wind:	220/24 G 34
Visibility:	10 Km.
Significant Weather:	NIL
Cloud:	SCT 1,800 ft.
Temperature/Dew Point:	12/06.

1.3 Crosswind Landings

The manufacturer states that there is no crosswind limitation for the 172 M. The demonstrated crosswind is 15 knots. The following is from the Flight Manual relating to crosswinds:

"The maximum allowable crosswind velocity is dependent upon pilot capability as well as aircraft limitations. With average pilot technique, direct crosswinds of 15 knots can be handled with safety".

Generally the pilot will use minimum flap setting required for the field length and use a wing-low, crab or a combination method of drift correction and land in a nearly level altitude.

1.4 Pilots Comments

The instructor said afterwards that his flap setting was less than 20°. He assessed that the cause of the incident was due to low-level turbulence and strong gusty wind conditions.

2. ANALYSIS

The forecast weather conditions obtained by the instructor prior to flight would indicate that the forecast crosswind element might exceed 15 kts. The actual conditions, obtained at 10.00 hrs, indicated a wind of 220/24 G 34, which at 30° left of runway heading would give a maximum crosswind gust of 17 kts. Whilst the crosswind might have been well within the capability of the instructor, it was not so for the pupil who at the time was being upgraded from a smaller Cessna 150 aircraft. Mindful of the prevailing crosswind conditions, it would have been prudent for the instructor to reiterate the crosswind landing and roll out technique to the student.

3. CONCLUSIONS

(a) Findings

1. Both propeller blades were damaged on landing.

2. The landing conducted by a pilot with no type experience, but under instruction, was attempted at, or slightly above, the aircrafts recommended crosswind limits.

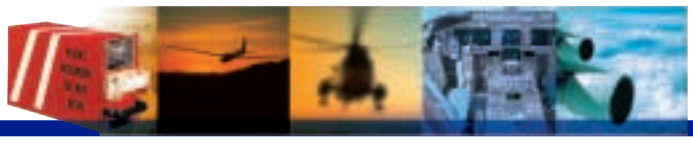
(b) Cause

1. A gust of wind caused the left wing to rise, the nose to drop, and the propeller to impact the runway surface.

4. SAFETY RECOMMENDATIONS

This Report does not sustain any Safety Recommendations.

- END -



PRELIMINARY INCIDENT REPORT

This is preliminary information, subject to change, and may contain errors.
Any errors in this Report will be corrected when the Final Report has been completed.

Report No:	2006-016
1. AIRCRAFT MANUFACTURER:	Airbus
Model:	A320
State of Registry:	Spain
Registration:	EC-HUK
Serial Number:	1318
Year of Manufacture:	2000
2. OPERATOR:	Iberia
3. TYPE OF OPERATION:	Public Transport
4. DATE / TIME:	3 May 2006 @ 18.53hrs
5. POSITION OF OCCURRENCE:	Dublin Airport, Ireland
6. PERSONS ON BOARD:	Crew: 6 Passengers: 97
7. INJURIES:	Crew: Nil Passengers: Nil
8. DAMAGE:	Fire in APU
9. INVESTIGATOR-IN-CHARGE:	Graham Liddy

This aircraft is equipped with a Honeywell 131-9A Auxiliary Power Unit (APU) mounted in the tail of the aircraft. After landing at Dublin, at the end of a flight from Barcelona, the crew attempted to start the APU. The APU achieved normal speed on this cycle, but an over-temperature on-speed condition was then detected and the APU automatically shut down. The crew made two further attempts to start the APU. Normal APU running was not achieved in either of these starts attempts and each start was terminated by the APU protection system. During these start attempts, the Control Tower observed smoke and then flames emanating from the APU. The Tower advised the aircraft crew of the problem and alerted the airport fire services. The crew stopped the aircraft on the Taxiway B3.

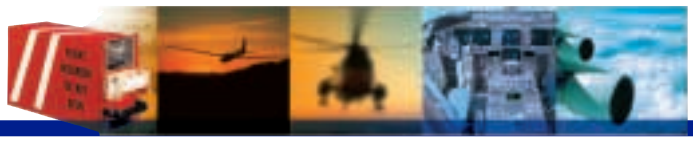
As the fire crew vehicles approached the aircraft from behind, debris was observed on the taxiway. The fire service tackled the fire, which was confined to the APU exhaust pipe, with foam and successfully extinguished it. Before the fire was extinguished, the Airport Fire Officer (AFO), who was in charge of the response team, called over the RT that there was a confirmed fire in the APU. ATC repeated this message to the aircraft.

The Captain initiated an emergency evacuation, which was conducted through the forward doors and the over-wing exits. The evacuation was accomplished quickly and without injuries. The debris noted above was subsequently recovered and identified as components of the APU rear bearing assembly. Examination of the aircraft found that the fire was confined to the APU exhaust pipe and that the failure of the APU was totally contained.

The APU was removed from the aircraft, as was the Flight Data Recorder and the Cockpit Voice Recorder. Supervised examination of the APU at the Honeywell facility at Raumheim, in Germany, showed that the APU rear bearing had seized and that the rear bearing support assembly was severely disrupted. The central tie shaft was grossly distorted in the rear bearing area and the forward end of the tie shaft had disconnected from the load compressor.

Further tests and examinations on the relevant APU components are continuing in order to determine the initial cause of the failure. The Investigation is ongoing and a Final Report will be published in due course.

- END -



PRELIMINARY INCIDENT REPORT

This is preliminary information, subject to change, and may contain errors.
Any errors in this Report will be corrected when the Final Report has been completed.

Report No:	2006-017
1. AIRCRAFT MANUFACTURER:	Airbus
Model:	A320
State of Registry:	Spain
Registration:	EC-JHJ
Serial Number:	1775
Year of Manufacture:	2002
2. OPERATOR:	LTE
3. TYPE OF OPERATION:	Public Transport
4. DATE / TIME:	10 June 2006 @ 12.29 hrs
5. POSITION OF OCCURRENCE:	Dublin Airport, Ireland
6. PERSONS ON BOARD:	Crew: 7 Passengers: 186
7. INJURIES:	Crew: Nil Passengers: Nil
8. DAMAGE:	Un-commanded Spoiler Actuation
9. INVESTIGATOR-IN-CHARGE:	Graham Liddy

While the aircraft was preparing for departure from Dublin, the flight crew noted that the No 5 left-hand (LH) wing spoiler was deployed in the fully open position. By resetting the system, the spoiler was successfully moved to the closed position prior to take-off.

After take-off, at an altitude of 1500 ft, the crew received a system warning indicating that the No 5 LH spoiler was again deployed in the fully open position. The crew noted that the auto-pilot was unable to hold the selected heading. The crew reverted to manual control, and experienced no difficulties in controlling the aircraft. They did note, however, that the aircraft's handling was different compared to the normal flight configuration. The crew advised Dublin ATC that they had a flight control problem and that they would return to Dublin. They did not declare an emergency. The aircraft landed without difficulty at Dublin.

Subsequent tests showed that the No 5 spoiler did deploy to the fully open position as soon as hydraulic pressure was supplied to the system (and consequently to the spoiler actuator). The spoiler also deployed when all electrical connections to the actuator were disconnected. The spoiler actuator, Lucas/Goodrich P/N 31077-111, was then removed and subjected to supervised testing at the manufacturer's facility. These tests showed that the problem lay in the actuator's electro hydraulic servo valve. The servo valve, MOOG Model D026-001B P/N A88004-003 was then tested under supervision at the MOOG facility in the UK. This examination showed that a seal in the spool valve had failed and that debris from this failure had blocked a port in the servo valve. It was determined that the effect of this blockage was to cause the spoiler actuator to move to full deflection.

Further tests and examinations on the failed seal are continuing in order to determine the initial cause of the failure. The Investigation is ongoing and a Final Report will be published in due course.

- END -

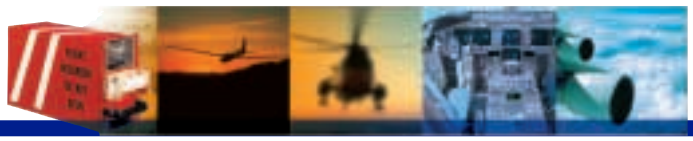
AAIU Synoptic Report No: 2006-021

AAIU File No: 2006/0058

Published: 02 October 2006

In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on 15 July 2006, appointed Mr Frank Russell as the Investigator-in-Charge to carry out an Investigation into this Incident and prepare a Synoptic Report.

Aircraft Type and Registration:	Robinson R-22 BETA 2, EI-EHB.
No. and Type of Engines:	1 x Lycoming 0360- J2A.
Aircraft Serial Number:	3569.
Year of Manufacture:	2004.
Date and Time (UTC):	15 July 2006 @ 1505 hrs.
Location:	Cork Airport (EICK).
Type of Flight:	Aerial Work (Training).
Persons on Board:	Crew - 1 Passengers - None.
Injuries:	Crew - None Passengers - N/A.
Nature of Damage:	Minor, bent rear cross tube on the skid assembly.
Commander's Licence:	Student Pilot Licence.
Commander's Details:	Male, aged 44 years
Commander's Flying Experience:	62.2 hours.
Information Source:	Reported by Operator. AAIU Incident Report Form submitted by Pilot.



SYNOPSIS

Following the activation of the low rotor RPM warning horn, the Pilot carried out a heavier than normal landing on the grass adjacent to the runway.

1. FACTUAL INFORMATION

1.1 History of the Flight

The student Pilot was preparing to undertake a solo x-country exercise, Cork Airport - Mallow - Cappoquin - Cork Airport. The weather conditions were favourable.

The Pilot recalls carrying out all the required pre-flight and after start checks, including a hover check and a spot turn. On calling ATC that he was ready for departure, he was told to "Hold Position". He turned his aircraft slightly to the right to view the runway and other traffic.

While awaiting departure clearance the low rotor RPM alarm sounded and its associated warning light came on. The Pilot immediately lowered the collective lever and made a harder than normal landing on the grass surface. He shut down and exited the helicopter safely. The aircraft was grounded by the Operator.

1.2 Damage to Aircraft

The Operator reported that the only damage sustained by EI-EHB was a bent rear cross tube on the skid assembly, the result of the hard landing, on the grass. The Operator added that, after an engineering examination, there was no mechanical explanation for the loss of power, i.e. no evidence of stuck valves, magneto failure, etc.

1.3 Conclusions

1. The Pilot may have inadvertently rolled off the throttle resulting in an RPM drop. The R 22 Pilots Operating Handbook is quiet explicit on this point. Safety notice SN-10 states, *"no matter what causes the low rotor RPM, the pilot must roll on the throttle and lower the collective simultaneously to recover RPM before investigating the problem. It must be a conditioned reflex"*

2. This training incident was likely the result of the Pilot's inexperience on type, as there was no technical issue that would account for the loss of rotor RPM.

2. SAFETY RECOMMENDATIONS

This Report does not sustain any Safety Recommendations.

- END -

PRELIMINARY INCIDENT REPORT

This is preliminary information, subject to change, and may contain errors.
Any errors in this Report will be corrected when the Final Report has been completed.

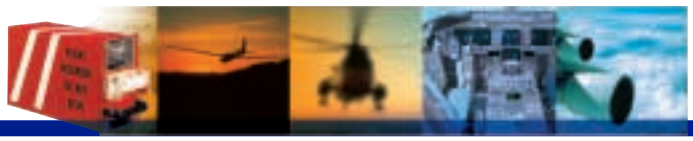
Report No:	**2006-024**
1. AIRCRAFT MANUFACTURER:	Eurocopter
Model:	AS 350
State of Registry:	UK
Registration:	G-JESI
Serial Number:	1205
Year of Manufacture:	1980
2. OPERATOR:	Cabair
3. TYPE OF OPERATION:	Public Transport -unscheduled
4. DATE / TIME:	23 September 2006 @ 19.10 hrs (L)
5. POSITION OF OCCURRENCE:	Dunkerrin, Co Offaly
6. PERSONS ON BOARD:	Crew: 1 Passengers: 4
7. INJURIES:	Crew: 0 Passengers: 0
8. DAMAGE:	None
9. INVESTIGATOR-IN-CHARGE:	Graham Liddy

Following arrival from Adare Co. Limerick on the Morning of 23 September, G-JESI, a Eurcopter AS350 helicopter, engaged in a private charter, was refuelled at the refuelling point in the helicopter landing site at the K Club, Co. Kildare, during the Ryder Cup event.

The refuelling was conducted "hot" i.e. with the engine running and the rotors turning. Prior to re-fuelling, the helicopter fuel gauge was reading 18% (97 litres). During refuelling the gauge rose to 20% (108 litres) and stopped. The Pilot asked the refueller operator how much fuel had been put into the helicopter and was told 250 Litres. The Pilot surmised that the gauge was sticking and therefore unreliable, and asked the refueller to put in a total of 300 Litres. The refuelling reportedly overran slightly and the Pilot was presented with a manually-generated fuel docket for 302 Litres, which he signed. The gauge remained at 20%.

The helicopter then took off and air-taxied to a landing point nearby. The helicopter remained parked at this location all day. At 18.30 hrs the helicopter started up and four passengers were embarked for a flight to Adare, Co. Limerick. The helicopter departed the K Club at approx 18.35 hrs. At this time the fuel gauge was still reading approximately 20%.

At 19.10 hrs, the helicopter landed in a field at Dunkerrin, Co. Offaly, south-west of Roscrea, due to a low fuel situation. The AAIU responded to this event. The fuel tank was drained the following morning and 6.5 Litres of fuel was recovered from the tank.



No evidence of a leak was found on the helicopter, in the field at Dunkerrin, or where the helicopter was parked at the K Club.

The helicopter was subsequently checked, and refuelled. During refuelling, the gauge and low contents warning light were checked against the bowser meter and appeared to be working normally. The helicopter was then flown back to the K-Club without any problems.

The facilities of the refuelling provider were subsequently inspected by the AAIU, with the assistance of the IAA, at both in the K Club and their main base. A series of anomalies in the fuel accounting system were noted. Due to these anomalies, it was not possible to audit the amount of fuel dispensed at the K Club on 23 September, and to reconcile this with the fuel received by each helicopter. The Irish Aviation Authority's (IAA) Aeronautical Information Circular (AIC) Nr 12/00, *"Fuel at Aerodromes and Heliports"* lays down the requirements for refuelling installations. There may be some doubt as to whether this AIC, which applies to "aviation fuel installations", applies to mobile refuelling facilities. This doubt could be compounded by the existence of paragraph 6 of the same AIC which covers *"Aviation Fuel Installations at Places used by Aircraft including Rotorcraft and Airships, other than Aerodromes"* which appears not to require the same record keeping as that laid down for Aerodromes and Heliports. Furthermore while this AIC does require records of fuel disbursements to be maintained and retained, in the case of Aerodromes and Heliports, it does not explicitly require the maintenance of the records required to conduct a full audit of the quantities of fuel received into the facility and dispensed or removed from the facility.

Hot refuelling is somewhat unusual, in that it is impossible for the helicopter's pilot to check the fuel contents independently of the fuel gauges, without shutting down, which would negate the purpose of the exercise. Given that a pilot must remain at the flight controls of a helicopter during hot refuelling, it is therefore difficult for the pilot of single-pilot helicopters to discharge his obligations under paragraph 1 of IAA AIC 38/98, *"Loading of Aviation Fuel"*.

The AAIU Investigation noted that hot refuelling is not mentioned in the refuelling provider's exposition or in their Operations Manual. The Investigation also noted that all the fuel dockets are manually written.

Interim Safety Recommendations

The Investigation is on going, but the AAIU makes the following six Interim Safety Recommendations:

1. The IAA should consider rewording AIC 12/00 to ensure that it explicitly covers mobile refuelling installations. **(SR 9 of 2006)**

2. The IAA should ensure that the hot refuelling of helicopters should only be provided where the provision of this service is explicitly covered in the refuelling provider's exposition. **(SR 10 of 2006)**

3. The IAA should ensure that the hot refuelling of helicopters, and associated safety procedures, should be explicitly covered in the Operations Manual of all refuelling providers who supply such a service. **(SR 11 of 2006)**

4. The IAA should ensure that the procedures covering hot refuelling of helicopters engaged in Public Transport and Aerial Work operations should be clearly laid down in the helicopter operator's Operations Manual. **(SR 12 of 2006)**

5. The IAA should ensure that the helicopter operator's Operation's Manual section covering the hot refuelling of helicopters should require the pilot to reconcile the initial fuel contents, and the added fuel, as per the refuelling docket, with the contents indicated by the helicopter's fuel gauge at the end of refuelling. If such reconciliation is not achieved, the helicopter should be shut down, and remain so until the fuel contents are independently verified. **(SR 13 of 2006)**

6. The IAA should ensure that providers of fuel to Public Transport and Aerial Work helicopters, who are authorised to provide hot refuelling, should be required to present the pilot with meter-generated (printed) fuel dockets when a helicopter is hot refuelled. On this docket, the initial and final fuel meter readings, and the quantity of fuel dispersed, should be clearly printed. Exemption from such a requirement may be issued to individual operators to cover specific situations such as helicopter SAR operations. **(SR. 14 of 2006)**

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