FINAL REPORT

AAIU Formal Report No: 2004/014
AAIU File No: 2002/0038
Published: 10 Sept 2004

Operator:	Private
Manufacturer:	Beechcraft/Raytheon
Model:	Beechcraft Bonanza A36 (modified)
Nationality:	U.S.A.
Registration:	N7205R
Location:	Ballyneale Stud, Ballingarry, Co Limerick
Date/Time (UTC):	9 August 2002 at 11.15 hrs

SYNOPSIS

Following take-off from a private grass airstrip, the aircraft did not achieve sufficient fly-away airspeed and stalled. It struck a solid hedgerow and came to rest in an open field adjacent to the airstrip. The aircraft was a write-off as a result of the accident, and a passenger subsequently died as a consequence of injuries received in the accident. The pilot and the other passenger also suffered injuries. The report makes two Safety Recommendations.

NOTIFICATION

Shannon ATC informed the AAIU of this accident approximately 50 minutes after it occurred. An employee of the aircraft's owner had initially notified Shannon ATC. The Chief Inspector of Accidents, Mr. Kevin Humphreys, directed that a Formal Investigation be conducted into this accident, and appointed Mr. Graham Liddy as Inspector-in-Charge, assisted by Mr Jurgen Whyte.

1. FACTUAL INFORMATION

1.1 History of the Flight

1.1.1 Background

The owner had recently purchased this aircraft. The pilot had assisted the owner in the acquisition and importation of the aircraft. The accident occurred on the first visit by the aircraft, and by the pilot, to the owner's airstrip at Ballyneale, Co Limerick.

1.1.2 Accident Flight

The pilot flew the aircraft from Stansted to Leeds Airport on the day before the accident. On the morning of the accident the aircraft was refuelled, filling the fuel tanks with a total of 121 US Gallons (458 litres) of Jet A1, and departed Leeds Airport for a direct flight to Ballyneale. The pilot was the only person on board the aircraft for this flight. He arrived over Ballyneale at approximately 10.30 hrs. He spoke by radio to a pilot employed by the owner, who was located at the owner's Cessna 182, parked just north of the runway beside a cross-track, which traversed the runway. The pilot on the ground briefed the pilot of N7205R on the airstrip and the conditions on the ground. In particular he advised him that a section of the runway was wet. He also brought the cross-track to the attention of the pilot. These communications were conducted on 123.45Mhz. The pilot of N7205R performed an initial approach and go-around with the undercarriage lowered, without landing, in order to familiarise himself with the airfield, as he had not visited it previously. He then landed on Runway (RWY) 27, without any difficulty, stopping about ¾ way down the runway. He then parked the aircraft to the left of the runway, adjacent to the cross-track. He showed the aircraft to the owner, who had not seen it previously.

Two passengers, one male and one female, both relatives of the owner, then started to board the aircraft, in preparation for a flight from the airstrip to Gloster in the UK. The main cabin area was configured in conference style, i.e. with 2 pairs of seats facing each other. The female passenger sat in the rearward-facing seat on the left side of the cabin. The male passenger sat in the rear forward-facing seat on the right side. Approximately 22 kg of luggage was loaded behind the rear seat. A small bag was carried in the nose baggage bay and another behind the co-pilot seat. The loading was supervised by the pilot of the Cessna 182. During the loading the owner and pilot went to the owner's house nearby, had a cup of coffee and returned to the aircraft shortly afterwards. On his return the pilot checked that both passengers were properly strapped in and that the luggage was secure. The pilot then got into the cockpit, and sat in the left-hand seat.

The pilot started the engine and taxied the aircraft back to the start of RWY 27. He then turned onto the runway heading and stopped 25 metres from the start of the runway and 2.3 metres to the right of the runway centre. Here he performed his pre-flight checks including engine run-up checks. These were satisfactory. He set the flaps at the Flap 1 (12º) position for take-off

He then initiated the take-off. Ground marks showed that on the take-off run the aircraft initially tracked towards the left of the runway. It then straightened up briefly, and then started to veer to the left again. It passed through a section of the runway, located towards the left edge of the runway, which had retained some surface water, and continued towards the left edge of the runway.

The aircraft rotated just before the cross-track, and close to a point where the owner and other people had gathered, just beside the runway. The aircraft lifted over the cross-track, and touched on again briefly. At this point the left main wheel was approximately 0.5 metres from the left edge of the runway, and the runway gradient was rising in front of the aircraft. The aircraft became airborne but entered an increasingly nose up attitude. The stall warning sounded in the cockpit and the aircraft started to sink, in a high nose up attitude. It was also drifting to the left of the runway. The pilot subsequently stated that he retracted the flaps at this point in an attempt to achieve a stall recovery. The aircraft passed over the left boundary of the airstrip as described in section 1.10 below. It then impacted on a hedgerow that ran at right angles to the runway direction. This hedgerow consisted of an earth bank (approximately 1.25 metres high) encased in a hedge that was approximately 2 metres high. The hedgerow is located 550 metres from the start of the runway.

The aircraft struck the hedgerow with the left wing approximately 10º low. The aircraft continued through the top of hedgerow and impacted the ground in the next field, in a nose down attitude, approximately 11 metres from the hedgerow. The aircraft continued across this field for approximately 42 metres, slewed to the right and came to a stop.

The owner and others arrived rapidly on the scene. The aircraft's battery was disconnected and the fuel cock was turned off. Shannon Air Traffic Control (ATC) had alerted the Shannon-based rescue helicopter to responds to the incident, but this was subsequently cancelled at the request of one of the owner's employees. The local emergency services were also notified and arrived shortly afterwards. The two passengers and the pilot were then removed and taken to Limerick Regional hospital by road at approximately 11.30 hrs.

1.1.3 Witness observations

1.1.3.1 The owner's regular pilot was standing beside the Cessna 182 that was parked just off the transverse track on the right side of the runway. He observed much of the accident flight. However his view was partially obscured as he was standing on the side of Cessna away from the runway. The Cessna's high wing restricted his vision upwards. He stated that the aircraft rotated just as it reach the cross-track and climbed away with a progressively steepening pitch angle. This witness was unsure of the maximum height reached by the aircraft but stated that it could have been approximately 100 ft. He then saw the aircraft starting to descend with a very nose-up attitude. It also drifted to the left with the left wing low. It disappeared from his view behind the hedge running parallel to the left side of the runway. At this point this witness estimated that the aircraft was about 20 ft above ground level (AGL). The witness was confident that there was no change of aircraft engine noise or audio pitch throughout the flight.

1.1.3.2 Other witnesses, including the owner and members of the estate staff, were standing slightly to the left of the runway, near the cross-track. One of these stated that the aircraft threw up water spray as it passed the wet area of the runway and described it as similar to a car going through a flood. None of the other witness at this location made this observation. Some of these witnesses also believed that the aircraft was "*struggling to get airborne and to climb away*". None of these witnesses observed any strange or abrupt changes of engine noise. Some of these witnesses were concerned that the aircraft was heading to the left side of the runway, and towards them, during the take-off run. As a result they moved back from where they were standing, in a direction away from the runway. Some of these witnesses stated that maximum height attained by the aircraft was approx 30 feet.

1.1.4 Pilots comments

1.1.4.1 The pilot was initially interviewed in hospital on the evening of the accident. He stated that the engine power appeared to wind back after take-off, and that the aircraft subsequently stalled. He had no recollection of the aircraft tracking to the left on the take-off run, nor was he aware of throwing up a significant amount of water at any point on the take-off run.

1.1.4.2 Following recovery from his injuries; the pilot was again interviewed some months after the accident. He gave a full and frank description of the flight. The engine run-up was normal and satisfactory. He stated that he applied 50% power against the brakes, and then released the brakes and progressively applied power. He was aware that a rapid increase of power would cause a torque swing to the left. He was also conscious of not exceeding the engine temperature limits and was monitoring the engine temperature gauge. He believed that the engine attained about 85% of maximum torque on the take-off run, which would be considered normal in the prevailing conditions. The pilot was aware of the tracking towards the left edge of the runway. He stated that he did not know the reason for this drift to the left, but thought that it was possible that the soft ground on the left side of the runway was dragging the aircraft in that direction. He believed that the aircraft rotated just before the cross-track, at an airspeed of about 85 kt. He knew that at this point the left wheel was close to the left edge of the runway. On the initial climb out he reached to the undercarriage switch and was in the process of selecting undercarriage up when he noted a lack of climb performance, which he believed to be due to an engine problem. He stated that he believed that the aircraft reached a maximum height of 150 to 200 ft. At this point the aircraft was in a high nose up attitude and was experiencing stall buffet and the stall warning was sounding. He pushed the stick forward and decided to raise the flaps in an attempt to regain flying speed. However the stall buffet continued, the left wing dropped, and the aircraft drifted to the left and lost height. It struck the hedge with a slightly nose up attitude, with the left wing low.

1.1.4.3 When asked if he had a view of the true horizon at the point of rotation, the pilot stated that it was obscured by the crest of the runway in front of him. He also stated that he had decided that Flap 1 would be more appropriate for take-off from this strip as he wanted to be airborne before the cross-track, if possible. The pilot was also asked about the engine close-down procedure, and was unfamiliar with the requirement to run the engine at idle for 2 minutes in order to drain the oil from the hot section bearings.

1.2 Injuries To Persons

Injuries	Crew	Passengers	Others
Fatal	0	1	0
Serious	1	1	0
Minor	0	0	0
None	0	0	

The pilot's head struck the instrument panel, and he also suffered back injuries, including two cracked vertebrae. He was detained in hospital and subsequently returned to the UK by air ambulance where he was hospitalised for a further time.

The female passenger, seated in the rearward facing seat, suffered head and neck injuries when her head struck the cabin frame and the window beside her seat. She also suffered a lumbar spine fracture and multiple soft-tissue injuries in addition to a diagnosis of post-traumatic stress disorder.

The elderly male passenger, seated in the forward facing rear seat, suffered internal bleeding and a fractured fibula. He underwent an operation to halt bleeding in the pelvic area. He collapsed and died nine days after the accident, while still in hospital.

1.3 Damage To Aircraft

The aircraft suffered substantial damage on the initial impact with the solid bank in the hedgerow. This impact ripped off the main undercarriage and the left tip tank, and caused the left wing to fold backwards underneath the fuselage. The nose wheel was also forced rearwards into its wheel-well. During the second impact in the next field the propeller assembly was sheared off. The fuselage of the aircraft remained intact but distorted. Both wings suffered major damage. The aircraft was deemed to be a write-off as result of the accident.

1.4 Other Damage

The hedgerow and the field suffered impact damage. Virtually all the fuel on the aircraft, approximately 270 litres of Jet A1, was scattered over the accident site, due to the rupture of all 4 fuel tanks.

1.5 Personnel Information:

1.5.1 Pilot

Personal Details:	Male, aged 27 years
Licence:	UK Private Pilot's Licence, issued on 10 August 1992 by UK CAA. He had previously held a UK CPL but this was not valid since 1999. USA PPL issued by FAA
Medical Certificate:	UK medical Class 3 valid until 4 September 2003. USA medical Class 1 issued on 18 April 2000, valid for 3 years

Note 1: The pilot's US PPL was validated on condition that he maintained a current UK licence, which he held at the time of the accident.

Note 2: This aircraft is classified as a complex aircraft under FAA Regulations, and an endorsement in the pilot's logbook for the operation of complex aeroplanes was required. The Pilot's logbook contained such an endorsement.

Note 3: This aircraft is classified as a high-performance aeroplane (more than 200 horsepower) under FAA Regulations, and an endorsement in the pilot's logbook for the operation of high-performance aeroplane would normally be required. However, as the pilot had experience of such aircraft before 4 August 1997, he was exempt from this requirement.

Flying Experience:

Total all types:	879	hours
Total all types PI:	675	hours
Total on type:	11.00	hours
Total on type PI:	4.45	hours
Last 90 days:	13.15	hours
Last 28 days:	5.10	hours
Last 24 hours:	2.55	hours

Note 1: On-type experience refers only to the turbine-engined version of the Bonanza A36.

Note 2: The pilot stated that he had about 5 to 10 hours experience on the piston-engined version of the Bonanza A36, and much of this was not recorded in his logbook.

Note 3: The pilot stated that prior to the flights Stansted-Leeds-Ballyneale, it had been approximately 18 months since he had previously flown the turbine-engined version of the Bonanza A36.

1.5.2 Pilot's logbook

The pilot furnished the Investigation with a photostat copy of his logbook. This recorded that his only experience on the turbine-engined Bonanza A36 (modified), prior to the day before the accident, was 8.05 hours, completed in October 1998. In relation to the piston-engined Bonanza A36, the logbook only records 2 flights. These were both ferry flights and were completed in January and July 2002 respectively, one of which was as pilot-in-command.

1.6 Aircraft Information

1.6.1 Leading Particulars

Aircraft type:	Beechcraft Bonanza A36 (modified)
Manufacturer:	Beech/Tradewind Turbines
Constructor's number:	E-2180
Year of manufacture:	1984
Certificate of registration:	Issued 10 October 2000
Certificate of airworthiness:	Utility category
Total airframe hours:	2,987.2 hours
Engines:	Allison Model 250 B17 F2
Serial No:	CAE-881245
Maximum authorised take-off weight:	3,849 lbs[1]
Estimated Take-off weight:	3,582 lbs
Centre of Gravity limits: (at accident weight)	80.4 to 87.7 inches
Centre of gravity at time of incident:	85.7 inches
Stall Speed at accident weight:	64 kt Indicated airspeed (IAS) at idle power setting with zero flap.

[1] Because all the aircraft data in the Flight Manuals is given in imperial units, this report uses these units for such data. For other data metric units are used.

1.6.2 General Information

1.6.2.1 Aircraft History

This aircraft was originally manufactured by the Beech Company, now Raytheon, in 1984, as a standard Beechcraft Bonanza A36, fitted with a 300 hp Continental piston engine. In 1986, the aircraft underwent a major modification, whereby a gas turbine turbo-prop engine, an Allison 250 B17 F2, was installed in place of the piston engine. This engine is rated at 450 HP, giving a 50% increase in available power compared to the original piston engine version. The fitting of turbo-prop engine involved considerable modification of the aircraft, including a longer nose, fitting of wing tip fuel tanks, a revised fuel system, new engine controls and new engine instrumentation. This modification was approved by a Federal Aviation Administration (FAA), by means of a Supplementary Type Certificate (STC), reference SA3523NM. This was issued to the Turbine Power Company of Texas in July 1986. This STC was subsequently amended in November 1987 and again in January 1992. The engine installation modification was performed by Tradewind Turbines.

The aircraft suffered a propeller strike, at a low power setting, in 1996 and a replacement Allison engine, serial number CAE-881245 was fitted. This engine was installed in the aircraft at the time of the accident. The propeller fitted was a three-blade Hartzell, type HC B3TF-7A/T9212K.

1.6.2.2 Aircraft Description

The Beechcraft Bonanza A36 is a low wing all metal aircraft with retractable tri-cycle undercarriage. This particular aircraft was laid out as a six-seater, with 2 pilot seats in the front of the cabin, each equipped with flight controls. The main cabin area was laid out in conference style, i.e. 2 pairs of seats facing each other. There was a luggage space behind the rear set of seats.

As part of the turbine modification, the nose was extended, in order to maintain the centre of gravity (C of G) due to the lighter turbine engine. Within the lengthened nose provision was made for another luggage locker.

1.6.2.3 Aircraft Turbine Modification

The turbine engine conversion of the original Beechcraft Bonanza A36 is a major modification of the aircraft. Because of the scale of the modification, a supplement to the approved Flight Manual was issued. This supplement was prepared by the designers of the modification, Turbine Power Company, of Austin, Texas, and approved by the U.S. FAA by means of the STC issued in July 1986. The Flight Manual Supplement is a sizeable volume of approximately 130 pages. The aircraft was required to be operated in accordance with this Flight Manual

Supplement, in addition to the standard Beechcraft Bonanza A36 Flight Manual.

There are some differences in these flight manuals. The Beechcraft Bonanza A36 Flight Manual does not specify a flap setting for take-off, but provides take-off performance data for flap settings of Zero Flap and Approach Flap. The STC Supplement recommends Flap 0 (0º) for take-off. Trade Wind Turbines, who currently perform the turbine modification in accordance with the STC, verified to this Investigation that 0º flap is recommended for all take-offs. However, they were unable to offer any explanation for the rationale behind this change from the original Beechcraft Bonanza A36 Flight manual.

1.6.3 Maintenance History

The aircraft underwent an annual inspection in the USA on 1 November 2001. Concurrently, a 100 hr, 200 hr and 300 hr inspection was completed on the engine. The Datcon meter was recorded at 1,335.6 hours at this time. Some minor rectification work was completed in May 2002 (1,386.6 Datcon hours) and again in June 2003 (1,390.1 Datcon hours). Total airframe time at this point was 2,948.6 hours. No maintenance was performed on the aircraft after it arrived in the UK in July 2002. At the time of the accident the Datcon reading was 1,426.2 hours. This would give an airframe total of 2,987.2 hours at the time of the accident. The next maintenance due would have been a 100 hr engine check at 1,435 Datcon hours. The schedule of the performed maintenance met the conditions required to maintain a valid FAA Certificate of Airworthiness.

1.6.4 Aircraft paperwork

The aircraft contained a valid FAA Certificate of Airworthiness (C of A) issued on 29 May 1984. It also contained a Certificate of Registration (C of R) dated 10 October 2000. This C of R did not reflect the recent change of ownership.

1.6.5 Aircraft centre of gravity

1.6.5.1 The STC Flight Manual contains Section VI to assist the pilot to calculate the weight and balance of the aircraft. This states that "*Section VI of the Basic* (Beech) *Pilot's Operating Handbook and FAA Approved Flight Manual remains unchanged except for the addition of a forward baggage/cargo compartment at 32 inches aft of datum and the difference in weights of fuel and oil*" and then provides 6 pages of information for weight and balance calculations. A significant factor in these calculations is the optional tip tanks, as fitted to N7205R. Capacity of the main tanks is 120 lbs and the effective Centre of Gravity (C of G) of this fuel is 75 inches aft of datum. Capacity of the tip tanks is 268 lbs with a C of G at 88.5 inches aft of datum. The STC Flight Manual stated that correct fuel management is to use 50% of main fuel tanks initially and then to start transfer from the tips into the mains.

Considerable calculation is required to determine the location of the position of the centre of gravity. These calculations involve factors such as fuel contents, fuel distribution by tank, as well as the usual factors such as crew, passenger and luggage weights and their distribution in the aircraft.

1.6.5.2 The Investigation found no record of any of weight and balance calculations for either of the 2 previous flights, or the accident flight, in the aircraft after the accident.

1.6.5.3 The Investigation calculated the C of G for the previous take-off from Leeds and determined that is was 77.8 inches aft of datum. The forward limit, at the calculated take–off weight for that flight, 3,583 lbs, is 79.6 inches aft of datum. This indicates that the C of G at this weight was 1.8 inches forward of the forward limit for the take-off from Leeds.

1.6.6 Aircraft take-off performance

1.6.6.1 The Section V of the STC Flight Manual states: "*Performance of the Allison 250-B17F/2 equipped Beech A36 meets the required certification performance criteria and is not published. For guideline information, use the Takeoff and Landing Distances shown in the Beech Pilot's Operating Handbook and F.A.A. Approved Airplane Flight Manual.*" It further states: "*Precise performance information will be added to this section when it is available*". The Investigation noted that no such information has been added to the STC Flight Manual.

1.6.6.2 Neither the STC Flight Manual or the Beech Pilot's Operating Handbook provided any guidance material or data for takeoff performance of this aircraft when operating on grass or soft runways.

1.6.7 Aircraft stall data

The Section V of the STC Flight Manual, page 5.5 gives the stall data for this aircraft at idle power. No data is given for power-on stall. This page states that the maximum height loss experienced while conducting stall tests was 200 ft. It also notes that the stall tests were measured at the most forward C of G, and that at some weights the full up (aft) elevator stop was reached prior to a full stalled condition.

1.6.8 Engine Performance

In this installation, the Rolls Royce Allison 250-B17 is temperature rather than power limited on take-off at normal ambient temperatures. This means that the pilot has to monitor engine temperature, as power is applied during take-off, in order to ensure that the engine temperature limits are not exceeded.

1.7 Meteorological Information

1.7.1 Met Éireann, the Irish Meteorological Service, provided the following aftercast for the accident:

General Situation:	A low-pressure system of 1000 hPa centred in the English Channel maintained a moderate northerly airflow over the area.
Wind:	At surface: 34012 kt At 2,000 ft: 36025 kt The wind profile suggests that at worst there would be isolated pockets of moderate turbulence
Weather:	Nil at Shannon, but possibly isolated showers
Visibility:	10+ kilometres
Cloud:	Scattered (Sct) 2,500 ft
Temperature:	16º Celsius
Dew-Point:	09º Celsius
MSL Pressure:	1010 hPa

1.7.2 The pilot and other witnesses at the airstrip stated that weather conditions were good at the time of the take-off with a cross wind of about 8 to 10 kt coming from the north. Witnesses at the airstrip gave the direction in the range 300º to 340º.

1.7.3 While it was fine at the time of the accident, there been considerable rain on the previous night and in the days prior to the accident. As a result, there was soft ground and some surface water in the low section of the runway.

1.8 Aids to Navigation

There were no aids to navigation at this airstrip. Aids to navigation were not a factor in this accident.

1.9 Communications

There was no airband radio communications equipment at this airstrip. However the pilot did establish communications, prior to landing, with the pilot of the parked Cessna 182, and was briefed on conditions at the airstrip.

1.10 Aerodrome Information

1.10.1 Airstrip Description

The airstrip is located 2 miles south east of the town of Ballingarry in West Limerick. It was constructed by the owner for his own private use and was not licensed by the Irish Aviation Authority (IAA).

The proposed use of the airstrip did not require it to be licensed. The airstrip consists of a single grass runway, 27/09, which is 789 metres long and 17.5 metres wide. It runs from a low hedge at the easterly end towards another low hedge at the westerly end. The runway does not extend fully to this hedge but stops about 85 metres before the hedge. At the end of the runway a 35-metre emergency stopping pit, filled with sand, had been constructed. Beyond this pit there is a 50-metre belt of land and trees, which are about 30 ft tall. The final westerly hedge borders a public minor road.

The airstrip was built on a field that was somewhat undulating. Considerable in-filling had been done to decrease this undulation. While there were gradients on the runway, they were well within the normally accepted limit of 2°. The airstrip owner informed the Investigation that the runway was constructed on a base comprising more than 16,000 cu. metres of compacted gravel and as such has a solid base throughout. The runway, starting from the eastern end, commences at a high point. It then descends to a low point, located 150 metres from the start, and 2.0 metres lower than the start. At this low point there is also a slight cross gradient, with the left side being lower. The down-gradient from the start of the runway to this low point is 0.75º.

From the low point the runway rises again to a rounded crest. The top of the crest is 1.75 metres above the low point, and is located 312 metres from the start of the runway. The runway then slopes away from this crest, down to a level section, which is approximately 250 metres long, and terminates at the stop pit. A cross-track traverses the runway at right angles 250 metres from the start, at a point that is approximately half way up the gradient from the initial low spot to the crest. The maximum gradient in this section between the low point and the track is approximately 1º. The cross-track consisted of two parallel depression made by vehicle wheels. The depressions had been partially filled with fine gravel.

A considerable amount of drainage work has been incorporated into the construction of the runway, and it was noted that this was generally successful in keeping the runway surface free of standing water. However, the Investigation noted that the low spot between the start and the crest was soft and water sodden on the left side of the runway, when inspected about 7 hours after the accident. It was noted by the Investigation that the aircraft had tracked through this soft area and had left significant wheel marks on this section of the runway.

Both edges of the runway were clearly defined by painted white markers at 20 metre intervals. The grass on the runway was kept short and provided a visual contrast with the longer grass beyond the edge. In some sections of the runway, the left edge was higher than the adjacent ground. In other sections the adjacent ground sloped down gently to the runway edge.

In the area where the aircraft became airborne, the left boundary of the airstrip consists of a post and rail wooden fence that is some 10 metres from the edge of the runway. A farm track separates this fence from a hedge, which is approximately 2 metres high. Inset in this hedge are two trees. These three features, the fence, track and hedge, all run parallel to the runway.

The airstrip was equipped with a windsock, located in line with the cross-track, approximately 20 metres to the north of the runway.

The airstrip had been in operation for about 13 weeks before the accident and the owner stated that none of the three pilots who had used it in this time had brought any problems to his attention.

1.10.2 Airstrip Approval

Limerick County Council, the Local Authority, has informed the Investigation that they would have informed the IAA, under the terms of the Planning and Development Regulations 2001, if a planning application had been received for the development of this airstrip. Where such an application is for a licensed aerodrome, the IAA will always examine the proposed development with regard to compliance with the requirements of the International Civil Aviation Organisation (ICAO) Annex 14. The IAA does not regulate unlicensed airstrips. The IAA has the power to require an airstrip to be licensed, but this power is rarely used. The IAA can provide the owners of unlicensed airstrips with advisory information where this is requested.

In the case of this airstrip, planning permission was not sought from the Local Authority. The Local authority has informed this Investigation that they consider that such permission was required and that they do not consider this to be an exempt development. Because planning permission was not sought, the IAA was not informed of the proposed development.

The airstrip owner informed the Investigation: "*that he had never intended to operate a licensed aerodrome at Ballyneale. The strip is for private use only. In line with normal practice, pilots are permitted to land there at their discretion, with the permission of the owner.*"

The owner further stated: *"I did not apply for Planning Permission, having received advice to the effect that 'field drainage on land which is used only for the purposes of agriculture' is classed as exempted development with no conditions or limitations. The project was brought to the attention of the local Planning Authority by a group of local residents, to establish whether Planning Permission was required and no objection was raised.*

If the Law changes and permission for an unlicensed airstrip is ever required, there is no reason why the strip at Ballyneale should not be approved."

1.11 Flight Recorders

1.11.1 Cockpit Voice Recorder

This aircraft was not equipped with a Cockpit Voice Recorder, nor was it required to be so equipped.

1.11.2 Flight Data Recorder

This aircraft was not equipped with a Flight Data Recorder, nor was it required to be so equipped.

1.12 Wreckage and Impact Information

1.12.1 Impact with hedgerow

Inspection of the impacted hedgerow and aircraft showed that the aircraft struck this hedgerow in an approximately level attitude in the pitch axis. The aircraft was approximately 10º left wing low, in the roll axis. The undercarriage was extended at the time of impact. The propeller cut a path through the foliage of the hedge and through the upper levels of the earth bank in the hedgerow.

The left wing also struck the bank and was folded backwards underneath the aircraft. The left tip tank departed when the left wing struck the bank.

1.12.2 Subsequent Impact

After the aircraft passed through the hedgerow, it descended in a nose down attitude. The nose made the initial impact in the next field, 11 metres past the hedgerow. The propeller cut 3 deep slash marks in the earth. The first of these marks was 0.25 metres deep and the second was 0.33 metres deep. The distance between the first and second slash marks was 0.27 metres. The ground marks showed that the aircraft continued to skid across this field, on its belly and left wing, for a further 31 metres. As it slowed, it veered to the right, turning through approximately 80º.

The complete propeller assembly sheared off the engine after making the slash marks and came to rest close to where the aircraft stopped.

1.12.3 Other Wreckage Information

Examination of the cockpit showed that the throttle and propeller levers were in the fully retarded position and that the flap switch was in the flap full down position, which is Flap 2 (30º).

1.12.4 Fuel

All four fuel tanks had ruptured due to the severity of the impact. The only significant fuel sample that was recovered by the Investigation was found in the separated left tip tank.

This fuel was found to be clean and free from contamination. Evidence of widespread fuel staining was found on the ground at the accident site.

1.13 Medical and Pathological Information

There were no medical factors in the causes of this accident. The post mortem of the male passenger showed that death was caused by cardio-respiratory failure due to pre-existing ischaemic heart disease and was associated with the injuries recently sustained in this accident.

1.14 Fire

There was no fire.

1.15 Survival Aspects

The pilot was wearing a lap strap seat harness with a single diagonal shoulder strap. Because of his small stature, his seat was adjusted to a forward position, close to the instrument panel. The passengers were wearing lap straps only. There were no shoulder straps fitted to these seats.

Shannon ATC alerted a Search and Rescue helicopter, based at Shannon. However, persons at the accident site stood down this response, as local resources had arrived at the scene.

1.16 Tests and Research

1.16.1 Engine inspection

1.16.1.1 Initial examination of the engine showed it to be in good overall condition. However the compressor assembly was packed with clay and most of the first stage compressor blades had sheared off.

1.16.1.2 After the aircraft was taken to the AAIU facility at Gormanston, Co Meath, the engine was removed from the aircraft. The aircraft and engine was further examined at this facility. The engine was then shipped to the engine manufacturer's facility at Indianapolis USA, where it was further examined under AAIU supervision. These examinations noted:

- The engine compartment sustained damage during the impact sequence.
- The engine-mounting bearer was distorted and the lower engine mount was bent and broken.
- The sun spur gear-shaft exhibited rotational distress to all gear teeth.
- The beta rod was separated at the forward end.
- The fuel filter was approximately 3/4 full of fuel.
- The fuel supply line from the fuel flow solenoid to the fuel nozzle contained 10 ml. of fuel. The presence of fuel was noted throughout the fuel supply system up to the fuel nozzle.
- Both oil and pneumatic rigid tubing showed numerous areas of bending but were not broken.
- Oil lines contained oil that was dark in colour with normal (unburned) aroma.
- The compressor was packed with clay throughout all four stages and could not be rotated.
- Nearly all blades on the first stage compressor wheel had separated. The remaining compressor blades exhibited bending opposite to the direction of rotation. The separated blades on the 1st stage wheel were fractured at the blade root in bending overload. The remaining compressor blades showed Foreign Object Damage (FOD) and/or bending damage. The bending was opposite to the direction of rotation.
- N2 (Power) shaft was free and rotated smoothly. It was noted that there was continuity to the propeller driveshaft.
- The accessory gearbox rotated freely on the N1 (Gas Generator) side once the compressor and scroll assembly was removed.
- The drive-shafts and splines of the fuel control, fuel pump and power turbine governor were intact and rotated freely.
- The starter/generator driveshaft had failed, and showed evidence of torsional shearing.
- Large and small pieces of compacted clay were found in the outer combustion case. A white cotton-like mould had formed inside the outer combustion case.

- The combustion liner appeared normal.

- All turbine nozzles appeared normal.

- The first, third and fourth stage turbine wheels appeared normal.

- The splined stub shaft on the second stage wheel was sheared. Metallurgical investigation indicated that the shear was the result of torsional overload. All other N1 and N2 shafting was intact.

- Visual evidence of coked oil was found in the number 6/7 bearing oil sumps. This was confirmed by X-ray Energy Dispersive Analysis (XED A).

- All bearings were oiled and rotated freely.

- The bleed valve was found in the closed position following the accident. In the normal power-off configuration a spring pushes this valve to the open position. It was held in the closed position by impacted clay, which had become lodged between the valve plate and the body during the crash sequence **(Appendix A)**. When the clay was removed, the valve returned to the open position. It was closed by hand and, after release, again returned to the open position. Referencing Rolls Royce Allison chart for bleed valve operation **(Appendix B)**, this shows that the bleed valve is fully closed at 82% N1 (max) with an ambient temperature of -70º F, and at 100% N1 with an ambient temperature of 145º F. The temperature at the time of the accident was 60.8º F. Using the Rolls Royce Allison chart this temperature would result in bleed valve closure at 93% N1. Between 63% and 93% N1 (max) the bleed valve would have been modulating, i.e. operating between the fully closed and fully open position. At less than 63% N1 (max), the valve would have been fully open.

- With exception of the hardware damage noted above, all other engine hardware appeared normal.

1.16.2 Propeller Inspection

1.16.2.1 Initial inspection of the propeller showed that all three blades had suffered considerable leading edge impact damage and bending of the blades. One blade (No. 1) had turned through approximately 180º in the hub. Examination of the 3 blades showed:

- Blade No. 1 had fore and aft bends. It had leading edge damage with a large gouge in the leading edge on the outer three inches of the blade tip.

- Blade No. 2 was bent aft about 30º at mid-blade. It had leading edge damage and was twisted toward low pitch.

- Blade No. 3 had fore and aft bends and was bent aft about 30º at mid-blade. It had leading edge damage.

- Blades No. 2 and No. 3 were in the feather position. Blade No. 1 was turned to extreme reverse, about 180º lower than the normal operating position.

1.16.2.2 The propeller was subsequently shipped to Indianapolis where it was stripped and examined by an investigator from the propeller manufacturer, under AAIU supervision. This examination noted:

- The propeller sustained substantial rotational damage.

- The propeller gearbox forward section was broken from the engine.

- The propeller drive-shaft fracture showed torsional shearing.

- No. 1 Blade link arm was disconnected from the blade clamp.

- The piston had four light witness marks caused by contact with the forward end of the cylinder. The marks were all located 2.34 inches from the aft end of the piston. This equates to approximately 22.2º blade angle. The normal blade angle at full power at maximum engine speed (2,050 RPM) is 22.5º.

- No signs of pre-existing defects were found in the propeller.

1.16.3 Examination of the Aircraft

The left wing flap was destroyed. The right wing flap had been forced rearwards during the impact. Both the left and right flap screw actuator jacks were found to be in the fully retracted position. Because of their design, it was not possible for the setting of these actuator jacks to have moved during the ground impact. The aircraft flight controls were examined. It was determined that all these controls worked in the correct sense, and that full movement and continuity was available, apart from damage caused by the accident. No evidence of any pre-existing defect was found in the aircraft.

1.17 Organizational and Management Information

1.17.1 The owner of the aircraft had business interests in the UK and required to travel frequently from his home at Ballyneale to the U.K. He had previously purchased a Cessna 182 RG for this purpose. A local pilot flew this aircraft. The owner himself had previously held a Private Pilot's Licence (Helicopters), and most of his flying was in a Bell 206, which he had owned and flown in the U.K.

The owner decided to upgrade to a faster larger aircraft and conducted considerable research into selection of an appropriate aircraft.

He had also discussed his requirements with the pilot of the accident flight. The pilot had previously flown a turbine-conversion Bonanza, and believed that it would meet the owner's requirements. A significant factor in the selection of the turbine-conversion Bonanza was the high power to weight ratio, giving good short field take-off performance on grass airstrips. The high cruising speed, cabin layout, carrying capacity and comfort levels were also factors in the selection

It was the owner's intention that the local pilot in Ballyneale would do a type conversion on to the Bonanza, and would be his regular pilot. He also proposed to build a hangar for the aircraft at Ballyneale.

1.17.2 The owner of the airstrip at Ballyneale is referred to in this report as the owner of the aircraft. However he is not the registered owner of the aircraft. Under USA law, a non-national cannot be the owner of an US registered aircraft. Hence the aircraft was registered to a corporation in Delaware USA. This registered owner is known as the "Trustee" (defined as a person to whom the legal title to property is entrusted to hold or use for another's benefit) and the de facto owner is known as the "Trustor". The aircraft was transferred from a previous registered owner to the current trustee on 15 July 2002.

1.18 <u>Additional Information</u>

1.18.1 The aircraft was purchased by the owner in July 2002 and flown to Stansted in the UK by a ferry pilot. The ferry pilot met the accident pilot and asked if he wanted any type conversion training. The accident pilot replied that he had flown the type previously and consequently felt there was no need for this training.

Following the delivery flight from the USA, the aircraft remained unused in Stansted for about two weeks, until the day before the accident.

1.18.2 Engine oil

The manual for the Allison 250 engine requires that the engine be run at idle power for 2 minutes at the end of a flight. There are two reasons for this procedure. The first is to cool the engine in order to reduce the shock cooling of shutdown. The second reason is to cool the engine oil in the bearings in the turbine section. Failure to ensure that this oil is cooled results in the oil in the bearings being overheated following shutdown. This overheating is due to heat being conducted from the hot turbine and the absence of oil circulation when the engine is closed down. This results in the oil in the bearings being "coked" and produces a black residue in the turbine lubricating oil. In severe cases this coking can lead to the blocking of the oil supply to the bearings and subsequent bearing failure due to a lack of lubrication.

1.18.3 Fatal injury

ICAO Annex 13 and Irish Statutory Instrument SI 205 of 1997 define a "fatal injury " as an injury sustained by a person in an (aviation) accident and which results in his or her death within 30 days of the date of the accident. Therefore this occurrence is classed as a fatal accident.

1.18.4 Engine torque effect

This modified aircraft is prone to significant yaw to the left during the take-off ground run due to the large torque of the turbine engine and the lengthened nose, which magnifies the torque effect. The yaw is more pronounced if engine power is applied rapidly. At low airspeeds the rudder is less effective, which reduces the ability to overcome the yaw effect.

1.18.5 Effect of C of G

With virtually all aircraft types, the position of the C of G has two effects on aircraft handling. With a forward C of G the aircraft requires a larger rearward pull on the control yoke to cause the aircraft to rotate at take-off. In this configuration the aircraft is also more stable in pitch and consequently a given elevator input has a reduced effect on the aircraft pitch angle. Conversely, with a rearward C of G, a smaller rearward pull on the yoke is required to rotate the aircraft at take-off, and the aircraft is more sensitive in pitch. In this condition a given elevator input has an increased effect on the aircraft pitch angle.

1.18.6 Other communications

Prior to this flight the pilot had a phone discussion with another pilot who had operated into the airstrip. This was not the pilot of the Cessna 182RG. The accident pilot stated that during this discussion, the other pilot had mentioned the roughness of the cross-track.

1.19 Useful or Effective Investigation Techniques

None

2. ANALYSIS

2.1 Engine analysis

2.1.1 The nature and direction of damage noted on the compressor section was consistent with the compressor operating at a high power setting.

2.1.2 The clay found in the outer combustion case was consistent with normal air movement through the compressor to the turbine, operating under normal power.

2.1.3 The torsional overload failure of the second stage wheel stub shaft and the splines twisted opposite to the direction of rotation was consistent with a sudden stoppage of the compressor, while the engine was operating at a high power setting.

2.1.4 The torsional overload failure of the starter/generator drive-shaft was consistent with a sudden stoppage of the N1 drive train, while the N1 section of the engine was operating at a high RPM.

2.1.5 The clay trapped in under the bleed valve indicated that the bleed valve was fully closed at the point on impact with the earth bank and therefore the gas producer (N1) was operating at 93% N1 (max), or greater, at the time of impact.

2.1.6 The damage observed on the rear compressor blades was consistence with the ingestion of clay and of the broken front compressor blades, during the impact sequence. No evidence of pre-impact Foreign Object Damage (FOD) was found.

2.1.7 The evidence of all the ground witnesses indicates that there was no change of engine noise or pitch before impact. A significant power loss would have resulted in a noticeable change in these parameters

2.1.7 All evidence obtained from the engine indicated that it was producing power at, or near to, full potential at the time of impact.

2.2 Propeller analysis

2.2.1 The three slash marks cut in the ground at the time of the second impact clearly show the all three blades were at an angle corresponding to the normal full power position. At the time of this impact none of the blades had gone into either fine pitch or the feathered position.

2.2.2 In order for the counterweight of No. 1 blade to be in the extreme reverse position, its rotational arc would interfere with the No. 2 blade counterweight, yet there were no impact marks to suggest contact with the two counterweights. This indicates that No. 2 blade was not in the feather position at the time when No. 1 blade was turned to the extreme reverse position. The movement of No. 2 and No. 3 blades to the feathered position was caused by the propeller spring. The oil pressure, which normally counters the action of this spring, disappeared when the propeller shaft failed in torsional shear. The unfettered spring then pushed these blades into the feathered position. No 1 blade did not move under the action of this spring, as its connecting link had already failed.

2.2.3 The torsional overload failure of the propeller driveshaft and the failure of the propeller gearbox were both consistent with a sudden stoppage of the propeller at high power and RPM.

2.2.4 The witness marks in the propeller hub indicate that the propeller was at a pitch setting corresponding almost exactly to full power pitch setting (22.5°) at normal engine maximum speed of 2,050 RPM. Any large power loss would have caused the blades to move to a significantly lower blade angle, as the governor would have reduced pitch to maintain 2,050 RPM.

2.2.5 All evidence obtained from the propeller indicated that it was running at maximum speed, and at a high power setting, at the time of impact.

2.3 Engine oil

The blackening of the engine oil, and the slight blackening of the turbine bearings indicated that the engine had been closed down without the required post-flight cool-down procedure. As the records show that the oil had been changed 91 hours before the accident, it is probable that such failure to observe correct shutdown procedures had occurred on the relatively recent history of the aircraft. The observed coking effects were minor and would not have effected the operation of the engine in any way. However, if this practise had been continued for a lengthy period, significant and detrimental coking of the bearing would have occurred.

2.4 Engine performance

The evidence obtained from the examination of the engine and propeller, indicate that the engine was operating normally, at full or nearly full power and at normal operating speeds, at the time of impact. Of particular importance in this analysis was:

- The position of the bleed valve indicating the speed of the N1 system was greater than 93% of N1(max)[2].

- The shear failure of the starter/generator quill shaft, indicating a high rotational speed at impact. It should be noted that this shaft is only connected to the N1 system and is independent of shock load transmitted to the propeller (N2) system.

- The damage to the compressor system, and the ingress of clay through the compressor and into the combustion area.

- The propeller hub marks, indicating a propeller angle of 22.3°.

Consequently a loss of power can be discounted as a cause of this accident. It should also be noted that this modified aircraft had an abundance of surplus power having a nominal power increase of 50% above the original aircraft. Any minor loss of power would have no noticeable effect, notwithstanding that no evidence was found to indicate any loss of power.

[2] For the purposes of this report, N1 (max) is 50,655 RPM of the gas produced section of the engine, at which speed the engine is developing its rated power of 450 HP.

Moreover, calculations indicate that N7205R could have maintained level flight even with a power loss of the order of 75% (i.e. level flight could have been maintained with the engine running at only 25% of rated power).

The Investigation has calculated that, at 25% of rated power, the NI would have been approximately 75% N1 (max). The closed position of the bleed valve indicates an N1 speed of at least 93% N1 (max) at impact, which corresponds to a power output in excess of 300 HP or at least 67% of the rated engine power. This indicated that, at the point of impact, the available power was at least 3 times that required to keep the aircraft airborne.

2.5 Propeller slash marks

Based on the distance between the initial slash marks made by the propeller blades when the nose of the aircraft struck the surface of the field, and assuming a propeller speed of 2,050 RPM, the forward speed of the aircraft can be calculated to be 66 kt at this second impact. While the depth and extent of these slash marks indicated that the propeller was turning at high speed and energy at the time of this second impact, it is highly probable that the propeller speed would have decayed to some extent during the initial impact with the bank of the hedgerow.

Thus the speed at the second impact was less than 66 kt, but it is impossible to make a more accurate estimate of the aircraft speed at the point of impact with the hedgerow.

2.6 Flap setting

The position of the flap actuator jacks, i.e. Flap 0, could not have been altered by impact. The actuator setting is consistent with the pilot's statement that he selected Flap 0 in an attempt to recover from the stall condition. The movement of the flap switch to the Flap 2 position was probably caused by rescue personnel and others in their efforts to remove the pilot and passengers from the aircraft, after the accident. The flap actuators did not move when the switch was subsequently (after the accident) moved to Flap 2, as the battery power have been disconnected.

2.7 The take-off run

The pilot was aware that the aircraft was tracking to the left on the take-off run. It is also obvious that if the drift had continued and the rotation was delayed, then the aircraft would have run off the left edge of the runway, into long grass and somewhat rough ground. Three factors may have played a part in this drift to the left:

- The progressive application of engine power, and its consequent torque swing to the left.

- The soft ground on the left side of the runway.

- Reduced efficacy of nose wheel steering due to a loss of friction in the wet grass.

The actual take-off run passed across soft area of the runway. This would have reduced the acceleration of the aircraft, and increased the take-off run. It is also be noted that the pilot's previous experience on this aircraft type was only on hard paved surfaces, on which a significantly better take-off performance would have been achieved compared to grass, particularly wet grass.

As the aircraft approached the take-off point the pilot was confronted with a number of difficulties:

- The rate of acceleration was less than anticipated, and the take-off roll was longer, due to the soft ground conditions.

- The pilot had to progressively increasing power, because a rapid application of power would produce a torque swing to the left.

- He had to continuously monitor the turbine temperature gauge, as he increased engine power, in order to prevent exceeding the turbine temperature limits. This would have diverted some of his attention onto the instrument panel.

- He had to deal with a drift to the left and to achieve take-off before the aircraft ran off the left edge of the runway.

- He wanted to take-off before the cross-track. This arose from his communications with two pilots who have used the airstrip.

- He was flying an aircraft on which he had little experience, from an unfamiliar grass airstrip. In particular, this was his first experience of trying to counteract the torque swing to the left, while operating on a wet grass strip. In this environment the available nose wheel friction, to counteract the torque effect, would have been considerably less than on hard surface runways

The ground marks indicate that the aircraft lifted off initially just before the cross-track but touched-on again briefly after the track. This indicates that the rotation might have been initiated at a sub-optimum air speed.

2.8 The initial climb

At the point of rotation, and subsequently, the pilot may have been unwittingly confronted with further complications:

- He may have been concerned that he was about to run off the left edge of the runway and may therefore have lifted off at a sub-optimum airspeed.

- Due to the fact that the ground was rising in front of the aircraft, the pilot could not see the natural horizon when the aircraft was in the low section of the runway, as it approached the rotation point. Instead he saw the crest of the runway in front of him, which was slightly above the natural horizon. This may have had a slight disorientating effect.

- Arising from his desire to achieve a very short take-off run, the pilot had selected Flap 1 setting for take-off, which he had not done previously on this aircraft type. The effect of this setting was to increase the effective wing angle of attack by 3º for a given aircraft pitch angle. Therefore if the pilot used his normal climb-out angle, as used with the usual Flap 0 setting, the effective angle of attack of the wing would have been 3º higher than normal, and correspondingly closer to the critical stall angle.

- As the aircraft passed beyond the crest in the runway, the ground fell away underneath the aircraft. If the aircraft was close to the ground at this point, as described by some witnesses, the effect of this down-gradient would have caused the aircraft to loose the effect of the lift cushion that exists when an aircraft is within half its wingspan of the ground (this is known as loss of "Ground Effect"). However the aircraft did successfully clear the hedge to the left of the runway, where the ground was almost level, which would indicate that the loss of ground effect was not a significant factor.

- The pilot may have come momentarily distracted as he sought the undercarriage selection switch immediately after take-off, due to his lack of recent experience on the aircraft type.

- The combination of the extended nose of this aircraft, the unfamiliar airstrip, the pilot's small stature and his lack of experience on this aircraft type may have reduced the visual cues to the pilot and may have resulted in an excessively steep climb angle.

A possible result of these factors, combined with a possible sub-optimum take-off speed, as discussed in 2.7 above, may have been that the initial climb was at high angle of attack and low airspeed, at the back end of the drag curve[3], with a consequently loss of climb performance.

[3] The back end of the drag curve is a position in the flight envelope, close to the stall speed, where the lift produced by the wing reduces significantly as airspeed reduces and the drag increases at a very rapid rate. The combination results in a major deterioration of climb performance.

2.9 The climb

There is significant difference in witness evidence as to the maximum height attained by the aircraft, varying from 30 to 200 ft. There is evidence that after lift-off, the aircraft entered a steep nose-up attitude. The pilot stated that the aircraft was experiencing stall buffet, and the stall warning was sounding. The evidence indicates that the aircraft entered a high nose up stalled attitude, shortly after take-off. The pilot's action of raising the flaps at this point would have exacerbated the stall condition. Raising the flaps is a standard recovery procedure for a stall encountered on approach, but its efficacy in this situation is dubious.

Most light aircraft, if rotated too early or stalled in the early stage of a climb-out, would probably "mush" back down to the runway surface. However given the very large surplus power, this particular aircraft was capable of climbing, or maintaining altitude, to some degree, more in the manner of a helicopter than an aircraft, for a short period, with the wing in semi-stalled condition, with significant vertical lift being generated by the propeller.

In order to un-stall the aircraft, it would have been necessary for the pilot to lower the nose, to enable the aircraft to accelerate above the stall speed. Due to the low height at which the aircraft stalled, and the initial high nose up attitude, insufficient height was available to effect a recovery before the aircraft struck the ground in a stalled, or semi-stalled, condition.

It will be recalled that the aircraft's Supplementary Flight Manual stated that a maximum height loss of 200 ft was noted in power-off stall tests. Such tests are conducted with a gradual reduction of airspeed, at the rate of 1 kt per second reduction of airspeed. The height required to recover from a stall with a high angle of attack, at a high power engine power setting, would be considerably greater than that encountered in the standard stall test.

2.10 Flight path

With regard to the maximum height attained by the aircraft, it may be noted that there was a distance of 300 metres between the lift-off point and the hedge where the first impact occurred. Assuming an average speed of 64 kt (stalling speed), this distance would have been traversed in about 9 seconds. If the aircraft were flying at 80 kt this distance would have been traversed in 7.5 seconds.

Analysis of this data, suggests two possibilities:

- The aircraft climbed at a very steep angle, immediately after take-off, attained a height of 100 to 200 ft and then stalled, and subsequently lost altitude quickly. The probable result of this scenario would be the aircraft hitting the ground at relative slow forward speed and a high rate of descent, with the wreckage displaying the classical compact wreckage distribution of a deep stall.

- The aircraft lifted off at low airspeed, and failed to attain full flying speed, and stalled when an attempt was made to gain altitude. However this was not a classic deep stall and the power of the engine ensured that airspeed close to stall speed was maintained. The aircraft would have continued for some distance and then would have gradually lost altitude.

The speed evidence derived from the propeller slash marks and the fact that the aircraft travelled 42 metres after sustaining two heavy impacts indicates that the aircraft was travelling at a speed of approximately 60 kt when it struck the hedgerow. This evidence supports the second of the above possibilities.

2.11 Centre of gravity (C of G)

The Investigation found no evidence that the pilot performed a weight and balance calculation prior to take-off for the accident flight, or for the two previous take-offs in the UK. The C of G for the accident flight, as shown in 1.6.1 above, i.e. 85.7 inches aft of datum, is based on a post-accident estimation. Certain assumptions had to be made, including the distribution of fuel between the main and tip tanks. The Investigation has calculated that the C of G was within the prescribed limits, but close to the aft limit for this final flight.

The Investigation is satisfied that the C of G of the aircraft for the previous flight from Leeds to Ballyneale, was forward of the C of G forward limit. While the information of the other take-off at Stansted is less complete, the Investigation believes that, here also, the C of G was at or forward of the forward limits. The result of the C of G being forward of the forward limit is that a larger than normal rearward pull on the control yoke was required to achieve rotation at take-off. If the pilot had applied a rearward pull of similar magnitude during the accident take-off from Ballyneale, where the C of G was close to the aft limits, the result would have been an excessively steep rotation at take-off. Furthermore, the reduced pitch stability associated with a C of G close to the aft limits would also have facilitated the aircraft entering an excessively nose-up attitude during the initial climb. As the pilot's only recent experience was with the aircraft in a nose heavy configuration (the two take-offs in the UK), he may have pulled back heavily on the final take-off and entered an excessively steep pitch attitude. The position of the centre of gravity close to the aft limits would have facilitated the aircraft entering a steeper than normal pitch attitude. In this regard it is should be noted that the pilot had not flown this aircraft type for four years prior to the commencement of this trip.

2.12 Runway Condition

Due to recent heavy rain, one section of the airstrip, located in the low area half way between the start of the take off run and the lift-off point, and sites on the left side of the runway, had become soft and water-logged. If the aircraft had remained on the runway centre-line on take-off, this would not have been a problem, as the aircraft would not have passed through this wet area. The pilot appears to have been satisfied with the condition of the airstrip, as ultimately the decision to take-off rested with him.

2.13 Organisational aspects

The owner had a clear vision of his requirements, i.e. quick, effective and personalised transport to the UK. He had previously held a helicopter licence, but had never held a licence for fixed wing aircraft.

This is not the first instance that had come to the attention of the AAIU where the application of considerable resources and effort to the mission of providing personal air transport, using professional pilots, has resulted in the selection and operation of high performance and/or complex aircraft, with unfortunate outcomes. Under current regulations, the operation of such of aircraft, is only required to be conducted, in accordance with the rules for Private Category aircraft. At this time, there continues to be, in Ireland and in the other Joint Aviation Authorities (JAA) States, no specific category for the operation of corporate aircraft. In a report of previous fatal accident (ref http://www.aaiu.ie/upload/general/3619-0.pdf) involving a UK registered aircraft, the AAIU made a Safety Recommendation to the UK CAA with regard to the need to regulate corporate aviation. This Safety Recommendation and the response of the UK CAA can be seen at http://www.aaiu.ie/upload/general/3618-0.PDF and in **Appendix C**. The same report also made a Safety Recommendation to the JAA, which can be seen at http://www.aaiu.ie/upload/general/4721-1.PDF and in **Appendix D**. No response to this Safety Recommendation was received by the AAIU. The Investigation understands that the regulation of corporate aviation is still under consideration by the JAA and that the appropriate JAA Regulations, JAR-OPS-2, are still awaiting finalisation.

2.14 Oversight aspects

N7205R was operated on the US register, but was to be based in Ireland, and was flown by a pilot who held a USA Pilots licence on condition that his UK Licence remained current. The FAA requirements were met as the aircraft was maintained in accordance with FAA regulations and flown with a pilot with a valid FAA licence. The Irish Aviation Authority (IAA) would normally only take an interest in the operation of foreign registered private category aircraft when there is an identified breach of Irish aviation law.

2.15 Airstrip development

For the reasons outline in section 1.10.2 above, the development of this airstrip had not come to the attention of the IAA. Because of airstrip was to be used as an unlicensed private airstrip, it did not require approval from the IAA. However the advise of the IAA was available to the owner if it had been requested. The Investigation is concerned that airstrips could be developed for use by high performance complex aircraft, such as N7205R, without suitable assessment of the suitability of the airstrip for use by such aircraft.

While this matter had no bearing on the cause of the accident, the Investigation believes that some aspect of the airstrip may have been a point of comment if the advice of a competent authority had been sought. An example is the presence of small gravel in the cross-track, in relation to the operation of a turbine aircraft.

It may be noted that the only specific requirement, under the Air Navigation Acts, for the operation for Private Category Aircraft from private property, is that such operations must have the property owner's permission. This criteria was met in relation to the operation of N7205R.

3. CONCLUSIONS

3.1 Findings

3.1.1 The pilot was properly licensed by the USA FAA and medically fit to conduct the flight.

3.1.2 The aircraft had a valid Certificate of Airworthiness (COA), which was maintained in accordance with the requirements of the USA FAA.

3.1.3 At take-off on the accident flight, the aircraft was within the certified take-off weights and centre of gravity limits.

3.1.4 There was no evidence found of aircraft malfunction or defect prior to impact.

3.1.5 The examination of the engine and propeller indicate that the engine was operating at full power at the time of the initial impact with the hedgerow, and that there was no loss of engine power prior to impact. Therefore a loss of engine power is not considered to be a factor in this accident.

3.1.6 The pilot was unfamiliar with the airstrip.

3.1.7 The pilot had very limited total and recent experience on this aircraft type.

3.1.8 The pilot had no experience of operating this aircraft type from grass airstrips.

3.1.9 The pilot used a take off flap setting other than that laid down in the approved Flight Manual for this modified aircraft.

3.1.10 During the take-off, the aircraft probably rotated at too low an airspeed.

3.1.11 The pilot allowed the aircraft to attain an excessive nose-up attitude during the climb-out, which resulted in a loss of airspeed and a full stall, at a height where successful recovery was improbable.

3.1.12 The IAA was not notified of the development of this airstrip, nor was their advice sought on its development. Given that it was proposed to use this airstrip for the operation of high performance complex turbine-engined aircraft, it would have been prudent to seek IAA advice on the airstrip development.

3.1.13 The continued operation of corporate aviation under the regulations governing Private Category general aviation is not in the best interest of aviation safety and the proposed JAR-OPS 2 regulations needs to be finalised and implemented.

3.2 Causes

3.2.1 The pilot did not achieve adequate airspeed for the climb-out. Consequently the aircraft stalled after take-off.

3.2.2 The pilot had very limited total and recent experience on this particular high performance complex aircraft.

3.2.3 The pilot had no experience on the operation of this aircraft type from grass airstrips, and no experience of operating from the airstrip in question.

4. SAFETY RECOMMENDATIONS

4.1 The European Aviation Safety Agency EASA[4] (as the successor to the JAA) should finalise and implement its proposals with regard to JAR-OPS 2 and corporate aviation as a matter of urgency. **(SR 33 of 2004)**

4.2 The IAA should use their good offices with EASA to ensure finalisation of JAR-OPS 2, with regard to corporate aviation. **(SR 34 of 2004)**

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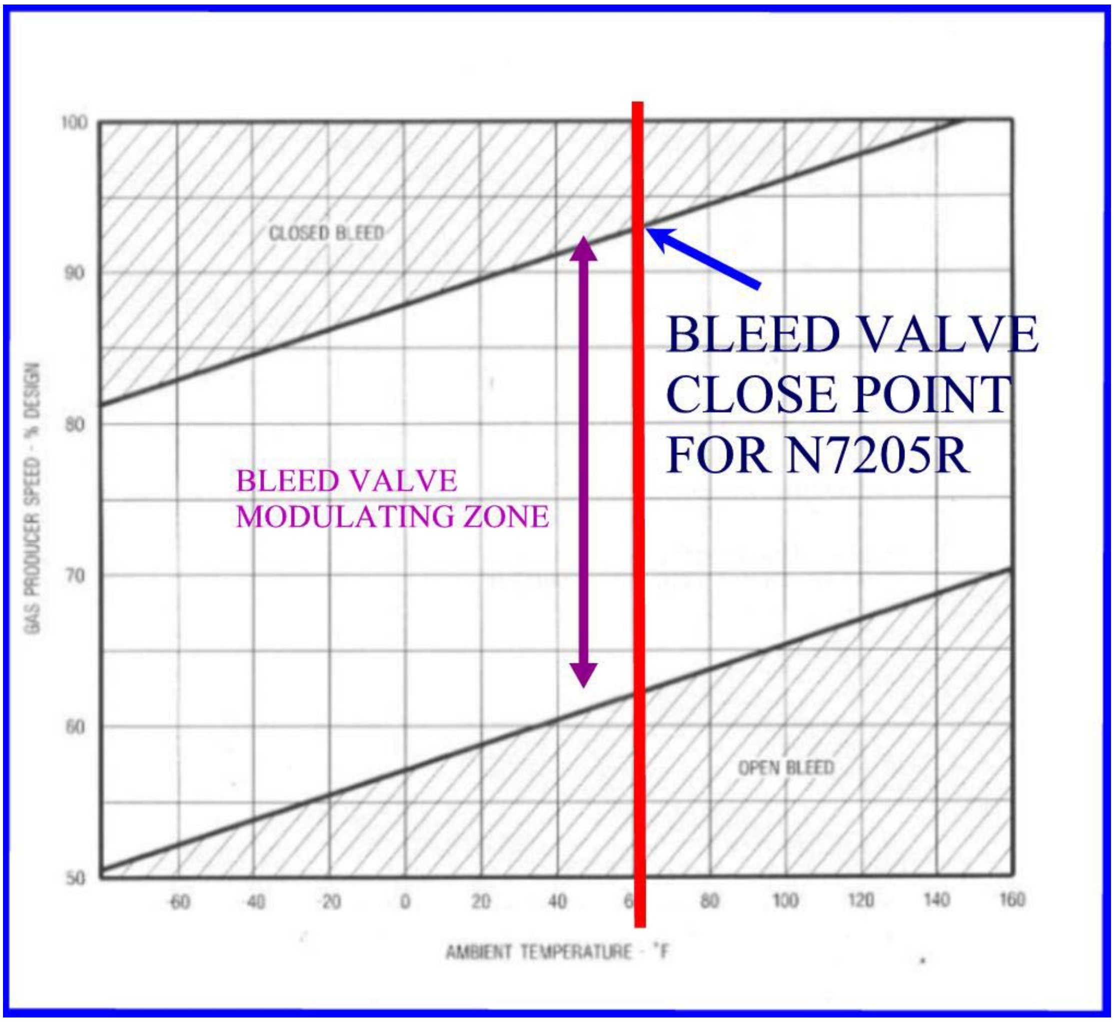
[4] The adoption on 15 July 2002 of a European Parliament and Council Regulation (EC) No 1592/2002 (OJ L 240, 7 September 2002 - PDF [225KB]) established a new Community system of air safety and environmental regulation and for the establishment of the European Aviation Safety Agency (EASA), which will start operating in September 2003. EASA is to take over the function of the JAA within the European Union.

Appendix A

This photo shows the bleed valve, as removed from the engine. The valve face can be seen in the fully closed position, in the outlet on the left side of the photo. The clay, which is jammed under the valve and holding it in the closed position, can also be seen.

Appendix B



This graph shows the bleed valve position as a function of N1 speed (%) and ambient temperature. The red vertical line show indicated the ambient conditions on the day of the accident. The graph shows that, in the conditions at the time of the accident, the bleed valve would have been fully closed at N1 greater than 93% and fully open at N1 less than 62%. Between N1 values of 62% and 93%, the bleed valve would have been modulating, i.e. between the fully open and fully closed position

Appendix C

Safety Recommendation Number:	007 of 1998
AAIU Event Reference:	1996-0076
Date of Publication of Safety Recommendation:	17/06/1998

Safety Recommendation:
The UK CAA should consider the establishment of a special category for the operation of corporate aircraft.

Response:

The following response was received from the UK CAA on 27/08/1998:-

"The Authority accepts this Recommendation. The Authority has considered the establishment of a special category for the operation of corporate aviation. Work begun in 1991 led to the development of draft proposals to amend the UK Air Navigation Order, thereby introducing specific requirements for the regulation of corporate aviation. The Authority then decided to discuss these draft proposals with its Operations Advisory Committee (OAC). The OAC is an independently chaired body of senior aviation industry experts who provide advice to the Authority on those matters, which may have an operational impact. Following discussions with the OAC, consensus was reached on the development of a regulatory framework for corporate aviation. However, at this time, the Joint Aviation Authorities announced that they were considering the introduction of Joint Aviation Requirements (JARs) to encompass corporate aviation. The Authority and the OAC agreed to postpone unilateral (UK) action in order to participate in the development of such a JAR. Given that there is currently no Joint Aviation Requirement in respect of corporate aviation, the Authority will review its earlier proposals, consulting as necessary, and decide on a best course of action. The Authority will complete its review by end- October 1998.
In the meantime, it should be noted that the Authority has published CAP 686 - Corporate Code of Practice (Helicopters). This publication contains operational guidance for private operators, including corporate operators, to be applied on a voluntary basis. Similarly, the Business Aircraft Users Association is updating its "Example Operations Manual" to align, where possible, with Joint Aviation Requirements -Operations (JAR-OPS) Part 1 (Aeroplanes).
CAA Status: Open"

In a further response dated 9 January 2002 the CAA stated:

"The UK Civil Aviation Authority has reviewed its earlier proposals for the establishment of a special category for the operation of corporate aviation, and has decided to support the Joint Aviation Authorities in the introduction of Joint Aviation Requirements (JARs) to encompass corporate aviation. The UK CAA is fully committed to the development of an appropriate regime for the regulation of corporate aviation under JAR-OPS 2, and it is anticipated that a mature draft of JAR-OPS 2 will be ready for public consultation during 2002.
Status Closed"

Appendix D

Safety Recommendation Number:	008 of 1998
AAIU Event Reference:	1996-0076
Date of Publication of Safety Recommendation:	17/06/1998

Safety Recommendation:

The JAA Joint working Group for JAR OPS 2, which reviews operation standards for aircraft operation in the JAA States, including the UK and Ireland, should consider the establishment of a special category for the operation of corporate aviation, to encompass the operation of aircraft such as G-HAUG.

Response:

No response received