



Air Accident Investigation Unit Ireland

FORMAL REPORT

ACCIDENT

**Bede Aircraft Corp BD-5GR, EI-DNN
Garranbaun, Co. Waterford, Ireland
25 July 2015**



**An Roinn Iompair
Turasóireachta agus Spóirt**

Department of Transport,
Tourism and Sport

FINAL REPORT

Foreword

This safety investigation is exclusively of a technical nature and the Final Report reflects the determination of the AAIU regarding the circumstances of this occurrence and its probable causes.

In accordance with the provisions of Annex 13¹ to the Convention on International Civil Aviation, Regulation (EU) No 996/2010² and Statutory Instrument No. 460 of 2009³, safety investigations are in no case concerned with apportioning blame or liability. They are independent of, separate from and without prejudice to any judicial or administrative proceedings to apportion blame or liability. The sole objective of this safety investigation and Final Report is the prevention of accidents and incidents.

Accordingly, it is inappropriate that AAIU Reports should be used to assign fault or blame or determine liability, since neither the safety investigation nor the reporting process has been undertaken for that purpose.

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¹ **Annex 13:** International Civil Aviation Organization (ICAO), Annex 13, Aircraft Accident and Incident Investigation.

² **Regulation (EU) No 996/2010** of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation.

³ **Statutory Instrument (SI) No. 460 of 2009:** Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulations 2009.



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In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No 996/2010 and the provisions of SI 460 of 2009, the Chief Inspector of Air Accidents on 25 July 2015, appointed Mr Paul Farrell as the Investigator-in-Charge to carry out an Investigation into this Accident and prepare a Report.

Aircraft Type and Registration:	Bede Aircraft Corp BD-5GR, EI-DNN	
No. and Type of Engines:	1 x Mid-West GIAE 110 R	
Aircraft Serial Number:	HJC 4523	
Year of Manufacturer:	Kit purchased, 1973; First Flight, 1994	
Date / Time (UTC)⁴	25 July 2015 @ 17.43 hrs	
Location:	Garranbaun, Co. Waterford N 52° 6.98', W 007° 32.51'	
Type of Operation:	General Aviation	
Persons On Board:	Crew - 1	Passengers - 0
Injuries:	Crew - 1 fatal	Passengers - 0
Nature of Damage:	Aircraft Destroyed	
Commander's Licence:	Private Pilot Licence (PPL) issued by the UK's Civil Aviation Authority (CAA)	
Commander's Details:	Male, aged 67 years	
Commander's Flying Experience:	3,200 hours approximately, of which approximately 60 hours were on the accident type	
Notification Source:	Air Traffic Control Duty Manager, Shannon	
Information Source:	AAIU Field Investigation	

⁴ **UTC:** Co-ordinated Universal Time. All timings in this report are quoted in UTC; to obtain the local time add one hour.

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SYNOPSIS

The aircraft was on a general aviation flight from Waterford Airport, via Ardmore, to Shannon Airport. Some minutes after take-off the Pilot made a Mayday call and informed Air Traffic Control (ATC) that he had an engine fire, had lost elevator authority and would have to land in a field. A forced landing was attempted into a field at Garraunbaun, Co. Waterford; this proved unsuccessful and the aircraft impacted the ground, with wreckage strewn over approximately 63 metres (m) along a general orientation of 050° magnetic. There was a significant post-accident ground fire. The Pilot did not survive the accident.

NOTIFICATION

The ATC Duty Manager at Shannon telephoned the AAIU Inspector-On-Call at approximately 18.05 hrs to inform him of the accident.

INVESTIGATION TEAM

A team of four Inspectors of Air Accidents travelled to Waterford on the evening of the accident to commence the Investigation. Following an initial examination the accident site was secured overnight by An Garda Síochána. The Investigation team returned on the following morning to continue examining the site and the wreckage.

1. FACTUAL INFORMATION

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1.1 History of the Flight

The aircraft was on a general aviation flight from Waterford Airport (EIWF) where it was normally based. At 17.30:14 hrs the aircraft contacted Waterford ATC requesting taxi *"for this flight to Shannon"*. When queried as to his maximum en-route altitude the Pilot replied *"max would be up to three thousand"*. At 17.30:52 hrs EI-DNN was cleared by Waterford ATC to backtrack and line up for Runway (RWY) 21. The Pilot advised Waterford ATC *"I'll be routing along the coast to Ardmore first before going on to Shannon"*. At the same time Waterford ATC was in communication with Shannon ATC requesting a transponder code for a *"VFR departure Echo India Delta November November to Shannon at three thousand"*. Shannon assigned the transponder code *"2623"* and Waterford advised Shannon of EI-DNN's intentions *"he'll be routing down towards Ardmore and then direct to Shannon and he'll be remaining clear of the controlled airspace around Cork"*.

The aircraft departed EIWF at 17.33 hrs and was transferred to Shannon ATC at 17.38:49 hrs. The quality of radio transmissions to Shannon was poor. EI-DNN can be faintly heard calling Shannon at 17.38:49 hrs *"Shannon good evening Echo India Delta November November"*. The transmission was so faint that it was not acknowledged by ATC. At 17.39:12 hrs the aircraft called again *"Shannon good evening Echo India Delta November November"*. This transmission, although crossed with another louder transmission, was heard by ATC who responded at 17.39:26 hrs *"Echo India Delta November November Shannon QNH is 1014"*.



The Pilot responded *"1014 level at one thousand two hundred just coming to Dungarvan, routing to Ardmore before heading to Shannon. At Ardmore...(unreadable)"*. At 17.39:49 hrs there was a routine exchange between EI-DNN and ATC Shannon relating to the Pilot's intentions to route to Shannon after Ardmore and that the Danger Area⁵ D6 was active.

At 17.41:44 hrs EI-DNN transmitted *"Shannon, Echo India Delta November November engine problem"*. Shannon ATC responded *"November November your transmissions are very weak"*. EI-DNN then transmitted *"Shannon Echo November November engine failure or ah engine problem. Heading back to..."*. The end of this last transmission was then drowned out by another aircraft's, louder transmission.

At 17.42:41 hrs EI-DNN transmitted *"Shannon Echo November November Mayday Mayday Mayday I'm going to have to land"*. On hearing the transmission ATC responded *"Echo India Delta November November go ahead again"*. The aircraft then broadcast *"Mayday, Mayday Mayday. I have engine failure. I have an engine on fire"*. ATC acknowledged and queried *"Roger, are you going back to Waterford"*, to which EI-DNN replied *"Negative I'm just going to have to find a field"*.

Shannon ATC then contacted Waterford ATC by telephone to apprise them of the situation and advised that EI-DNN may be returning to EIWF. A second aircraft, which was following EI-DNN to Ardmore and Shannon, had just taken off from EIWF and the two controllers discussed the co-ordination of this aircraft's instructions to ensure that it did not affect EI-DNN. The second aircraft which was just at the boundary of the Waterford control zone was advised to remain north of Kilmacthomas.

At 17.42:54 hrs Shannon ATC called EI-DNN *"Echo India Delta November November report persons on board"*. The Pilot replied *"Ah one POB. I've lost elevator authority as well as the fire"*. This was acknowledged by Shannon ATC. A final transmission was then heard from EI-DNN which was very difficult to understand but did contain the phrase *"ending up in a field"*. The Investigation notes that the Pilot's voice was composed and professional during these transmissions.

Shortly afterwards, at 17.43:40 hrs, the second aircraft reported *"Eh I can see some smoke ahead of me on the ground"*. The second aircraft routed to the area where the smoke was observed. The pilot of the second aircraft confirmed to Waterford ATC that EI-DNN had crashed and passed latitude and longitude information for the crash site to ATC. At ATC's request, he remained on station for a period of time.

Waterford ATC alerted the emergency services, as did several members of the public.

1.1.1 Witnesses

The Investigation is grateful to the many witnesses who took the time and trouble to contact the Investigation to report their accounts of what they had seen. The following are synopses of eight of these witness accounts:

⁵ **Danger Area:** Airspace of defined dimensions within which activities dangerous to the flight of aircraft may exist at specified times; D6 is located around Kilworth, Co. Cork.

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Witness No. 1

He had seen the plane before, didn't see it on Saturday but did hear it. His wife and another person saw it flying low when facing southeast it was from left to right. The engine was heard to be running until the sound of impact. Another person present couldn't get over how low it was. This witness did not report seeing any fire.

Witness No. 2

The aircraft sounded like a car with no exhaust and was moving very fast. The noise was unbelievable. There was a sudden change in noise and the aircraft banked to the right. The aircraft turned about 160 degrees but the noise didn't get back to what it was. He thought he saw some sort of trail but it was very faint. It clipped the ditch, hit the ground, bounced, there was a ball of flame and it exploded when it reached its final resting place.

Witness No. 3

Saw the red plane come down, the engine did sound funny, thought it had engine trouble. The plane disappeared; there was a bang and a plume of black smoke. As the aircraft came around the engine note sounded lower but it did not cut out.

Witness No. 4

Heard a terrible noise, went outside and saw a little red plane coming, noise was unbelievable. It went nearly over our house, the engine cut out, it was going terribly fast and started up again after a few seconds. He made a turn and it cut out again over Garranbaun. Lost sight of it then as it went behind some trees. The engine was stopped. Witness did not see or hear the impact.

Witness No. 5

He heard what he described as a noise of an aircraft you would hear in a war movie. It was very loud. It was getting louder; like it was descending. He went outside to see what was causing it. He saw a small aircraft which he described as dark coloured, greeny/black or grey. It was flying level. It had flown nearly directly over them, and was now flying out to sea, towards the cliffs at Dungarvan. He said, as he looked at it he was facing the Dungarvan direction. He saw no smoke or fire from the aircraft.

Witness No. 6

Witness was in her garden near Tramore between 18.15 and 18.45 hrs local time when she heard a very piercing sound. At first she thought it was a *"dog in distress"*. The sound got louder. When she located its origin, she saw a small plane over the town of Tramore (not over the sea). It was heading for the coast. It was dark in colour (could not confirm exact colour). It was not high. Witness was used to the sound of light aircraft and the rescue helicopter as she is close to the flight path into Waterford airport; witness reported this one sounded very different. It was heading out along the coast. The (engine) sound did not change during this time. She did not notice any smoke fire or vapour from aircraft.



Witness No. 7

Heard and saw the plane coming from the Waterford direction towards Dungarvan; *"it was flying low enough"*. Initially engine sounded ok, but then heard the engine *"racing up and down"*, *"not smooth"*. The aircraft turned around and was now in front of the house, heading back towards Waterford. The engine sound continued all the way until it crashed. He said the aircraft was now unusually low (200 - 300 ft above his house). He could see it quite clearly; it was red in colour; he could see the pilot in the cockpit. The aircraft was wings level and not pointing up or down. Its speed was the same throughout its flight. He saw no smoke, fire or heat-haze coming from it. He thought that it had its undercarriage down (it looked different passing his house going east, than when he saw it first). It disappeared behind some trees near his property and then he saw a large plume of smoke. It looked like a large mushroom or tree in shape, and was very black.

Witness called 999 and immediately left for where he thought the crash had occurred. He got there within seven or eight minutes of the accident happening.

Witness No. 8

Witness was located north of the Gold Coast Hotel/Golf Club. He first heard the plane when he was outside with his son. It made *"an awful commotion, sounding like a powered hang glider, like a flying chainsaw"*. The time was around 18.40 hrs local time. He did not think anything was wrong with the plane at that stage.

He then left where he was standing, to go to his shed. He could see the aircraft to the south of him (over the Gold Coast Hotel/Golf Club). It was heading west. It seemed to be at a *"normal height"*. This was the closest the aircraft got to him. Shortly after this he heard the engine cut out. He was quite certain of this. The aircraft went completely silent. He did not think this very unusual, as he was used to light aircraft from Waterford carrying out training in this area and practicing (engine failures). The engine sound *"came back on"* two to three seconds later. He went into his shed.

When he came back out he noted that the engine sound did not seem as loud as before. But he thought this might have been because the aircraft was farther away. The aircraft was now north of him and heading east. It seemed to be lower, but the witness was unsure as it was further away. It was now over the R675 road, in the region of Ballinroad.

He described the aircraft as red but was not sure. There was no smoke or vapour coming from the aircraft. A relative came out of the house to look, and asked *"is that thing going down?"* It was lower at this stage. The view of the aircraft became obscured by trees (200 yards from him). He ran to another location on his property to see if he could see it, and expected it to reappear *"out over the hill"*. But at that moment he saw a large mushroom cloud of black smoke. Then a smaller mushroom cloud of smoke. Then there was a general third plume of smoke.

His son dialled 999 to report the accident and he then set off towards the scene of the accident. When he got there, there were already three to four people at the site. He arrived about 10 minutes before the emergency services. He walked back along the track of the accident, and into the field before the accident site to see if anyone had *"got out of the plane"*.

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1.2 Injuries to Persons

Injuries	Crew	Passengers	Others
Fatal	1		
Serious			
Minor /None			

1.3 Damage to Aircraft

The aircraft was destroyed.

1.4 Other Damage

Some of the agricultural field surface and its boundary hedge row suffered scorching.

1.5 Personnel Information

The Pilot held a Private Pilot Licence (PPL) issued by the UK's Civil Aviation Authority (CAA). The Pilot had a Single-Engine Piston (SEP) Landplane (L) rating which was valid until 6 June 2017; his Class 2 medical certificate had been revalidated by a UK based Aero Medical Examiner (AME) on 8 July 2015.

The Pilot had accumulated in the order of 3,200 hours total flying experience, of which approximately 60 hours were on the accident type.

The Pilot was described by a contemporary in the UK Light Aircraft Association (LAA) as "*an experienced LAA inspector and a real enthusiast*".

1.6 Aircraft Information

1.6.1 General

The BD-5GR aircraft type was a kit plane designed by Jim Bede and sold by the Bede Aircraft Corporation in the early 1970s. The Pilot, who was also the owner, built the aircraft from such a kit. The aircraft fuselage was 17 ft long with a 17.5 ft wingspan. The Bede BD-5 is a single seat, low wing, all metal, retractable undercarriage, monoplane. The cabin is ahead of the engine. The mid-body engine drives a pusher propeller via a reduction drive belt and propeller shaft. The original design envisaged the availability of a two-stroke engine to power the propeller, but such an engine was never made available. It is estimated that of more than 5,000 kits sold; only a few hundred were completed. Those that were completed used various engine installations.

The aircraft has a conventional arrangement of wings, ailerons, flaps, fin and rudder with an all flying tailplane fitted with an anti-servo⁶ trim tab.

⁶ **Anti-servo:** An anti-servo tab resists the movement of the surface to which it is fitted. In this case, it is placed on the elevator to provide 'artificial' feedback to the pilot, through the controls.



The majority of the aircraft was fabricated from 2024-T3 Aluminium⁷ and 4130 cond N⁸ steel. A stainless steel firewall sealed the cabin off from the engine bay. **Photo No. 1** shows the accident aircraft with certain items of interest annotated.

The Pilot acquired the airframe components for the “A wing” variant during 1973 and 1974. The aircraft was first registered in the UK on 10 October 1974. A “G wing” kit was purchased in 1980. A Honda engine package and a fuselage stretch kit were obtained in 1983.



Photo No. 1: annotated photograph of the accident aircraft

In the case of the accident aircraft the Owner had initially used a Honda auto engine to provide power. This engine installation was considered to be very heavy, not as reliable as anticipated and there were no definitive installation diagrams provided.

For Permit-to-Fly aircraft, where the requirements of ICAO Annex 8, Airworthiness of Aircraft, do not apply i.e. the aircraft is not the subject of a Type Certificate⁹, it is up to each state to make their own decisions to issue a permit or not for any non-certified aircraft. The aircraft was issued with an UK CAA Airworthiness approval Note No. 13149 on the 8th September 1994 and Permits to Fly certificates No. PA 003476/001 on 7th October 1994 and No. PA003476/002 on 28th July 1995.

On 14 December 1994, while carrying out a go-around at Chivenor Airfield, Devon, UK, the aircraft suffered an engine stoppage at approximately 100 ft. The aircraft made a wheels-up landing on a grass strip.

⁷ **2024-T3 Aluminium:** A high strength Aluminium alloy with desirable machinability and surface finish properties combined with acceptable workability; typical uses include the manufacture of aircraft parts and structural components.

⁸ **4130 Aircraft Cold Rolled Condition N (Normalized):** A Chromium Molybdenum alloy steel, with desirable welding, fabrication and hardenability properties, specifically formulated for use in aircraft construction.

⁹ **Type Certificate:** A document issued by a Contracting State to define the design of an aircraft type and to certify that this design meets the appropriate airworthiness requirements of that State.

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The UK Air Accidents Investigation Branch (AAIB) published a report on the accident (EW/G94/12/04) which described significant damage suffered by the fuselage underside, main gear doors and the left aileron and its attachment point. The pilot on that occasion was a test pilot who had been nominated by the Owner, and accepted by the UK CAA, to act as test pilot for the initial flights. The cause of the accident was attributed to teeth which were ripped off the propeller drive belt and it was suggested that this may have been a pre-impact fault which caused the engine failure.

The Pilot subsequently incorporated a Mid-West GIAE 110 R, twin rotor, water cooled, rotary (Wankel¹⁰) engine which delivered 110 horsepower (HP) at 7,000 revolutions per minute (RPM). The rotary engine installation was known to be particularly noisy. The main housings are aluminium alloy castings, cooled with a pump-circulated pressurised water-glycol mixture and supporting a coalescing oil separator assembly mounted directly onto the central casting, rotor cooling air outlet flange. A known characteristic of Wankel engines is that they run very hot on the engine's ignition and exhaust side. As installed in the accident aircraft, the engine's right hand side was the "hot" side.

The aircraft was fitted with four fuel pumps; two were pressure pumps for engine fuel supply and two were transfer pumps for moving fuel between the wing tanks in-flight to ensure that the aircraft remained balanced. Notes compiled by a pilot who had flown the accident aircraft record that the reason for two of each pump was redundancy; only one pressure/transfer pump was used at any time, and the engine was shut down by switching off the fuel pumps using the switches located on the left hand side console.

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1.6.2 Civil Aviation Authority Permit-to-Fly Refusal

On 27 September 1999, the CAA wrote to the Pilot advising him that in light of his stated intention (earlier that year) to apply again for a Permit-to-Fly for the aircraft, the CAA had reviewed the basis on which the approval was to be granted. The result of that review was that the CAA was not prepared to proceed toward the issue of a Permit-to-Fly for an aeroplane which had essentially the same flight characteristics as the BD-5 aircraft which had flown previously in the USA.

The CAA cited statistics obtained from the Federal Aviation Administration (FAA) and National Transportation Safety Board (NTSB) which gave the total number of BD-5 incidents/accidents (1972-1998) as 81 with 22 fatalities and 15 serious injuries. The CAA also indicated its belief that many incidents involving aircraft in the BD-5 category go unreported and it concluded that the true incident/accident totals may be significantly higher. The CAA noted that between 5,000 and 6,000 BD-5 aircraft kits were sold but that many of these lacked significant parts, particularly relating to the engine installation and therefore only a small percentage of these kits were completed as flying aircraft. The CAA estimated the number of completed aircraft to be in the low hundreds.

¹⁰ **Wankel engine:** An internal combustion engine using an eccentric rotary motion to implement the four stroke cycle. The design has a number of technical strengths including a reduction in the number of moving parts, lower engine weight, less vibration and improved power to weight ratios.



The CAA said that *“A total fleet of a few hundred aircraft combined with in excess of 80 notified accidents (with 37 involving serious injury or death) represents a very poor safety record which cannot be used as an alternative to compliance with the airworthiness requirements. Consequently, we must apply the appropriate code of design requirements in full to the BD-5”*.

The CAA stated that the stalling speed in landing configuration of the BD-5 was well in excess of the maximum of 45 knots Calibrated Airspeed set out in the JAR-VLA (Joint Aviation Requirements - Very Light Aircraft) standard; consequently, the applicable standard for considering the permit application would be JAR 23. The CAA further informed the Investigation that the high stalling speed meant that the BD-5 was outside the scope of the approval of the LAA, formerly the Popular Flying Association (PFA). This meant that the investigation of the acceptability of the BD-5 for a UK Permit-to-Fly had to be established by the staff of the Civil Aviation Authority directly.

The CAA went on to cite a 1976 assessment of a BD-5B, carried out by a CAA test pilot with the co-operation of the Kit Manufacturer. The CAA set out four examples of significant non-compliance with JAR 23, which were:

- The directional stability of the aircraft was neutral to negative; this was a non-compliance with JAR 23.171 and 23.177 (*‘the static directional stability ... must be positive’*), and 23.161 (*‘the aeroplane must maintain lateral and directional trim’*).
- The control forces were very low and largely masked by circuit friction; this was a non-compliance with JAR 23.155 (*‘the stick force to achieve the positive limit manoeuvring load factor may not be less than 15 lb’*) and potentially with JAR 23.173 (*‘the stick force must vary with speed and be clearly perceptible to the pilot’*).
- The rudder was ineffective in the stall regime. This was a probable non-compliance with JAR 23.201 (*‘during stalling it must be possible to prevent more than 15 degrees of yaw’*) and 23.221 (*‘it must be possible to recover from a one turn spin within one additional turn’*).
- The aircraft was also considered to be potentially non-compliant with JAR 23.141 (*‘the aircraft must not require exceptional piloting skill or alertness’*).

The letter concluded that as the purpose of the airworthiness requirements was to issue a minimum acceptable standard it was logical to consider that the poor safety record may be directly related to the non-compliant features of the design. Ultimately, the CAA said that any aeroplane geometrically similar to the Bede BD-5 aircraft which had flown in the USA will not comply with appropriate airworthiness standards and therefore would not be granted a Permit-to-Fly.

The letter advised the Pilot of his right to appeal the decision. The Pilot and two other interested aircraft owners did lodge an appeal which was heard on 31 March 2000. The review was heard by a panel of two non-executive directors of the UK CAA (Members of the CAA) supported by a member of the CAA's Legal Department, in accordance with Regulation 6 of the CAA Regulations.

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Although the appellants adduced their own analysis of the accident history of the aircraft type and also advanced a number of challenges to the assertions on which the CAA had reached its decision, the original decision was upheld and the CAA discontinued the granting of Permits to Fly for BD-5 aircraft.

1.6.3 Registration in Ireland

In July 2001, the Irish Aviation Authority (IAA) received an inquiry in relation to the possibility of registering the accident aircraft in Ireland. On 21 August 2001, the IAA advised the Pilot that the responsibility for recommendation to issue a Permit-to-Fly was delegated to the Society of Amateur Aircraft Constructors (SAAC) and that such an aircraft would not be accepted unless SAAC was in a position to ensure continued airworthiness of the aircraft concerned.

In January 2005, SAAC made enquiries with the IAA regarding the acceptance of the type for the granting of a Permit-to-Fly. The IAA agreed to this for two projects only, the accident aircraft and another example of the type. The IAA applied conditions that the aircraft must be built by experienced pilots and builders and that the projects must be carried out entirely by the individuals named and not transferred from any other builder. Applications were made in the names of the Pilot and the other owner, both experienced builders, who had completed all work on the aircraft in question with airworthiness oversight from the UK CAA. The IAA considered this to be satisfactory.

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In January 2006, applications for registration were made by the owners of the two aircraft. The accident aircraft was removed from the UK register on 26 January 2006. An IAA Certificate of Registration was issued for the aircraft on February 7, 2007. In March 2006, a SAAC airworthiness Inspector completed inspection reports on each aircraft. In September 2006, SAAC submitted their standard form, designated SF08, to the IAA. IAA documentation records that Form SF08 was *“completed for each aircraft stating that they meet the criteria described in section 9.22 of their Manual and that they hold the details described in section 10 of their Manual and that they have reviewed the history of the aircraft model as previously constructed elsewhere and find that the aircraft has not exhibited any reported unsafe characteristics when produced as an amateur built aircraft”*.

The IAA provided the Investigation with a document (memo) dated 12 January 2007 which it said provided a summary of the investigation that took place in the previous year. The IAA said *“This document described the design and construction of the aircraft. It cites numerous flying examples and reviewed incidents and accidents, primarily from the USA. The views of Austrocontrol were sought since they had two flying examples on their register. The documentation described the project background and provided the conditions for registration in Ireland.”* This memo concluded that the two applications (the accident aircraft and another BD-5) were *“... acceptable for registration in Ireland as homebuilt BD-5G aircraft. The aircraft may be operated under a permit to fly only ...”*



The IAA memo states that between September 2006 and January 2007 a follow-up of the existing flying examples and accident reports was carried out. The memo recorded that *"Numerous flying examples exist: There are approximately 152 on the US N register. 2 on the Austrian register (one is reported to be the holder of a world airspeed record of 189.735 knots). Some are also found on the Australian (2) Canadian (6) and South African registers".* IAA documentation also stated *"there have been 61 reported accidents in the USA since 1972; engine failure being the most common and not usually proving to be fatal. This is no different to other homebuilt aircraft types. Of the 23 fatal accidents recorded 19 can be attributed to lack of experience with the type, low flying hours and inadvertent stalls."*

The IAA memo goes on to say *"There are 2 BD-5's known to be registered in the EU (Austria). The experience of [...] of the Certification and Airworthiness department in Austrocontrol was sought. He stated that they had no particular problems with this type. There was a single in-flight engine failure which resulted in a forced landing, but little damage. They consider the accident/failure rates of this aircraft to be no different to any other homebuild"*.

The Investigation asked Austrocontrol (the Austrian National Aviation Authority) if the text quoted above was an accurate interpretation of what it had meant to say. A reply from Austrocontrol, from the same individual to whom the IAA referred in its documentation, stated:

I do not think that the statement you mention does reflect the actual situation with the BD-5.

Actually we have two BD-5 on our register and several building approvals have been issued.

The BD-5 is an Amateur build aircraft, but no type certification has been issued. There are several different modifications (wings and powerplant) available, so none is comparable.

It is a light, fast aircraft and it is not easy to find small pilots and small engines [to] fit into the airframe.

It needs an [a] competent trained pilot accepting the limitations.

We had several engine issues mostly with the two stroke engines.

About 3 years ago we had a fatal accident with a BD-5 jet which was on the N-Register outside our register competence.

We had one owner/builder who was a PC-7 mil pilot holding the speed record over years with his BD-5 and only minor issues over that time.

As a summary:

If you have a good technical builder/owner which is also a competent pilot, it will work.

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If one is buying a BD-5 because it is so cool, than [then] it might be a potential candidate for an incident.

I do not have data in hands to support any statistics.

The IAA informed the Investigation that in deciding to allow the aircraft to operate on a Permit-to-Fly it was more conservative than AustroControl because it imposed an operational limitation that only the pilot/registered owner could fly the aircraft. An IAA Certificate of Registration was issued for the aircraft on February 7, 2007.

The aircraft log book shows that on March 26, 2007, a SAAC Inspector carried out an Inspection of the aircraft prior to its first flight with its Irish Registration; the Inspector deemed the aircraft '*fit for service*'. The aircraft then flew for fifteen minutes on that day; it was the first time the aircraft had flown since the rotary engine had been installed.

In 2009, SAAC merged with CAACI (Classic Aircraft & Aerobatic Club of Ireland) to form The Irish Light Aviation Society (ILAS). Aircraft under ILAS aegis operate on a Validity Permit issued by the IAA on foot of inspections carried out (and reports submitted) by ILAS personnel. EI-DNN was inspected by an ILAS inspector on 7 June, 2015 and deemed '*fit for service*'. On foot of this inspection, on 16 June, 2015, the IAA Validity Permit was extended for the period 16 June, 2015 to 16 June, 2016.

1.6.4 Aircraft Maintenance

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The Pilot, who was the constructor of the aircraft, also carried out all maintenance tasks on the aircraft. Several persons who spoke with the Investigation described him as an accomplished engineer and his technical knowledge and competence were held in high regard; the aircraft was described as a labour of love by many who knew the Pilot.

An ILAS inspector was assigned to the aircraft and he was in regular contact with the owner regarding aircraft maintenance tasks. Prior to the accident, the Pilot had spoken by telephone with the ILAS inspector about a possible replacement of a fuel pump on the aircraft. After the accident, given that the Pilot was the person responsible for the maintenance of the aircraft and due to the extent of the damage suffered by the aircraft, it was not possible to determine whether or not he had proceeded with such a replacement.

The aircraft logbook was kept at the Pilot's residence in the UK. The last log book entry is dated 7 June, 2015; it was for a check flight following the installation of an 8.33 Kilo Hertz (KHz) radio to the aircraft. The entry records that the radio installation was deemed serviceable. On the same date, the logbook records the ILAS inspector's assessment of the aircraft as '*fit for service*'.

At the Investigation's request, the Pilot's family provided five large box-files of documentation spanning the life of the aircraft since the original kit was acquired in the 1970s. The detailed and comprehensive records maintained by the Pilot are testament to his methodical and painstaking approach to the construction and maintenance of the aircraft.



1.6.5 Aircraft Operating Issues

The Investigation was provided with a document titled “*Essential Checks and Notes for flying Bede BD-5 EI-DNN that are different to the norm*”, which had been prepared by the Pilot as an aide-memoire for other pilots who occasionally flew the aircraft.

These notes include, *inter alia*, the following:

- *After refuelling make sure there is tape over the filler caps or they can depart plane in flight.*
- *Keep engine at as low an RPM as possible to avoid [over] heating engine and get taxi clearance as soon as possible.*
- *At the hold if there is a delay tell ATC you will shut engine down until it clears, if no delay get going.*
- *Using the trim lever rather than stick for pitch control makes it easier to fly and you will note changes in engine setting do have a noticeable effect on pitch*
- *The Oil header tank will spill oil onto the hot exhaust in any negative condition.*
- *If engine quits be prepared for a nose up pitch.*
- *Keep an eye on the coolant temp as you return [from a flight] and put ground cooling fan on.*
- *If the coolant temp hits red line it will start to dump liquid. Once the header tank is empty the circulation will stop and engine will cook. Don't take off if the indication is near red line. In flight if it hits red line attempt nearest airfield but expect an out landing. (gear up is safer option on unproven ground).*
- *[During taxi] Use burst of power then idle to keep speed up as that puts less heat into coolant.*

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Another set of notes prepared by the Pilot includes:

- *Fuel caps do need to be taped down after filling as the locking method is not reliable and can be sucked off the plane to be FOD at lift off.*

1.7 Meteorological Information

Met Éireann, the Irish Meteorological Service, provided the following information after the incident:

Meteorological Situation:	The area was under the influence of a relatively moist south-westerly airflow		
Wind:	Surface:	230°/9 kts	
	2,000 feet:	240°/15 kts	
Visibility:	10+ km		
Weather:	Nil		
Cloud:	FEW018 SCT020		
Surface Temp/Dew Pt:	Temp 13°C, Dew Point 10°C		
MSL Pressure:	1016 hPa		
Freezing Level:	7,000 ft		

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1.8 Aids to Navigation

Navigation aids were not relevant to this Investigation.

1.9 Communications

The Pilot was in radio communication with EINN and EIWF ATC personnel. Recordings of these communications were made available to the Investigation and are included throughout this Report.

1.10 Aerodrome Information

The accident did not occur at an aerodrome. Consequently, Aerodrome Information was not relevant to this Investigation.

1.11 Flight Recorders

No recorders were fitted, nor were they required to be.

1.12 Wreckage and Impact Information

The aircraft impacted into agricultural land at Garranbaun, Co. Waterford, Ireland. Site observations suggest that the aircraft was upright when it impacted. The wreckage trail (see **Appendix A**) was approximately 63 m long and had a general orientation of 050° magnetic, from the point of first contact to the final resting place of the main wreckage. The first impact was between the left wing tip and a tree in a boundary hedgerow; the left main spar shows a significant impact mark (**Photo No. 2**).

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Photo No. 2: Left wing viewed from below with impact mark on main spar

The wing tip separated at this point. As the aircraft travelled onwards it lost the left aileron and then the entire left wing. The remainder of the aircraft then impacted a second boundary hedgerow and tumbled before coming to rest, inverted, in the hedgerow between two fields.



There was evidence of significant post-impact fire, at the site of the separated left wing, at the second hedgerow impact and at the main wreckage site. Plumes of black smoke were reported by witnesses and black sooting was evident throughout the wreckage trail. Initial site examination confirmed that there was significant fire damage to the aircraft. The wreckage was carefully documented and removed to the AAIU facility at Gormanston, Co. Meath.

Regarding in-flight fires, Wood and Sweginnis¹¹ caution, *“If the fire is not contained or extinguished and the aircraft crashes, a post-impact fire invariably results which destroys considerable evidence of the nature and origin of the in-flight fire”*. In order to ensure that all possible information regarding the source and progress of the in-flight fire was gleaned from the examination of the aircraft wreckage, the services of a forensic fire investigation expert were retained by the Investigation.

The aircraft wreckage was dis-assembled in an attempt to identify the source of the in-flight fire. Due to the intensity of the post-accident fire, there were significant deposits of molten and fractured metal located within and throughout the engine compartment. The engine and its accessories had suffered significant mechanical disruption and fire damage (**Photo No. 3**). It was not possible to distinguish in-flight fire damage from post-impact fire damage, nor was it possible to determine the precise seat or cause of the in-flight fire. Engine dis-assembly did not reveal any evidence of mechanical failure within the engine nor was there any evidence of fire within the core of the engine.

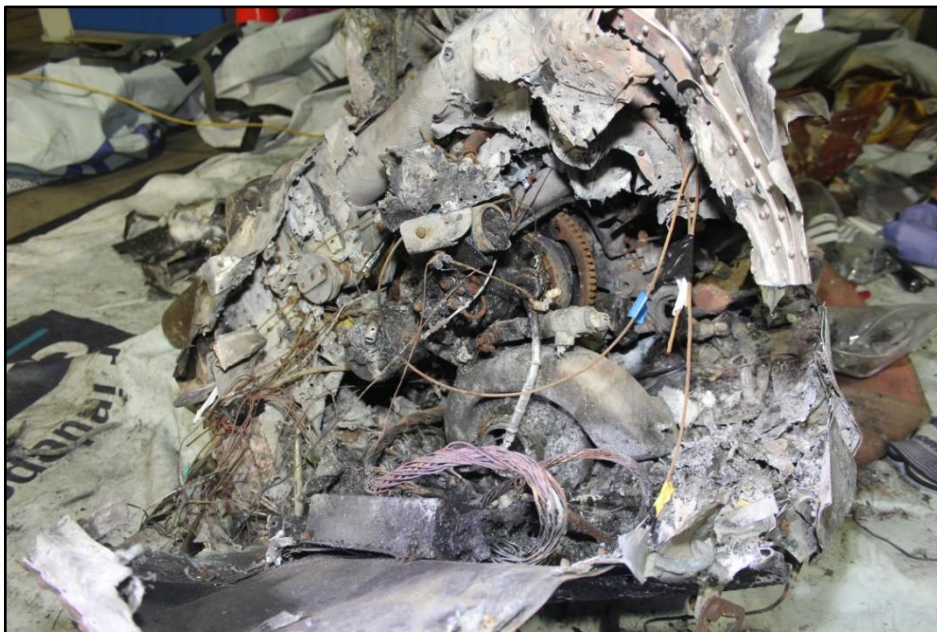


Photo No. 3: Engine bay showing engine disruption and extent of fire damage

The propeller had separated from its mounting shaft and was found approximately 51 m further on from the initial impact point. The tip of one propeller blade was broken off (**Photo No. 4**); the other blade tip was intact.

¹¹ Wood, Richard H., Sweginnis, Robert W., 2006, Aircraft Accident Investigation, Second Edition

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Photo No. 4: Propeller with fractured tip (GPS added by the Investigation)

In addition to seeking to determine the source and origin of the in-flight fire, the Investigation also sought to determine the reason for the loss of elevator authority which the Pilot reported to ATC. During the initial wreckage examination at the accident site, the Investigation confirmed the continuity of the elevator control circuit. The control circuit involves two cables which pass through the engine bay, running through a twin pulley block. The Investigation noted that the pulley block had suffered significant heat damage and that rubberised rollers had been melted away (**Photo No. 5**).



Photo No. 5: Damaged elevator pulley block



The Propeller Drive belt was of steel wire and rubber construction. This exhibited a high degree of fire damage with much of the rubber burnt away and the steel wires exposed and separated (**Photo No. 6**).



Photo No. 6: Fire-damaged Propeller Drive belt

Examination of the separated left hand wing revealed that the fuel tank filler cap was loosely positioned within the neck of the fuel tank. The locking lever on the cap had popped up and there was no evidence of any tape securing the filler cap in position (**Photo No. 7**).



Photo No. 7: Left-hand wing fuel cap (as found)

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Examination of the still-attached right hand wing revealed that the fuel tank filler cap was missing (**Photo No. 8**). There was no evidence of any tape that may have been used to secure the cap in position. The missing fuel cap was not recovered by the Investigation.



Photo No. 8: Right-hand wing without fuel cap (as found)

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1.13 Medical Information

The CAA informed the Investigation that the Pilot's Class 2 medical was revalidated by an approved Aero Medical Examiner (AME) on July 8, 2015.

An autopsy report on the Pilot concluded that *"death in this case was caused by severe trauma secondary to a plane accident."* The autopsy toxicology report stated that drugs were not detected, ethanol was not detected and the Pilot's Carbon Monoxide *"%saturation"* result was quoted as *"<10"*. The report also recorded *"There was no evidence of soot material in the trachea or upper airways or bronchi"*.

1.14 Fire

The Pilot made two separate reports to ATC stating that he had an engine fire. In his transmissions which started at 17.42:41 hrs he said, *inter alia*, *"Mayday, Mayday Mayday. I have engine failure. I have an engine on fire"*; in response to an ATC query at 17.42:54 hrs he replied *"Ah one POB. I've lost elevator authority as well as the fire"*.

The pilot of the following aircraft identified the accident location due to *"smoke ahead of me on the ground"* and arrived overhead the site shortly after the accident. This second pilot took two aerial photographs of the accident site using a mobile phone. These photographs were provided to the Investigation and they showed sooting along the wreckage trail with plumes of smoke emanating from the point at which the main wreckage impacted with the hedgerow and the point at which it came to rest.



When the Forensic Fire Investigator's expert knowledge and opinions were combined with the site observations the following, likely, sequence of fire and impact events was arrived at:

- The first fire event was reported to be an engine fire whilst the aircraft was in flight.
- The first impact event was determined to be the left side (port) wing colliding with a tree in the hedgerow of the west boundary of the field. The underside of the fuselage also hit the top of the hedgerow at the same time, tearing off the antenna and air 'scoop' situated under the cockpit area.
- The second fire event after the reported engine fire was due to the first impact event that not only detached the wing from the fuselage but also tore open the 'wet wing' fuel tank. This ejected fuel in what appears, from the physical evidence of the scorching to foliage adjacent to the impact tree, to be in an atomised form causing a localised deflagration¹² of the fuel. The burning fuel also 'scorched' the antenna and air 'scoop'.
- The second impact event was when the underside of the fuselage struck the ground a short distance from the hedgerow on the west boundary of the field tearing off the main undercarriage gear doors (which were closed) and leaving a visible impact mark in the ground. The aircraft then continued in a straight line for approximately 60 m in a north-easterly direction with its right (starboard) wing still attached. At some point the aircraft propeller broke off from its mounting and was located to the left of the slide path. It was also noted that the one propeller blade tip had broken off earlier and was located near the initial impact point.
- The third fire event occurred approximately 10 m before the field's north boundary hedgerow/wall; this was a second deflagration that scorched the foliage beneath the aircraft, most probably due to the remaining fuel in the right hand wing being dispersed and ignited.
- The third impact event was when the fuselage and right wing collided with the north hedgerow/wall.
- The fourth fire event occurred and involved a deflagration of fuel at the third impact area and was due to fuel ejecting from the aircraft and igniting.
- The fourth impact event was when, following the third impact, the aircraft became inverted by rotating (flicking) 180 degrees eastward about its longitudinal axis; it finally came to rest spanning a disused pathway between the field's north boundary hedgerow/wall and the south boundary hedgerow/wall of the adjacent field.
- The fifth fire event involved the burning of the remainder of the fuel in the right (starboard) 'wet' wing that was still partially attached to the fuselage and which engulfed the (now inverted) cockpit area.

¹² **Deflagration:** A subsonic gaseous combustion resulting in intense heat and light and (possibly) a low level shock wave. Most aircraft impact "fireballs" are technically deflagrations.

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It was not possible to identify a specific location for the fire's origin from the laid out aircraft parts. However, when identifiable parts that had been damaged by fire were relocated to their original positions, the Forensic Fire Investigator observed that the area within the engine compartment behind the pilot's seat bulkhead and on the right side of the engine had sustained greater fire and heat damage. The Investigation noted that this area had a high concentration of fuel pipes.

1.15 Survival Aspects

When the main wreckage came to rest, inverted, it was exposed to intense fire and suffered significant damage which included widespread melting of metal components within the engine bay. The seat harness retained the Pilot in the aircraft cockpit throughout the impact sequence which involved at least four different impacts of varying intensities. The accident was not survivable.

1.16 Tests and Research

The propeller was attached to the engine output shaft by a cast aluminium flange/spigot. The propeller had separated from the aircraft due to a fracture through the spigot detail, at the radius with the flange. The propeller was examined by a metallurgist to attempt to determine if it was under engine power when the aircraft impacted.

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The metallurgist's report states that *"There was no visible evidence of pre-existing material defects or stable crack growth mechanisms, such as fatigue"*.

The metallurgist found that on one side of the diameter, the fracture surface was perpendicular to the major axis of the spigot. This was consistent with the region of fracture initiation. On the opposite side, it was inclined on shear planes. This was consistent with the final region to separate. These features indicated that the fracture had progressed circumferentially around the spigot in two directions (indicated by blue arrows in **Photo No. 9**).

This was consistent with failure in bending, with no significant contribution from torsional loading.



Photo No. 9: Fractured propeller attachment spigot

The metallurgist was not able to positively determine whether or not the propeller was being driven at the time of impact. However, the metallurgist considered that on the balance of probabilities, it was considered more likely that it was not being driven at that time.

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1.17 Organizational and Management Information

Not applicable.

1.18 Additional Information

Not applicable.

1.19 Useful or Effective Investigation Techniques

Not applicable.

2. ANALYSIS

2.1 General

The aircraft was not fitted with flight recorders, nor was it required to be. The aircraft wreckage suffered significant post-impact fire damage and it was not possible to distinguish in-flight fire damage from post-impact fire damage; nor was it possible to determine the precise seat or cause of the in-flight fire.

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The Pilot was an accomplished engineer and an experienced pilot who had completed all assembly and maintenance work on the aircraft. The Investigation is satisfied from his two reports to ATC that the aircraft had suffered an in-flight fire which the Pilot described as an *“engine fire”*. The Pilot’s associated comment that *“he had lost elevator authority”*, was probably due to heat/fire damage to the elevator cable dual pulley which was located in the engine compartment.

2.2 The Accident Flight

Confronted with the in-flight fire the Pilot informed ATC that rather than returning to EIWF he was *“just going to have to find a field”*. Subsequently, the loss of elevator authority would have added significantly to the Pilot’s challenge in making a forced landing into an unprepared field. Witness reports differ on whether the aircraft engine was running and delivering full power throughout all of its manoeuvring; some witnesses reported brief engines stoppages and changes in the engine sound, whilst others did not. It should be noted that rotary engines are known to emit a significantly louder, and whinier, sound than conventional piston engines; this fact may account for witness reports that the engine noise was *“unbelievable”*, *“different”*, etc. It should also be noted that power was transferred from the engine to the propeller shaft by a reduction drive belt; it is possible that this belt suffered heat and fire damage in flight (similar to the elevator cable pulley block); this could be a factor in changes in the aircraft sound and could have compromised the thrust generated and available to the Pilot.

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The autopsy finding that *“There was no evidence of soot material in the trachea or upper airways or bronchi”* suggests that the Pilot/cockpit was not exposed to combustion products from the fire in-flight.

2.3 The Accident Site and Wreckage

The wreckage trail had a general orientation of 050° magnetic. However, the first impact with a tree in the boundary hedgerow resulted in the left wing suffering a significant indentation and the wing itself separating. It is possible that such an impact may have changed the aircraft’s original heading as it approached the field, causing the aircraft to yaw to the left. Consequently, it is possible that the Pilot’s initial intention may have been to land across the field (090° magnetic approximately) and that the circumstances of the first impact changed this direction.

In either case, with a 9 kts wind coming from 230° magnetic, the aircraft would have been subject to a tail wind component which increased the aircraft’s groundspeed, making the forced landing attempt more difficult. Photographs taken by the following aircraft, in the immediate aftermath of the accident, showed smoke plumes which were being driven by on-shore winds.



The wreckage examination found the undercarriage doors were closed. This was consistent with the Pilot's own notes which said *"gear up is safer option on unproven ground"*. The Investigation also noted that when a test pilot made a previous forced landing in the accident aircraft in 1994, that landing was accomplished on a grass strip with the landing gear up.

The fuel tank cap from the left hand wing was loose and its locking lever had popped up. The fuel cap from the right hand wing was missing and not recovered. The Pilot's notes warned *"Fuel caps do need to be taped down after filling as the locking method is not reliable and can be sucked off the plane to be FOD at lift off."* No evidence was found that such tape had been installed; however, due to the extensive fire damage suffered by both wings it is possible that the tape and adhesive residue had burned away. Although the right hand fuel cap was not recovered at the accident site (or elsewhere) this was not conclusive evidence that the cap was not installed, or that it departed the aircraft in-flight. Thus, it was not possible to definitively say if both fuel caps were installed and properly taped down when the aircraft took off.

2.4 Fire Investigation

From the Pilot's transmissions and site and wreckage examination it appears that there were five distinct fire events: the in-flight fire in the engine compartment; the deflagration when the left wing separated and its fuel tank ruptured; the third and fourth fire events occurred as the aircraft approached the field boundary and involved fuel from the left hand wing tank scorching the foliage. The fifth fire event occurred when the aircraft came to rest, inverted, and a fuel-fed ground fire took hold.

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The materials used to manufacture the components housed in the engine compartment were primarily made from metal and would not be considered suitable to initiate and sustain an in-flight fire. Consequently, the persistent in-flight fire which the Pilot reported was most likely a fuel-fed fire. In the event that a fuel leak developed in the engine compartment, the fact that the rotary engine has a constantly hot side and that rotary engine exhaust temperatures can be very high, meant that potential ignition sources were readily available within the engine compartment. It was not possible to identify a specific location for the fire's origin amongst the aircraft parts which were laid out. However, when identifiable parts that had been damaged by fire were relocated to their original positions, the Forensic Fire Investigator observed that the area within the engine compartment behind the pilot's seat bulkhead and on the right side of the engine had sustained greater fire and heat damage; this area corresponds to the *"hot"* side of the rotary engine installation and is also the area where there was a concentration of fuel pipes. It seems likely that the in-flight fire was seated in this area.

2.5 Plausible Scenarios

In the absence of definitive evidence regarding the origin of the in-flight fire, the Investigation reviewed all available evidence with the Forensic Fire Investigator. The two most plausible scenarios for in-flight fire initiation which emerged were:

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- Leaking fuel from the right hand wing tank entered the engine compartment and ignited within the engine compartment.
 - The fuel filler orifices were located on the upper surface of each wing. The fuel filler caps were reported to have a tendency to ‘pop’ open and the Pilot had adopted a practice of securing them with tape. The right hand fuel filler cap was not recovered at the accident site.

If fuel from the tank did enter the engine compartment and ignite then the heat could quickly compromise other fuel pipes within the engine and literally add fuel to the fire. However, it is likely that since the Pilot’s notes warned of the need for tape, caps may have departed the aircraft in flight before without causing fire in flight.

- Release of fuel within the engine compartment which then ignited.
 - With the concentration of fuel piping on the hot side of the engine, any fuel leak, whether from a loose coupling or damaged pipe, would certainly ignite; once started, the fire would be sustained by the continued leak of fuel. Records available to the Investigation did not indicate any recent maintenance work on the fuel system. The Pilot had discussed a possible fuel pump replacement with the ILAS inspector, however it is not known if he proceeded with the pump replacement.

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Either of these scenarios would result in heat and fire damaging the elevator pulley block which was mounted in the engine compartment and thus would be consistent with the Pilot’s report to ATC that he had *“lost elevator authority as well as the fire”*. However, as the Pilot was aware that fuel caps could depart the aircraft if not taped down it would seem that such an event had happened before but did not lead to a fire. Furthermore, while Witness No. 2 *“thought he saw some sort of trail but it was very faint”* none of the other witnesses reported seeing a vapour trail from the aircraft despite being specifically asked about this by the Investigation. The Investigation believes that if fuel was being discharged from the wing tank, witnesses would have been aware of it. Accordingly, the Investigation believes that the more likely scenario was the ignition of fuel released within the engine compartment.

2.6 Forced Landing

The Pilot attempted to carry out a wheels-up forced landing into an agricultural field. The circumstances of this forced landing were sub optimal. The aircraft was subject to a tail wind component which increased its groundspeed. The Pilot had lost elevator authority which meant that his control of aircraft pitch was compromised.

Finally, it is likely that the propeller was not being driven during the final stages of the flight; if the aircraft’s thrust had been compromised by loss of engine power and/or reduced propeller belt drive, the Pilot’s notes recorded that a nose-up pitching action was to be expected which, without elevator authority, would have been particularly challenging.



2.7 Aircraft Registration

The aircraft was originally constructed and registered in the UK. On 27 September 1999, the CAA wrote to the Pilot advising him that as a result of a review the CAA was not prepared to proceed toward the issue of a Permit-to-Fly for an aeroplane which had essentially the same flight characteristics as the BD-5 aircraft which had flown previously in the USA. The CAA had reached this decision following an analysis of accident statistics and data which it had obtained from the US FAA and NTSB.

The CAA said *"A total fleet of a few hundred aircraft combined with in excess of 80 notified accidents (with 37 involving serious injury or death) represents a very poor safety record which cannot be used as an alternative to compliance with the airworthiness requirements. Consequently, we must apply the appropriate code of design requirements in full to the BD-5."*

Having deemed that the safety record of the BD-5 type in the US was unacceptable as a basis for continued registration of BD-5s in the UK, the CAA said that continued registration could only be granted if compliance with relevant airworthiness standards was demonstrated. The CAA identified the relevant standard as JAR 23. Using a 1976 CAA Test Pilot report for a BD-5B aircraft the CAA identified four significant non-compliances with JAR 23. Consequently, the CAA refused to grant Permits to Fly for BD-5 aircraft. The Pilot and two other interested parties appealed the decision. In March 2000 a UK appeals board upheld the original decision.

Following an initial registration inquiry with the IAA in 2001, the owner engaged with SAAC and in 2006 SAAC made a formal application to the IAA to register the accident aircraft. IAA documentation (January 2007) stated *"there have been 61 reported accidents in the USA since 1972"*. The IAA documentation goes on to say *"There are 2 BD-5's known to be registered in the EU (Austria)." One of these two aircraft had an engine failure and forced landing. According to the IAA documents the Austrian authorities considered "the accident/failure rates of this aircraft to be no different to any other homebuild."* However, when the Investigation contacted Austrian authorities it said that the views attributed to it in the IAA documentation did not *"reflect the actual situation with the BD-5"*.

The IAA records make no mention of the CAA Permit-to-Fly refusal and also quote a lower total number of accidents (61) in 2007, than the *"in excess of 80"* which the CAA quoted in 1999 and of which the CAA went on to say *"the true incident/accident totals may be significantly higher"* due to under reporting.

Whilst noting that the CAA Permit-to-Fly refusal was appealed by the Pilot (and others) and that during that appeal the appellants disputed the CAA's interpretation of the accident statistics, the Investigation notes that no reference to the CAA's position, or consideration of the concerns which led the CAA to refuse to issue Permits to Fly for BD-5 aircraft, were included in the IAA records provided to the Investigation. The Investigation believes that it would have been prudent to have sought and documented the CAA's rationale for its Permit-to-Fly refusal.

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There was a second BD-5 on the Irish register. The IAA informed the Investigation that this other aircraft was registered on 14 February 2007 and removed from the register on 13 June 2016 at the owner's request. It never received a Permit-to-Fly during its time on the Irish register. Furthermore, the IAA informed the Investigation that this aircraft and the accident aircraft were the only two BD-5 aircraft which it agreed to register and that in future it will not accept any other BD-5 applications for registration.

3. CONCLUSIONS

(a) Findings

1. Shortly after departure from EIWF, the Pilot made a MAYDAY call and advised ATC that he had an engine fire.
2. The Pilot subsequently reported that he had lost elevator authority as well as having an engine fire.
3. The Pilot elected to make a forced landing into an agricultural field.
4. The aircraft was subject to a tail wind component as it approached the selected field.
5. The left wing of the aircraft impacted a tree in the boundary hedgerow and separated from the aircraft.
6. The aircraft wreckage trail was approximately 63 m long and had a general orientation of 050° magnetic, from point of first impact to the final resting place of the main wreckage.
7. There were five distinct fire events: the in-flight fire in the engine compartment; the deflagration when the left wing separated and its fuel tank ruptured; the third and fourth fire events occurred as the aircraft approached the field boundary and involved fuel from the left hand wing tank scorching the foliage. The fifth fire event occurred when the aircraft came to rest, inverted, and a fuel-fed ground fire took hold.
8. The accident was not survivable.
9. It was not possible to discern between pre and post-impact fire damage to the extent necessary to determine the cause of the in-flight fire.
10. The Investigation believes that the more likely scenario was the ignition of fuel released within the engine compartment.
11. It is likely that the propeller was not being driven during the final stages of the flight.
12. The Pilot's licence and medical certificate were valid for the flight.



13. In 1999, as a result of a review, the CAA decided that it was not prepared to issue Permits-to-Fly for aeroplanes which had essentially the same flight characteristics as the BD-5 aircraft which had flown previously in the USA.
14. Following an application from the Owner, the IAA conducted its own review and a Certificate of Registration was issued for the aircraft on February 7, 2007.

(b) Probable Cause

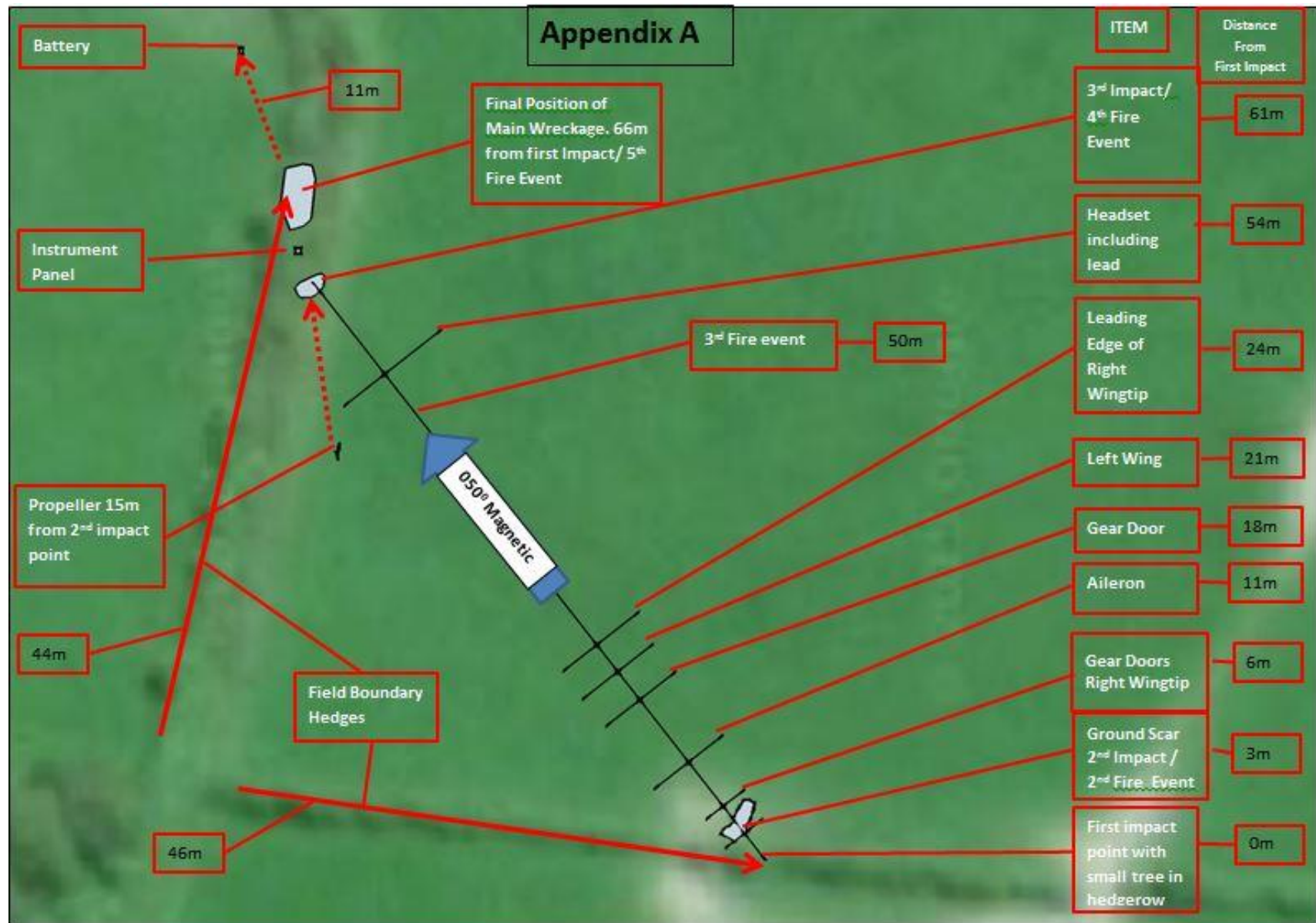
1. A fire which developed in the aircraft's engine compartment following take-off from EIWF.

(c) Contributory Cause(s)

1. Loss of elevator authority.
2. The left-hand wing impacted with a tree in a boundary hedgerow of the field in which the forced landing was attempted.

4. SAFETY RECOMMENDATIONS

The Investigation does not support any Safety Recommendations



- END -

In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No. 996/2010, and Statutory Instrument No. 460 of 2009, Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulation, 2009, the sole purpose of this investigation is to prevent aviation accidents and serious incidents. It is not the purpose of any such 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.

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