Air Accident Investigation Unit Ireland

ACCIDENT REPORT
Laverda SpA, F.8L Falco IV, EI-BMF
Powerscourt, Co. Wicklow
10 April 2010

Department of Transport Tourism and Sport
An Roinn Iompair Turasóireachta Agus Spóirt

AAIU Report No: 2011-013
State File No: IRL00910024
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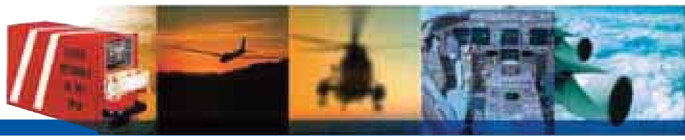
In accordance with the provisions of SI 460 of 2009, the Chief Inspector of Air Accidents, on 10 April 2010, appointed Mr. Leo Murray as the Investigator-in-Charge to carry out a Field Investigation into this Accident and prepare a Report. The sole purpose of this Investigation is the prevention of aviation Accidents and Incidents. It is not the purpose of the Investigation to apportion blame or liability.

Operator:	Private
Manufacturer:	Laverda SpA
Model:	F.8L Falco IV
Nationality:	Ireland
Registration:	EI-BMF
Location:	Powerscourt, Co. Wicklow
Date/Time (UTC)[1]:	10 April 2010 @ 14.09 hrs

1 **UTC:** Co-ordinated Universal Time, equivalent to local summer time minus 1 hour on the day of the accident



SYNOPSIS

The aircraft returned to a private airfield at Powerscourt after a local flight lasting approximately 30 minutes. During the final stages of the approach, the Pilot initiated a go-around on a runway with a steep up-slope. During the go-around[2], the left wing of the aircraft struck a tree beyond the far end of this runway. Following a series of subsequent ground impacts the aircraft came to rest in an inverted position in a field adjacent to the airfield. Post-impact, a fuel-fed fire immediately occurred. The Passenger was fatally injured and the Pilot subsequently died of his injuries.

NOTIFICATION

The Station Manager at Shannon ATC notified the AAIU of the accident at 14.30 hrs on 10 April 2010. Three Inspectors of Air Accidents arrived on scene at 15.40 hrs the same day and commenced an Investigation.

1. FACTUAL INFORMATION

1.1 History of the Flight

The purpose of the flight was to conduct a local trip over Gorey in Co. Wexford, a town situated approximately 50 km to the south of the departure airfield. Weather on the day was good with light variable winds from the southeast. Due to a significant slope on the runway, the take-off was made on RWY 12 in a downhill direction, which was the routine procedure at this airfield. The Pilot initially flew east and then south to Gorey on a Visual Flight Rules (VFR) flight before returning to Powerscourt Airfield.

At the end of the flight, the aircraft flew past a hotel situated in Powerscourt Estate and positioned visually to land uphill on RWY 30. A witness stated that the landing gear was in the down position when the aircraft was on final approach. At low altitude, and prior to ground contact, the landing attempt was abandoned and a go-around was initiated. The aircraft was observed to climb out on runway heading, cross a local access road and the boundary fence of Powerscourt Golf Course at low altitude and under power.

The left wing of the aircraft struck the upper branches of a single tree situated approximately 71 metres (m) beyond the runway end (**Photo No. 1**). The aircraft then contacted the ground with the left wingtip, and made a second, more substantial impact before coming to rest in an inverted position approximately 133 m beyond the tree. A fuel-fed fire then occurred which consumed most of the aircraft structure. The Passenger was fatally injured. The Pilot was airlifted to hospital by an Irish Coast Guard helicopter and died of his injuries two days later.

2 **Go-around:** An approach for landing is discontinued and the aircraft climbs away to a safe altitude, referred to in the Falco Flight Manual as a 'baulked landing'.

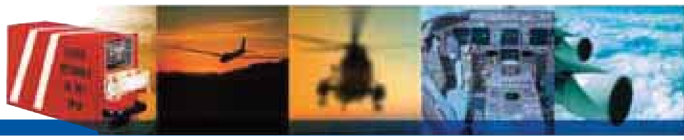
Photo No. 1: Final position of the wreckage, impact point with tree indicated.

1.1.1 Witness Statements

The Investigation spoke with a number of witnesses to the accident. The majority of witnesses interviewed were situated on the golf course adjacent to the north-westerly end of the runway. The witness statements may be generally summarised as follows: The aircraft was observed taking off from Powerscourt Airfield towards the east at approximately 13.40 hrs. The aircraft was next observed flying past the hotel at approximately 14.00 hrs, rocking its wings as it flew past and under normal control. The aircraft was then observed making its approach from the east adjacent to Sugarloaf Mountain.

As the aircraft descended past an observer, it was at low power with all three landing gear legs extended. At a point late on the approach, a go-around was initiated. The aircraft was observed climbing up along the runway centreline under power at a low speed and had not gained significant height when passing abeam the golf course boundary. Several witnesses reported that they heard the engine backfiring prior to impact with the tree. The aircraft veered to the right and struck the upper portion of the tree with its left wing before impacting nose down and coming to rest inverted.

A post impact fire immediately occurred. Witnesses stated that the Pilot '*fell out of the aircraft*'. He was given immediate attention and cared for until the arrival of the Emergency Services. It was subsequently reported to the Investigation that while the Pilot was being given first aid, he remarked to the first responders that '*he had forgotten the gear*'. Witnesses reported that no assistance could be given to the passenger because of the fire.



1.2 Injuries to Persons

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

1.3 Damage to Aircraft

The aircraft was destroyed.

1.4 Other Damage

The aircraft impacted a tree and came to rest in a field with newly planted crop with consequent ground scarring and fire scorching.

1.5 Personnel Information

The Pilot, aged 69, held a Private Pilot Licence (Aeroplanes) first issued on 13 October 1969 and valid until 1 July 2012. A Single-Engine Class Rating was valid to 31 May 2011. A Class II medical certificate pertaining to this licence was valid to 19 June 2010.

The Pilot had a significant amount of general aviation flying experience. From 4 April 1953, his logbooks show that he flew a total of 55 types of aircraft, with a total flight time logged of 2,113 hours, including 389 hours on gliders. The Pilot had logged 856 hours experience on the Falco F.8L, a type that he had first flown in July 1975.

Records show that in the 12 months prior to the accident, he had flown a total of 13 hours and 20 minutes in EI-BMF, of which 3 hours 25 minutes were logged in the previous 90 days. Prior to the accident flight, the Pilot last flew the aircraft on 1 March 2010 on a 30 minute local flight following an Annual Inspection that had been carried out on the aircraft.

1.6 Aircraft Information

1.6.1 General

The Falco F.8L is a two-seat, single engine, high-performance low-wing cantilever monoplane of wooden construction. The F.8L Series IV is powered by a Lycoming O-320-B3B horizontally-opposed, normally-aspirated piston engine driving a Hartzell two-blade constant speed propeller. Accommodation is provided for two occupants in an enclosed cockpit with side-by-side seating. Access to the cockpit is made through a rearward-sliding transparent canopy. There was no alternative means of egress from the cockpit.

The accident aircraft, Serial Number 416, was a Series IV aircraft, and was one of 20 examples built at Trento, Italy in 1968 by Laverda SpA. The type is fitted with electrically-operated, retractable landing gear, of tricycle configuration. The nose wheel retracts rearwards and the main units retract inwards by means of worm gears connected to the main gear legs by a linkage system. The landing gear is extended and retracted by means of a toggle switch on the central instrument panel.

The flaps are extended and retracted by means of an electric motor located on the bottom of the fuselage behind the main spar underneath the baggage platform. This motor operates the flaps through a worm tube and two small connecting rods. Control of the Flaps was by means of a toggle switch. A mechanical flap position indicator was situated on the left side of the lower front panel, below the engine controls. Both the landing gear and flaps are operated by means of similar toggle switches and are both situated on the same panel (**Photo No. 2**).

Photo No. 2: Centre instrument panel of EI-BMF showing location of flaps and landing gear selector switches. (M. Nixon, 2009)

The fuel system in EI-BMF comprised two 70 litre fuel tanks situated fore and aft of the cockpit. The fuel tanks had a total capacity of 140 litres. Fuel must be used from the rear tank first to prevent an aft Centre of Gravity situation occurring.

Normal operating procedure requires that fuel should be selected from the front tank during take-off and initial climb before switching to the rear tank. Maximum take-off and landing weight was 1,808 lbs in the Normal and Utility categories, This weight was limited to 1,653 lbs in the Aerobatic category. Basic aerobatic manoeuvres were permitted in the Utility category.

In the clean configuration, with flaps up and landing gear retracted, the aircraft would typically stall at 63 mph. The airspeed indicator was marked with a white arc, indicating the indicated speed range with flaps extended. The minimum indicated airspeed on the white flap arc was 70 mph. The Flight Manual describes the procedure for a go-around or 'baulked landing' as: apply full power, retract the landing gear, position the flaps to 20° and then follow normal take-off procedure and retract flaps to up at 80-85 mph.

The aircraft was first registered as G-AWSU in the United Kingdom to a private owner on 31 October 1968. Following several changes of ownership, the Pilot was registered as a part-owner on 5 August 1975. It was first registered in the State as EI-BMF to the Pilot on 28 January 1982. A change of ownership was made on 29 October 1986 to include a new partner in the ownership of the aircraft.

1.6.2 Weight and Balance

The Pilot uplifted 89 litres of Avgas 100LL[3] in EI-BMF at Kilrush Airfield on 10 December 2009. As no other fuel uplifts were recorded, and no fuel is available at Powerscourt Airfield, it is considered likely that this was the last uplift of fuel prior to the accident. The fuel uplift made on that date was noted in the Pilot's logbook as '*Full 89 litres*' and this was also verified by the fuel records at Kilrush Airfield. As the opportunity to uplift fuel was only made during such a visit, it is likely that the fuel tanks were filled. This indicates that the aircraft probably departed Kilrush Airfield with a total of 140 litres. Records show that subsequent to the fuel uplift, the aircraft made 3 flights prior to the accident totalling approximately 1 hour 20 minutes and consuming approximately 50 litres (80 lbs) of fuel. Calculation of the probable weight and balance for the accident flight is presented in **Appendix A**.

1.6.3 Maintenance Information

From when it was first registered in the State, the aircraft was maintained and operated under a Certificate of Airworthiness in the Private category. As the European Aviation Safety Agency (EASA) did not issue a type certificate for the Falco Series of aircraft under Annex II to Regulation 1592/2002[4], the aircraft was operated from February 2009 under a Flight Permit issued by the Irish Aviation Authority (IAA). EI-BMF had a valid Flight Permit (No. 921) at the time of the accident.

Under the Flight Permit scheme, the aircraft was correctly maintained in accordance with an Approved Maintenance Programme (ILAS[5] 2). The engine however had to be maintained as a certified engine under the provisions of the Permit System.

At the time of the accident the aircraft had flown a total of 1,717 hours. The following Inspections were carried out on EI-BMF since 24 February 2009:

Inspection	Date	Airframe hours (since new)	Engine hours (since overhaul on 11.3.97)	Propeller hours (since overhaul on 13.2.08)
Annual	24.2.09	1,703:20	192:30	14:10
6 Months	12.8.09	1,711:05	201:25	21:55
Annual	1.3.10	1,716:40	207:00	27:30

An Annual Inspection was carried out on 1 March 2010. This inspection included an engine oil change; oil filter inspection (satisfactory); removal, cleaning, and inspection of spark plugs prior to re-fitting; checking of rocker arms and valve springs; and installation of new gaskets. A compression check on the engine was performed and was satisfactory. At the time of the accident, 13 years had elapsed since last complete engine overhaul. The manufacturer's recommended limit is 12 years. However the IAA approves extensions beyond 12 years, subject to certain conditions as laid down in Aeronautical Notice Nr A43 (Issue 3) dated 12/08/1999. EI-BMF had been examined for compliance with these conditions during the March 2010 annual inspection and a 12 month extension was recommended by the licensed engineer performing the inspection, in accordance with Aeronautical Notice A43. Propeller condition was inspected and found satisfactory. Certificates of Release to Service were issued on 11 March 2010 for the Transponder and Compass swing and attached to the aircraft logbooks.

3 **Avgas 100LL**: Aviation gasoline, 100 Octane Low Lead.

4 **Regulation 1592/2002**: List of aircraft which are no longer supported by a manufacturer.

5 **ILAS**: Irish Light Aviation Society.

1.7 Meteorological Information

Met Éireann, the Irish Meteorological Service, provided the following aftercast information regarding the meteorological conditions at Powerscourt, Co. Wicklow at the time of the accident:

High pressure to the east of Scotland maintained a light to moderate, south to southeast airflow over the accident area. Observational data retrieved from nearby weather stations, coupled with radar and satellite imagery, suggest that the following conditions pertained at the time of the accident:

Surface Wind:	140 degrees, at 5 to 7 kts (Directional variations of 20 degrees were possible)
Wind at 2,000 ft:	170 degrees, at 10 kts
Visibility:	25 km
Significant Weather:	Nil
Cloud:	'Few/Scattered' at 2,500 ft, 'Broken' at 7,000 ft
Surface Temperatures:	Air Temperature 15° C, Dew Point 6° C
Pressure:	1032 hectoPascals (hPa)
Freezing level:	Above 10,000 ft

However, it is noted that there is no meteorological observation station near the Powerscourt Airfield, and that such locations, surrounded by hill and mountains, can experience local winds which may be significantly different in strength and direction, compared to the overall meteorological situation.

An experienced pilot, who was at the airfield when the aircraft took off, reported that the wind speed and direction at the airfield was varying significantly at that time and could be described as "blustery". A member of the Investigation team also noted later that the wind was very variable, at one stage forcing the local windsock to the horizontal, in a downwind direction along the RWY 30. A series of three photographs, taken immediately after the accident, show significant variation in the hanging angle of the windsock close to the accident site (indicating variable wind strength), and also a change of direction of the order of magnitude of 180°.

1.8 Aids to Navigation

Aids to navigation were not a factor in this accident.

1.9 Communications

Communications were not a factor in this accident. The flight was operated in Class G airspace[6] where there was no requirement to contact any ATC Unit.

6 **Class G airspace:** Flights are permitted under visual and instrument flight rules and receive flight information if requested.

1.10 Aerodrome Information

Powerscourt Airfield was a private, unlicensed airfield situated in Powerscourt Estate, Co. Wicklow at an elevation of 550 ft AMSL[7]. No radio aids, lighting or fuel were available and operations were conducted under VFR. The airfield had a single grass runway, designated RWY 12 to the southeast and RWY 30 towards the northwest. Runway dimensions were published as 600 m by 16 m.

There is an upslope on RWY 30 of 5% (2.86 degrees), and a corresponding downslope on the reciprocal RWY 12. The northwest end of the runway is bounded by a paved road providing access to the hangar and a private house. A deer fence rising to 6 ft and a hedge encloses the boundary of the golf course adjacent to the road. A single windsock was situated to the right of the hangar. There was no equipment for recording wind speed or direction, and there was no requirement for such equipment to be installed. A map showing the location of the runway, the obstacle struck (tree) and final position of wreckage is reproduced in **Appendix B**.

A pilot who had flown with the Pilot on previous occasions informed the Investigation that it was the Pilot's normal practice to take-off downhill on RWY 12 and land uphill on the reciprocal RWY 30. The downslope on RWY 12 is illustrated in **Photo No. 3**. The practice of landing on the reciprocal runway to that of take-off could only be carried out in calm or light wind conditions. This is further discussed in **Section 2.1**.

The Investigation also heard evidence that during take-off on RWY 12, the downslope aided the Pilot to accelerate the aircraft quickly, and that he continued acceleration after take-off by keeping the aircraft nose low during the initial climb as the ground dropped away significantly in this direction.

The Investigation noted that information relating to Powerscourt Airfield in published VFR Flight Guides cautions a 30 m height difference between RWY 12 and RWY 30 and significant slope on the runway, and the existence of a 6 ft high deer fence on the threshold of RWY 12. The guides did not refer to the tree on the extended centre-line of RWY 30. The data for these publications was normally provided by the airfield owner, which in this case was the Pilot.

***Photo No. 3:** View of take-off direction RWY 12.*

7 **AMSL**: Above mean sea level.

1.11 Flight Recorders

Not installed and not required to be.

1.12 Wreckage and Impact Information

The accident site was preserved by An Garda Síochána until the arrival of the AAIU. A preliminary survey was carried out at the site to identify impact marks and record distribution of the wreckage. Inspection of the runway surface revealed no evidence of the aircraft making contact with the runway surface prior, during or after the go-around was initiated. The first point of contact was with a tree, situated 71 m beyond the runway. The overall height of the tree was approximately 30 ft. The impact was close to the tree top; damaged branches showed that the aircraft was in a right bank at the time of impact.

The first evidence of ground contact was that made by the port wingtip at a distance of 114.7 m beyond the tree. A section of the port wingtip was found embedded in the ground at this point. Further ground contact in the form of a gouge occurred 5.8 m further on, followed by a shallow crater 2.5 m across. Small pieces of debris were found in this area, the largest portion being a section of wing skin. The aircraft finally came to rest in an inverted position 133 m beyond the tree.

An intense post-impact fire occurred, which destroyed the entire airframe structure. Inspection of the wreckage revealed that the only portions not significantly damaged by fire were the fin and elevators, which remained substantially intact; and the outer portion and trailing edge of the starboard wing. The main wing-spar, constructed of wood, was severely damaged by fire. The fuselage was consumed entirely by fire. Only metal components were identifiable, including the landing gear, cockpit seat frames, and flight control cables. Apart from the port wingtip section, which was recovered from the point of initial ground contact, little remained of the port wing structure. The port (metal) aileron and control linkages were in-situ, but damaged by the effects of fire. A check was made of each of the control cables, which showed continuity to each primary flight surface.

The engine and propeller were relatively intact, but had detached at the engine bearer and faced towards the rear. There was heat damage and melting at the rear of the engine block and similar to the propeller as it now lay in that area. The nose gear and main landing gear were in the extended position. The main landing gear legs and extension worm gears were fire damaged, but recovered as a single unit.

The flap system was damaged extensively by the effects of fire. Examination of the flap mechanism indicates that the flaps were most likely in the fully retracted position.

1.13 Medical and Pathological Information

The Pilot was airlifted by helicopter to hospital. He had suffered 80% full thickness body surface burns and fractures. He was transferred to the Burns Intensive Care Unit in another hospital later the same day. His condition subsequently deteriorated and he died on 12 April 2010.

A post mortem toxicological report identified the presence of *Morphine* and *Midazolam*. The Investigation was informed that these prescribed drugs were administered while he was in hospital. No Ethanol was detected. The pathology report stated that death was due to '*1) multiorgan failure, due to 2) severe shock caused by extensive (80%) body surface burns, 3) consistent with deceased being trapped in a fire in the cockpit of a small aircraft*'.

The Passenger died at the scene. A post mortem toxicological report identified that no drugs or alcohol were present. The pathology report stated that '*death resulted from multiple injuries sustained in an aircraft crash*'.

1.14 Fire

A post impact fuel-fed fire consumed the majority of the aircraft structure which was constructed primarily of wood. The Falco design has two fuel tanks situated fore and aft of the cockpit. The forward fuel tank was completely consumed by fire, approximately 50% of the aft fuel tank structure remained which was deformed by heat.

1.15 Survival Aspects

Photographic evidence shows that the aircraft came to rest inverted, lying to the starboard side. The back of the passenger's seat was deformed indicating that crushing of the passenger cockpit space occurred. The Pilot was observed by witnesses to 'fall out of the aircraft'. Assistance was rendered immediately by relatives of the Pilot and others who had arrived. The Pilot suffered severe injuries which ultimately proved to be fatal.

1.16 Tests and Research

The wreckage was brought to the AAIU facility at Gormanston two days following the accident, and laid out to aid identification of components. The external examination of the engine showed that it had suffered significant impact and heat damage. The effects of the post impact fire were more intense towards the rear of the engine. On disassembly, it was found that one exhaust valve, No. 4, was stuck in the fully open position, probably due to impact and/or heat damage to the rear lug which supports the inlet and exhaust valve rocker shaft. This lug had been bent forward by impact or heat distortion and had seized the rocker. Once the rocker was removed, the valve moved quite freely. It was also established by the position of the engine components that this valve was in the open position when the engine stopped. Investigation also found that a hydraulic valve lifter on No. 3 inlet valve was stiff – this was consistent with extensive heat distortion at the rear end of the engine during the post impact fire.

Photographic evidence obtained by the Investigation and inspection of the wreckage at the accident site, show that the landing gear was in the extended position. This was confirmed by inspection of the main landing gear worm gears and the degree of extension found. The design of the worm gear mechanism is such that no slippage, or movement due to impact forces can occur. Examination of the wreckage indicated that the flaps were in the retracted (UP) position.

1.17 Organisational and Management Information

Not applicable.

1.18 Additional Information

1.18.1 Aircraft Performance

Generally the thrust power available from a normally-aspirated piston engine and propeller combination will increase as speed increases, but the rate of increase will reduce as the speed is increased. For a particular engine, under given atmospheric conditions, the power available can be represented by a curve plotted of power available against airspeed. This is illustrated in **Figure No. 1**.

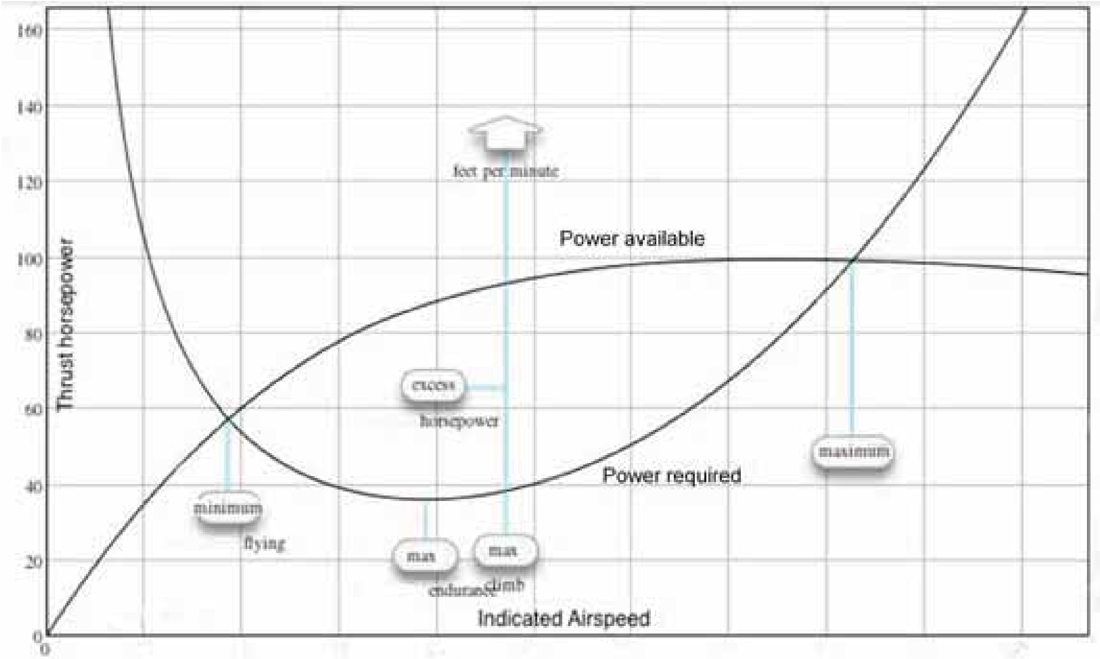


Figure No. 1: Illustration of power available and power required (total drag) curves *(Benchmark)*

A second curve, the power required curve, is a complex curve and is the sum of the total drag over the speed range of the aircraft. As the aircraft speed slows, the Induced drag[8] increases. At high speeds the Parasitic and Form drag[9] components increase. The total sum of these drag components produces a u-shaped curve when plotted against increasing speed. This curve may also be termed the power required curve. Level flight is only possible where the power available is greater than the power required. The intersection of the power/drag curves at the high speed end is the maximum speed in level flight. The speed at which the greatest difference exists between the power available and power required curves ('excess horsepower') is the speed at which the greatest excess of engine power occurs. This speed is consequently the speed at which to achieve the best rate of climb. The best angle of climb occurs at a somewhat lower speed.

1.18.2 Fuel Considerations

EI-BMF used Avgas 100LL type fuel, and it was this type of fuel that was last uplifted prior to the accident. While Avgas will suffer a small loss of volatility when stored in unsealed containers, such as aircraft fuel tanks, the consequential reduction of engine power is generally considered to be minimal.

8 **Induced drag:** Lift acts at right angles to the airflow, the rearward component of which results in drag. This component of drag is greatest at low speed and decreases with the square of the airspeed.

9 **Parasitic and Form drag**: Refers to all other components of drag resulting from skin friction and frontal area. These other components increase with square of the airspeed.

1.18.3 Evaluation Flight

At an early stage, the Investigation considered that the question of the ability of EI-BMF to achieve the climb performance required to clear the tree at the end of the runway might be crucial to the understanding of this accident. Consequently the Investigation used an evaluation flight on a similar aircraft to determine its climb performance when in the configuration that EI-BMF was believed to be in during the go-around manoeuvre. This information is not available in the aircraft's Flight Manual.

The performance checks were conducted on a Falco IV. For safety reasons the evaluation flight was conducted at 4,000 ft AMSL. The ambient conditions were OAT 11 °C and QNH of 1017 hectoPascals (hPa). The two occupants weighed 67.7 kg and 74.9 kg and 6 kg of ballast was placed in the rear of the luggage space to achieve the evaluation flight weight desired. The Pilot flew two series of simulated go-arounds at different airspeeds.

The first series was conducted using a normal approach configuration, with landing gear down and flaps in the full down position. The aircraft conducted a normal descent profile down from 4,400 ft down to 4,000 ft, where a go-around was initiated. The go-around was conducted at the same airspeed as the approach. The time to climb back to 4,100 ft and to 4,200 ft was then recorded. When the go-around was initiated the flaps were retracted but the landing gear was left down (**Table No. 1**).

The second series of go-arounds were carried out in an identical manner, with the exception that zero flaps (flaps retracted) were used in the approach phase. The go-around was commenced by applying full power, pulling up to climb attitude and timing commenced. In all cases the landing gear remained extended and the time taken to achieve a climb to 4,100 ft and 4,200 ft was recorded. The two series of tests were conducted at speeds of 75, 80 and 85 mph during the approach and climb phases (**Table No. 2**).

The results of the evaluation flight were:

First Series: Landing gear remained extended, approach flaps retracted during go-around from 4,000ft			
Climb airspeed:	75 mph	80 mph	85 mph
Time to 4,100 ft (Sec):	18:39	15:47	18:95
Time to 4,200 ft (Sec):	26:38	22:75	25:48

Table No. 1

Second Series: Landing gear remained extended, flaps remained retracted during approach and go-around from 4,000ft			
Climb airspeed:	75 mph	80 mph	85 mph
Time to 4,100 ft (Sec):	12:75	12:58	13:54
Time to 4,200 ft (Sec):	24:62	22:83	19:91

Table No. 2

Data obtained was factored for altitude. In calculating the achieved climb angle, the reduction of Indicated Air Speed (IAS) with respect to True Air Speed (TAS) with altitude has been taken into account, as this reduces the achieved climb angle.

The rates of climb (ROC) and angles of climb achieved in the two series were:

First Series:

IAS (mph)	ROC (ft/min) achieved to 4,100 ft	Achieved climb angle (degrees)	ROC (ft/min) achieved to 4,200 ft	ROC (ft/min) achieved between 4,100 and 4,200 ft
75	317	2.8	455	808
80	388	2.9	527	824
85	326	2.3	471	846

Table No. 3

Second Series:

IAS (mph)	ROC (ft/min) achieved to 4,100 ft	Achieved climb angle (degrees)	ROC (ft/min) achieved to 4,200 ft	ROC (ft/min) achieved between 4,100 and 4,200 ft
75	471	3.8	487	505
80	477	3.6	525	585
85	443	3.1	602	941

Table No. 4

The pilot who carried out the evaluation flight also supplied information regarding the stall speeds in aircraft used for the check flights:

Configuration:	Stall speed (mph)	Safe Approach speed (mph)[10]
Flaps up, landing gear retracted	64	83
Flaps up, landing gear extended	63	81
Flaps 20, landing gear extended	59	77
Flaps Full, landing gear extended	55	72

1.18.4 Standard Climb Performance

In normal configuration (flaps and landing gear retracted), the Falco IV, equipped with a variable pitch propeller (as was EI-BMF) achieves a rate of climb of 1,140 ft/min. This is equates to an achievable climb angle of 8.9°.

10 **Safe approach speed:** A safe approach speed may be calculated using stall speed times 1.3; for a standard flap 20 approach configuration this equates to 77 mph on this aircraft.

2. ANALYSIS

2.1 General

The flight on the day of the accident was conducted in good weather and was routine up to the point of final approach. During the final stages of the approach the Pilot initiated a go-around, during the execution of the go-around the aircraft collided with an obstacle (the tree) in the direct flight path. The aircraft came to rest inverted and an intense post impact fire occurred. The Investigation found no evidence of pre-accident defects with the airframe, engine or propeller of EI-BMF. The aircraft was estimated to be within weight and Centre of Gravity limits at the time of the accident.

It is usual for an aircraft to take-off and land into wind (the same direction) as with a given windspeed the corresponding groundspeed will be reduced, thereby reducing the take-off and landing roll required. In the case of Powerscourt Airfield, it was necessary for the aircraft take off downhill, as a take-off up slope would result in slow acceleration and a lengthy ground roll. Likewise, the landing roll was required to be made uphill to reduce the length of the landing roll.

At Powerscourt, having to take-off and land in opposite directions meant that this procedure could only be carried out in calm or light wind conditions. Otherwise, the effect of a strong tailwind, either on take-off or landing, would result in a high groundspeed and lengthen the take-off or landing roll by a large and probably unsafe margin.

2.2 Technical Examination

2.2.1 General

The Investigation examined the control surfaces and control runs at the accident site and found that all control runs were continuous. Witness evidence indicates that the aircraft was under control, albeit at a low altitude, prior to the impact with the tree. The post impact fire was probably caused by rupture of the front fuel tank or fuel supply line in proximity of the hot exhaust manifold when the engine and engine bearer tore loose on impact.

The position of the main landing gear legs and worm gear mechanism confirmed that the landing gear was in the extended position. As no slippage was possible, the position as found was representative of the actual position of the landing gear prior to impact.

2.2.2 Engine

The damage to the engine identified by the Investigation was associated with the impact and subsequent fire. No evidence of a pre-existing defect in the engine was found. A number of witnesses reported that the engine backfired prior to impact with the tree. Such backfires are frequently associated with a sudden commanded reduction of throttle.

Plotting the ambient temperature and dew point for the conditions prevailing at the time of the accident showed that serious icing could be expected at descent power settings (**Appendix C**). Given the terrain on the approach, a period of descent at low power would have been required on the approach. Therefore it is possible that some icing may have occurred, which would have reduced the available power in the subsequent go-around. However the fact that the Pilot initiated the go-around, when flying towards rising terrain, indicates that he did not have concerns regarding the performance of the engine.

As the aircraft had not been refuelled in the previous four months, a slight deterioration may have occurred in the volatility of the fuel. The Investigation is of the opinion that this would not have had any appreciable effect on the performance of the aircraft as the fuel used was Avgas 100LL.

2.3 Aircraft Climb Performance

The position of the landing gear confirmed that the landing gear was down at the time of the accident. The comment made by the Pilot immediately after the accident supports the conclusion that he was probably unaware that the landing gear was down until he exited the aircraft. At this point in time, before the aircraft was consumed by the fire, the landing gear position, with the three legs pointing upwards, rather than stowed in the retracted position, would have been immediately obvious, as the aircraft was inverted.

The climb performance of an aircraft is result of complex relationships between a range of factors. These include the ambient conditions of air density and temperature, the drag characteristics of the specific aircraft, the available engine power and propeller efficiency, the flap setting and the speed at which the climb is flown. The best rate of climb is achieved at a speed slightly higher than the minimum drag speed, as the engine/propeller thrust power increases with airspeed. The best angle of climb performance is achieved at a slightly lower airspeed, normally to the left of the best climb speed. The criticality of using the optimum climb speed in the Falco is shown in Table 3 of the check flight results, where a variation of only 5 mph on either side of 80 mph resulted in a reduction of the rate of climb of nearly 20%.

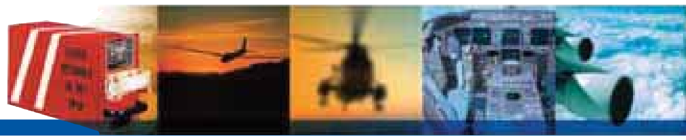
The maximum rate of climb for the Falco, in the optimum configuration, (landing gear up) at sea level and 15°C, is 1,140 ft per minute. At 4,000 ft this would reduce to approximately 850 ft per min. This is 268% better than the poorest rate of climb measured during the check flights (317 ft/min) and 190% better than the best rate of climb recorded (447 ft/min), where the landing gear was in the down position. This demonstrates that the climb performance is significantly adversely affected by climbing with the landing gear lowered. From the data in **Tables 3** and **4**, it can be seen that the ROC between 4,100 ft and 4,200 ft was higher than that achieved in the first 100 ft. This data is included to show that during the transition from approach to go-around, the climb performance is inferior in the first 100 ft of the climb compared to an establish climb. The data for the first 100 ft is particularly relevant, as the climb from the lowest possible point on the approach to the impact point on the tree was approximately 116 ft.

2.4 Flap Position

Available data (**Section 1.18.3**) indicates that the selection of flaps in either the take-off (20° position) or in the raised (UP) position has little effect on the achieved rate of climb. However because the climb airspeed is higher with the flaps raised, the climb angle achieved with the flaps raised is less.

The Investigation determined that the flaps were likely to have been in the retracted position. The achieved climb angle and the forward visibility would both have been adversely affected by the flaps being in the retracted (UP) position. Climb with the flaps raised would also result in an increased nose up angle during the climb. Due to the position of the engine and the relatively low seating position in the Falco, this would result in a significant reduction of forward vision.

No direct evidence is available with regard to the flap position selected during the approach. However, the desired touch-down point was located in the lower region of a valley, with raised ground on the approach path. To maintain best terrain clearance and to lower the approach speed, it is probable that the Pilot would have selected full flap for the approach.



However in the event of a go-around, the Pilot would have to retract the flaps (20° then UP) and to accelerate the aircraft to counteract the increased stall speed resulting from flap retraction. This would take time and delays the achievement of full climb performance. This can be clearly seen in the difference in the achieved climb rates for the first 100 ft when the check flight results for First Series tests (approach with flap – **Table 3**) are compared to those achieved in the Second Series tests (approach without flap – **Table 4**). An approach with full flap results in an average reduction of 25% in the achieved climb rate in the first 100 ft after the initiation of the go-around.

2.5 Effect of Tailwind

A tail wind has no effect on the achieved *rate* of climb. However, a tailwind increases the speed of an aircraft over the ground. This would result in an aircraft covering a further distance over the ground while a given gain of height is achieved. Thus a tailwind decreases the *angle* of the achieved climb. A difficulty with calculating the extent of the effect is that the reduction of the climb angle, for a given rate of climb, is less with higher airspeed. In this accident there is no accurate information available regarding the wind strength and direction at time of the accident. However, calculations show that at an airspeed of 75 mph and a rate of climb of 317 ft/min, the effect of a 10 kt tailwind is to decrease the achieved angle of climb from 2.8° to 2.38°, a reduction of 15%.

2.6 Initiation of Go-around

No quantitative evidence was found with respect to the point along the runway and the height at which the Pilot initiated a go-around. The only established fact was that the aircraft did not actually touch the runway at any point, as evidenced by the absence of any recent ground marks on the runway.

2.7 Achieved Climb Performance

The Investigation considered taking the results from the check flights and applying them to this accident. This would involve taking the data from these flights and applying the relevant factors to convert them into the appropriate figures for Powerscourt Airfield at the time of the accident. The relevant factors would be air temperature and pressure and height above sea level. However other incalculable variables also apply. It is impossible to quantify any difference in performance that may exist between the two aircraft which were over 30 years old. Variations in aircraft condition, wing roughness, propeller and engine condition would all affect the validity of any comparison.

Furthermore, there are variables that cannot be definitely established such as the flap position on approach, which would have had an effect on the achieved climb performance, as discussed in **Section 2.3 Climb Performance**. Finally there are a number of variables that could not be determined. These include:

- The point along the runway where the Pilot initiated the go-around
- The height above the runway where the go-around was initiated
- The speed at which the climb was performed
- The wind speed and direction at the time of the accident
- The time taken to transition from approach to climb configuration

Consequently, the Investigation considered two performance scenarios, plotted the achieved climb angle in both cases and superimposed these on a section of the runway profile. The first scenario considered was an approach with full flaps, climb airspeed at optimum climb airspeed, landing gear down and zero wind. The climb achievable by the aircraft is shown as line **A** on **Appendix D** and the aircraft contacts the tree. If the aircraft had descended below this line when the go-around was initiated and was operating within these parameters, then a sufficient angle of climb to clear the tree would not have been achieved. The second scenario considered was an approach with full flaps, climb airspeed 5 mph below optimum, landing gear down and a 10 kt tailwind. The climb achievable by the aircraft is shown as line **B** on **Appendix D**. If the aircraft had descended below this line when the go-around was initiated and was operating within these parameters, then a sufficient angle of climb to clear the tree would not have been achieved.

In both of the above scenarios the data from the evaluation flight was used, but adjusted to take account of the difference in conditions between the evaluation flight and the accident flight.

The plots show that a go-around initiated at any point between line **A** and line **B** would have been at best marginal, and that any variation for the optimum climb airspeed or the presence of a tailwind would result in an insufficient climb angle, leading to impact with the tree. Taking an overall view, the possibility of a successful go-around with the landing gear down, on this runway, was at best, marginal in this aircraft.

The achievable climb angle in the landing gear-up configuration is also shown, for both zero wind (line **C**) and 10 kts tailwind condition (line **D**).

These lines do not make any allowance for the transition from the approach phase to the climb phase. However, the lines do show that the aircraft was capable, in the landing gear up configuration, of successfully performing a go-around, where the go-around was initiated at any point in the approach (assuming no touch-down), and would clear the deer fence and tree by a significant margin. The positions of lines **A** and **B** also show that the significant obstacle was the tree, not the deer fence.

2.8 The Go-around Decision

There is no direct evidence as to why the Pilot initiated a go-around. At a late stage in the approach the Pilot decided to carry out a go-around. The reason for this decision cannot be determined with certainty, but it is possible that the Pilot may have become aware of a higher than expected groundspeed due to a tailwind, or of an unexpected increase in the tailwind late on the approach leading to a touchdown too far down the runway. The decision to initiate to go-around was prudent in such circumstances.

2.9 The Aerodrome

The combination of the airfields location, on the side of a valley, and the slope on the runway created a challenging situation for any pilot. The possible presence of localised winds and turbulence would add to such difficulties. The Investigation was informed that there was only a small number (possibly only one) instance where the aircraft had taken off uphill, i.e. on the RWY 30. Due to the downslope, landings were not made on the opposite direction, i.e. RWY 12. Consequently the tree that was struck by the aircraft, located on the runway centre-line 71 m beyond the end of the runway, was never a problem for aircraft taking off or landing, in that they did not have to clear it on take-off and did not have to approach over it on landing. The only case where the tree would pose a hazard was during a low-level go-around on RWY 12, as on the accident flight. Such low-level go-arounds were probably an infrequent event. This may explain why the tree was allowed to grow and reach the size where it became a significant obstacle during a low level go-around.

2.10 Cockpit Ergonomics

The Falco is a high performance light aircraft. It features retractable landing gear which is not the norm for such aircraft. It has a high wing loading and consequently a high stalling speed. Its approach speed is therefore high and consequently a pilot would be faced with a demanding situation when confronted with a go-around into rising terrain, as was the case in this accident.

The ergonomics of the centre instrument panel in EI-BMF was not ideal. Both the landing gear and flap selector switches are mounted on this panel, and are of similar type (**Photo No. 2**). The flap selector switch is situated on the left of the panel and the landing gear selector switch is in the centre. These two switches are separated by two similar toggle switches and normally the Pilot must actuate both switches at specific phases of flight during a go-around. It is possible that, having made a decision to go-around, the Pilot may have inadvertently selected the flap switch instead of the landing gear.

2.11 Other Factors

It is possible that the Pilot, when he had cleared the deer fence at the end of the runway, believed that he had cleared what he had understood to be the significant obstacle and relaxed the back-pressure on the control stick. This could have resulted in lowering of the nose of the aircraft so that the tree now came into his view. At this stage he may have realised that he could not climb over the tree and attempted to avoid it. This would explain the impact damage to the tree, which is consistent with the aircraft being banked about 15° to the right. In this scenario, the zero flap position used in the go-around, which would have resulted in a steeper nose up attitude during the climb, thereby restricting forward visibility, was significant.

The possibility of this scenario is further supported by the fact that the caution information for visiting pilots, which was prepared by the Pilot, cautioned against a deer fence at the threshold, but it did not make reference to the tree. This would indicate that the Pilot may have been well aware of the fence hazard, but that the potential hazard posed by the tree was not identified. In this context it is possible that, in the past, the tree was not a significant hazard, but over time it grew to become a significant one.

2.12 Survivability

Impact forces to the engine fractured and twisted the engine bearer structure such that the engine came to rest facing rearwards. This damage most probably ruptured the fuel line and possibly the front fuel tank which was probably almost full of fuel (**Appendix A**). Due to the proximity of the hot exhaust pipework, the fuel ignited immediately causing the post impact fire. This fire was fed by the wooden structure of the aircraft and consumed most of the aircraft.

Due to the final, inverted position of the wreckage, and the post impact fire that occurred, evacuation would have been difficult considering that the survival space of the cockpit under the main wreckage was partially crushed. With the aircraft inverted, the Pilot was observed to fall out through the shattered canopy, probably when he released his harness. This means of escape was not available to the passenger, as ground clearance was significantly less on the right side of the aircraft as it was lying on the right wingtip. With his injuries and crushing of the survival space the passenger was unable to exit the aircraft.

3. CONCLUSIONS

(a) Findings

1. The Pilot was properly licensed.

2. The aircraft was properly maintained and had a valid Flight Permit.

3. No evidence of pre-accident defects was found in the airframe, engine or propeller of EI-BMF.

4. The aircraft was within weight and Centre of Gravity limits at the time of the accident.

5. At a point prior to touchdown, the Pilot initiated a go-around. The reason for this could not be definitely established.

6. The go-round was conducted with the landing gear in the down position.

7. Climb performance in the go-around was degraded due to the excessive drag created by the extended landing gear.

8. The climb performance of the aircraft with the landing gear lowered, combined with the characteristics of this airfield, made the go-around, at best, a marginal operation. Any tailwind would have exacerbated the situation.

9. A tree, which posed a significant obstacle in the event of a go-around, had been permitted to grow and develop in line with the runway.

10. The aircraft performance was sufficient to have achieved a successful go-around if the landing gear had been raised.

11. The ergonomics of the landing gear and flap switches in EI-BMF was not ideal and may have contributed to mis-selection of the flap switch with the intention being to raise the landing gear.

12. The probability of survival in this accident was low.

(b) Probable Cause

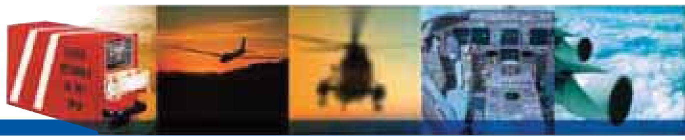
Due to the landing gear being left in the lowered position, adequate climb performance was not achieved during a go-around, which was conducted into rising terrain in which an obstacle was present on the extended centreline of the runway.

(c) Contributory Causes

1. A tree on the extended centreline of RWY 30, was allowed to grow and develop such that it became a significant obstacle to operations.

2. The proximity of the obstacle in the direct flight path may not have been apparent to the Pilot during the climb.

3. The ambient conditions on the day may have produced a tailwind condition during the approach and go-around.



4. SAFETY RECOMMENDATIONS

The Preliminary Report into this accident, published on 6 May 2010 made one Interim Safety Recommendation as follows:

That the landowner of Powerscourt Airfield suspends all operations at the airfield pending completion of this Investigation. ***(IRLD2010003)***

Shortly after this recommendation was issued, the Investigation was informed that the airfield was closed. In the light of this action, Safety Recommendation **IRLD2010003** is now closed.

This Investigation does not sustain any Safety Recommendations.

APPENDIX A

Estimated weight and balance of EI-BMF on the day of the accident, 10 April 2010

Limitations:		
Maximum take-off weight:	1,808 lbs	
Maximum landing weight:	1,808 lbs	
Centre of Gravity limits:	Forward:	68.5 in
	Aft:	70.6 in

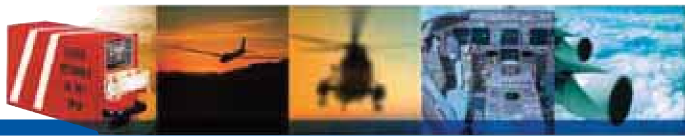
The following calculation assumes the aircraft to have departed Kilrush on 10 December 2009 with full fuel tanks and allows for consumption of fuel for flights made subsequently. Standard weights are used for the occupants.

At take-off:

Item:	**Weight:** (lbs)	**Arm:** (in)	**Moment:** (lb/in)
Basic empty weight:	1228	66.1	81170.8
Pilot/Passenger:	366	85.2	31183.2
Baggage:	0	109.9	0.0
Fuel-Front Tank:	111	44.8	4972.8
Fuel-Rear Tank:	31	128.4	3980.4
Oil:	14	21.6	302.4
Gross weight:	**1750**	**69.5**	121609.6

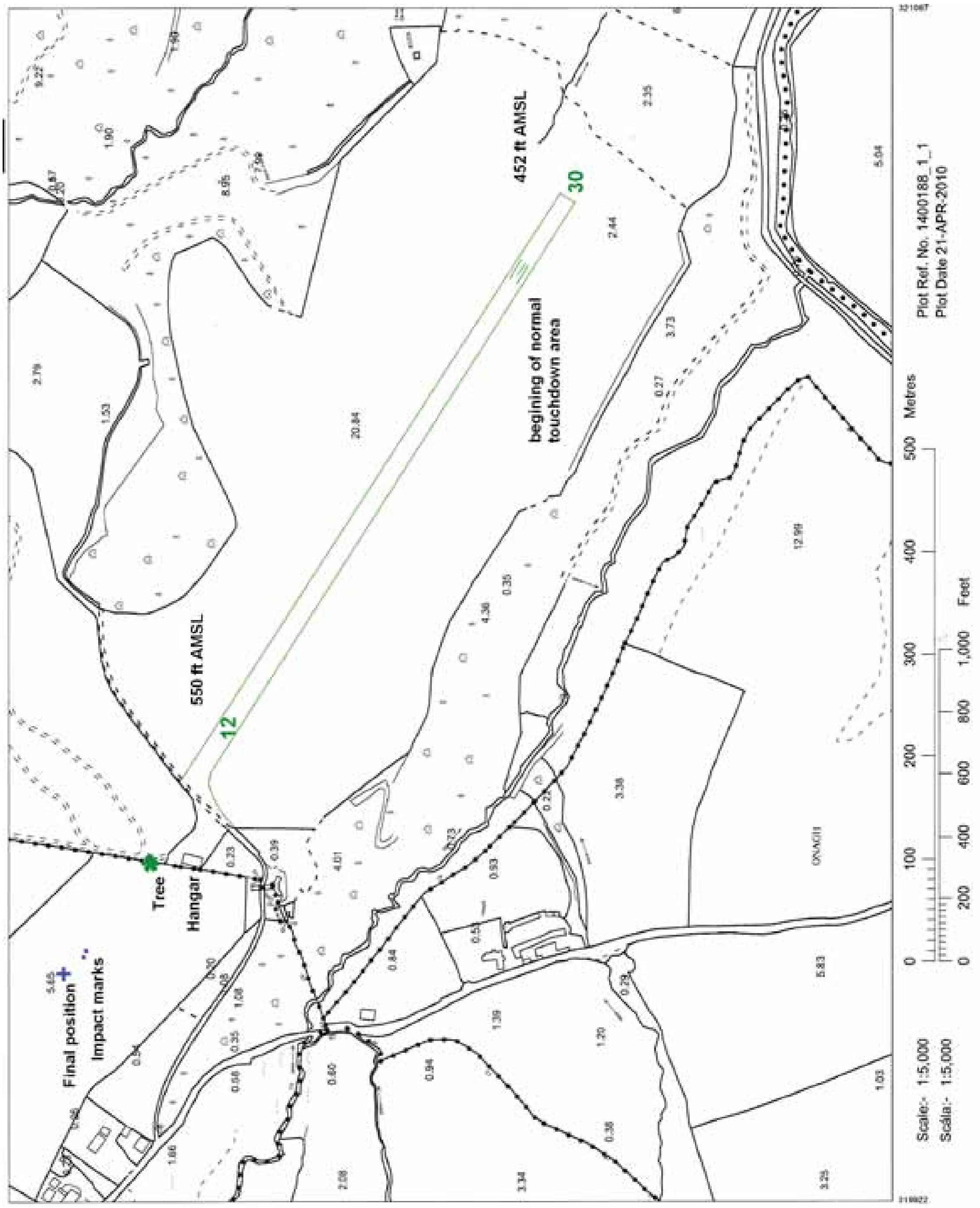
At the time of the accident:

Item:	**Weight: (lbs)**	**Arm: (in)**	**Moment: (lb/in)**
Basic empty weight:	1228	66.1	81170.8
Pilot/Passenger:	366	85.2	31183.2
Baggage:	0	109.9	0.0
Fuel-Front Tank:	106	44.8	4748.8
Fuel-Rear Tank:	5	128.4	642.0
Oil:	14	21.6	302.4
Gross weight:	**1719**	**68.6**	118047.2



APPENDIX B

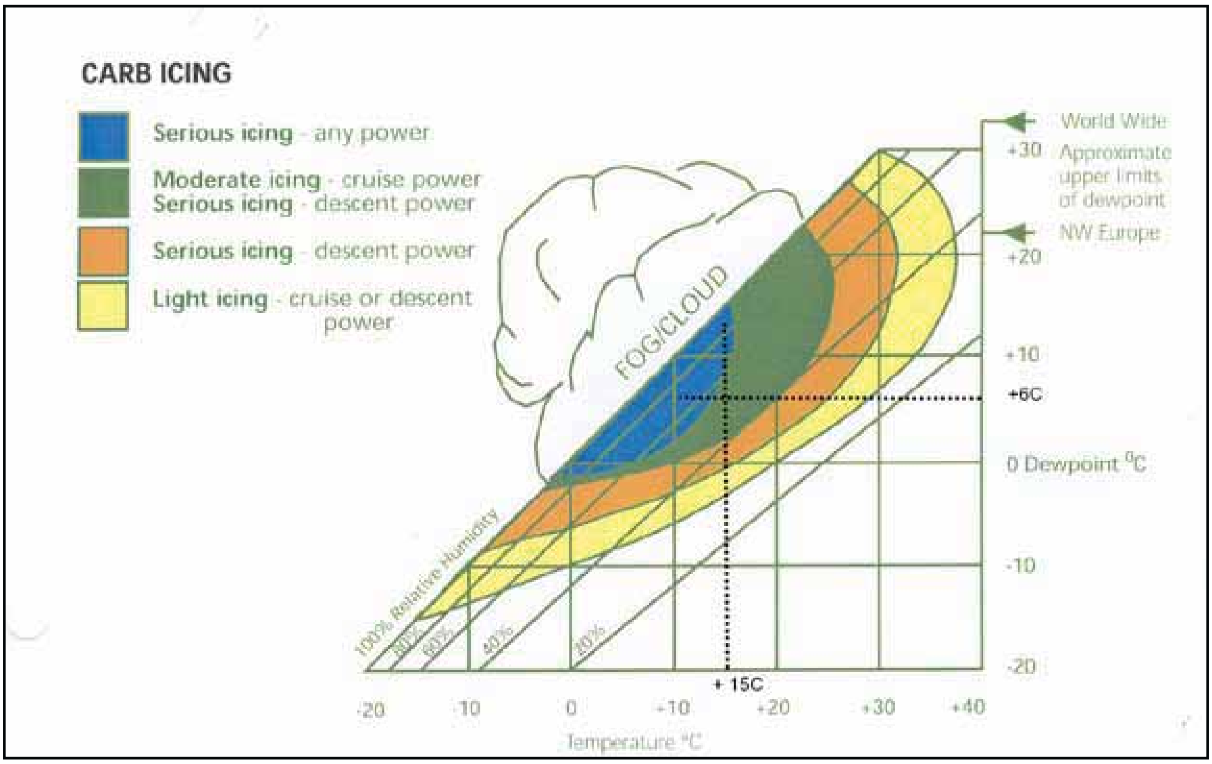
Powerscourt Airfield showing location of Runway, obstacle struck (tree) and final position of wreckage



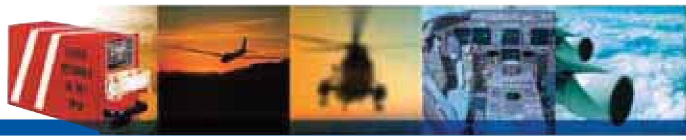
Based on Ordnance Survey Digital Map (3616-A)

APPENDIX C

Chart showing conditions of possible Carburettor Icing

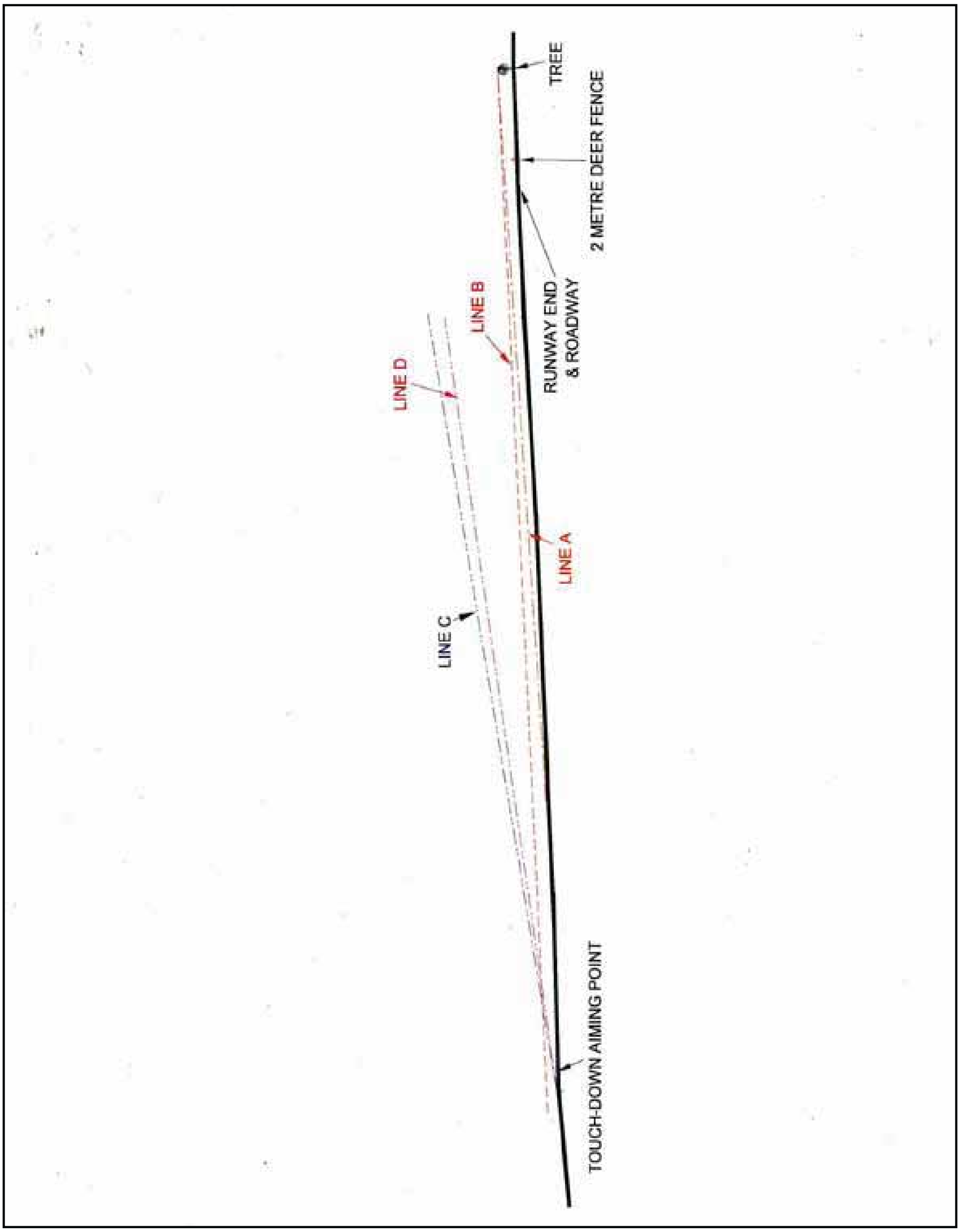


(*Civil Aviation Authority, UK*)



APPENDIX D

Section of runway profile with performance lines superimposed



- END -

In accordance with Annex 13 to the International Civil Aviation Organisation Convention, 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 these investigations is to prevent aviation accidents and serious incidents. It is not the purpose of any such accident investigation and the associated investigation report to apportion blame or liability.

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

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Department of Transport Tourism and Sport
An Roinn Iompair Turasóireachta Agus Spóirt

A.A.I.U.,
Department of Transport Tourism and Sport,
2nd Floor, Leeson Lane,
Dublin 2, Ireland.
Tel (24x7): *+353 1 604 1293 or*
+353 1 241 1777
Fax: *+353 1 604 1514*
Email: *info@aaiu.ie*
Web: *www.aaiu.ie*