

FINAL REPORT

AAIU Synoptic Report No: 2009-026

State File No: IRL00909016

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In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on 11 March 2009, appointed Mr. Paul Farrell as the Investigator-in-Charge to carry out a Field Investigation into this Accident and prepare a Synoptic Report.

Aircraft Type and Registration:	Piper - PA 28-181 (ARCHER II), D-EAOB
No. and Type of Engines:	1 x Lycoming O-360-A4M
Aircraft Serial Number:	28-90082
Year of Manufacture:	1988
Date and Time (UTC):	11 March 2009 @ 08.50 hrs
Location:	Athboy Airfield (EIMH), Co. Meath
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - Nil Passengers - Nil
Nature of Damage:	Substantial
Commander's Licence:	PPL (A) issued by the Irish Aviation Authority
Commander's Details:	Male, aged 51 years
Commander's Flying Experience:	1,659 hours, of which approx 40 were on type
Notification Source:	Pilot and ATC Duty Manager, Shannon Airport
Information Source:	Pilot Report, AAIU field inspection

SYNOPSIS

The aircraft, carrying the Pilot and two passengers, departed EIMH with the intention of flying to Cheltenham (UK). After take-off the aircraft failed to climb and accelerate as the Pilot expected and the port stabiliser¹ struck a hedge that forms the airfield boundary. The Pilot elected to make a forced landing in the adjacent stubble field. During the forced landing the aircraft suffered substantial damage, the nose wheel sheared off and the starboard undercarriage leg collapsed before the aircraft eventually came to rest 165 metres (m) into the field. There were no injuries and the Pilot and passengers exited the aircraft without third party assistance. There was no post-impact fire.

¹A "Stabiliser" is the fixed, horizontal, tail-mounted, airfoil-sectioned surface that has elevators and a rudder hinged to its trailing edge.

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1. FACTUAL INFORMATION

1.1 History of the Flight

The aircraft, carrying the Pilot and two passengers departed EIMH and the intention was to fly to Cheltenham (UK). The Pilot, who held a valid Private Pilot Licence (Aircraft) issued by the Irish Aviation Authority (IAA), completed his weight and balance and performance calculations on the evening before the flight.

About 15 minutes prior to the flight, the Pilot walked to the windsock at EIMH to assess the wind conditions for himself. He concluded that for the intended departure on RWY 11, the wind was a direct crosswind of about 10 kts. He carried out pre-departure power checks into wind and had assessed the power drops as normal; 75-100 rpm for each magneto, 50-100 rpm for the carburettor heat.

The Pilot said that he selected Flap 25° for the take-off. Having travelled 60% of the available runway length, he was confident that the aircraft would develop sufficient speed for a successful take-off. The aircraft took-off at about 75% of the available runway length, at around 60 KIAS. The aircraft failed to climb and accelerate as the Pilot expected, and he lowered the nose to try to build up speed. The aircraft's port stabiliser struck a hedge that forms the airfield boundary. The Pilot heard a loud bang from the left, which he thought was from the wing or undercarriage wheel hitting the hedge. He then elected to make a forced landing in the adjacent field.

The Pilot instructed his passengers to brace for a sudden stop landing and he retarded the Power and Mixture controls. The aircraft made first ground contact 135 m beyond the Airfield boundary. The aircraft travelled another 30 m (approximately) fracturing its nose wheel before slewing anti-clockwise and coming to rest on a heading of 300° magnetic with the main starboard undercarriage collapsed towards the aircraft centreline (**Photo No. 1**). The Pilot selected master switch and fuel to off.

There were no injuries and that the Pilot and passengers exited the aircraft without third party assistance. They pulled the baggage from the aircraft and then moved away from the aircraft. There was no post-impact fire.

The Pilot contacted Air Traffic Control (ATC) to cancel his flight plan and advise them of the accident. Both the Pilot and the Duty Manager at Shannon ATC advised the Air Accident Investigation Unit (AAIU) of the accident. Two Inspectors of Air Accidents proceeded to the scene arriving approximately two and a half hours after the accident.

1.2 General Observations On-Site

RWY 11 at EIMH is a grass runway 1,650 feet long with a slight downward slope. On the day of the accident the surface was found to be quite wet. The wheels of vehicles travelling on the Airfield margins were observed throwing up water and light mud. The Investigation walked the length of the runway and noted that there was several areas where the aircraft nose wheel appeared to have "dug-in" and gouged the grass surface leaving clearly visible mud patches.

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Photo No. 1: General disposition of the accident site

1.3 Aircraft Damage

The propeller blade tips were folded back, damage which was consistent with the low power setting which the Pilot reported using for the forced landing (**Photo No. 2**). The port stabiliser had suffered significant damage from the impact with the boundary hedge (**Photo No. 3**). Vegetation found on the outboard tip of the port stabiliser was matched to the vegetation in the airfield boundary hedge.

The Investigation verified the continuity of all control runs. Each fuel tank was inspected and found to be completely filled with Avgas. Fuel samples were taken and these revealed no contamination. The aircraft was serviceable and well maintained. Subsequent examination of the technical records presented to the Investigation revealed no anomalies. The aircraft had a valid Certificate of Airworthiness.



Photo No. 2: Propeller damage consistent with low power setting

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Photo No. 3: Port Stabiliser damage from boundary hedge impact

1.4 Pilot Interview

The Investigation interviewed the Pilot at EIMH. The Pilot stated that 2,300 rpm was the normal engine speed for take-off and the engine had delivered this speed throughout the take-off run. He experienced no difficulties with engine power.

He said that in his weight calculations he allowed 70 Kg for his male passenger and 65 kg for his female passenger. The Pilot stated that he believed that the failure to achieve successful take-off was due to his underestimation of the adverse affect that the moist ground would have on the aircraft's take-off performance.

1.5 Meteorology

Met Éireann provided the following aftercast for conditions in the Athboy area at the time of the Accident.

Meteorological Situation:	<i>The Athboy area was under the influence of a warm sector with the warm front lying through the Irish Sea and the associated cold front approaching the West coast of Ireland.</i>	
Wind:	Surface:	<i>220°/10 kts with possibility of gusts to 15-20 kts</i>
	2000 feet:	<i>240°/25 kts</i>
Visibility:	<i>15 to 20 km on average but 7 to 10 km was possible in local mist.</i>	
Weather:	<i>Some local mist possible</i>	
Cloud:	<i>Nearest observations to the region indicate cloud ceilings of 700-1,000ft</i>	
Surface Temp/Dew Point:	<i>11/10° C</i>	
MSL Pressure:	<i>1,019 hPa</i>	
Freezing Level:	<i>Circa 7-8,000 ft</i>	

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Three hours after the accident, while the Investigation was at the site, sudden shifts in wind direction up to 45° with strong gusts that produced significant tail winds were noted.

1.6 Aircraft Weight

On arrival at the aircraft the Investigation noted the absence of the two passengers and the baggage. Consequently the Investigation was unable to independently determine the weights of the two passengers or of the baggage and so the Pilot's weight and balance calculations have been used as the basis for analysing the aircraft performance, as shown below:-

	Weight (lbs)	Arm (inches)	Moment (Lb.in)/1000
Empty Weight	1632.18	87.56	142.91
Pilot & Passenger	343.20	80.51	27.63
Rear Passenger	149.60	118.11	17.67
Baggage	22.00	142.80	3.14
Fuel	<u>288.20</u>	95.00	<u>27.38</u>
Total	2435.18		218.73

Table No. 1: Pilot's Weight and Balance calculations

The Investigation notes that these calculations attribute a mass of 68 Kg (150 lbs) to the male passenger and 63 Kgs (139 lbs) to the female passenger. During interview the Pilot stated that he had allowed 70 Kg (154 lbs) for the male passenger and 65 Kg (143 lbs) for the female passenger.

The Pilot's Operating Handbook and FAA Approved Airplane Flight Manual quotes the "Maximum Takeoff Weight for Normal category operations" as 2,550 lbs.

1.7 Performance

Performance information is given in Section 5 of "The Pilot's Operating Handbook and FAA Approved Airplane Flight Manual." The 25° flap take-off charts provided for both performance and ground roll are for "paved, level, dry runway". The first page of the performance planning section contains the warnings.

"The Performance Charts are unfactored²" and "Effects of conditions not considered on the charts must be evaluated by the pilot, such as the effect of soft or grass runway surface on take off and landing performance".

² Unfactored "means the data represents the performance achieved by the manufacturer using a new aeroplane in ideal conditions. This level of performance will not be achieved if the flying techniques used by the manufacturer are not followed closely or if the meteorological conditions are not as favourable as those encountered during testing. It is therefore PRUDENT TO ADD SAFETY FACTORS to the data in order to take account of less favourable conditions". (Source: UK CAA, "AIC 127/2006, TAKE-OFF, CLIMB AND LANDING PERFORMANCE OF LIGHT AEROPLANES")

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For the calculated weight of the aircraft (2,435 lbs), both the “*Takeoff Performance*” and the “*Takeoff Ground Roll*” charts specify a “*Lift Off*” speed of (just below) 47 KIAS. This is consistent with the instructions for “*Soft Field*” and “*Short Field, Obstacle Clearance*” given in Section 4 (Normal Procedures) of “*The Pilot’s Operating Handbook and FAA Approved Airplane Flight Manual*”; in both cases the instructions are “*Flaps 25° Set, Accelerate to 41 to 49 KIAS depending on aircraft weight*”.

The Pilot stated that he accelerated to around 60 KIAS before take-off. This airspeed is consistent with the “*Normal*” take-off instructions, which direct the Pilot to “*Accelerate to 52 to 65 KIAS*”.

1.8 UK CAA Aircraft Performance Factoring Guidance

The UK CAA produced “*SafetySense Leaflet 7 Aircraft Performance*”, which is based on information contained in the UK CAA’s Aeronautical Information Circular “*AIC 127/2006, TAKE-OFF, CLIMB AND LANDING PERFORMANCE OF LIGHT AEROPLANES*”. The purpose of the leaflet was to provide performance planning guidance to pilots and the leaflet noted at the outset “*Accidents such as failure to get airborne, collision with obstacles after take-off and over-run on landing occur frequently to light aeroplanes*”. The leaflet provides detailed information on many aspects of performance planning including the use of “*unfactored*” performance data. The leaflet concludes with a summary table listing the variables affecting performance together with the factors which should be applied when performance planning for non-Public Transport operations. This is reproduced in **Table No. 2** below.

UK CAA, “*AIC 127/2006, TAKE-OFF, CLIMB AND LANDING PERFORMANCE OF LIGHT AEROPLANES*”, states “*Unless otherwise specified in the aeroplanes manual, handbook or supplement, a factor of 1.33 for take-off is recommended, and should be applied after the application of the corrections for the variables*”. So when interpreting **Table No. 2** it must be understood that the column “*CONDITION*” describes various “*variables*” which can affect take-off and landing such as aircraft weight, ambient temperature and a variety of ground conditions such as grass length, soft ground, etc. All pertinent variables are assessed and the relevant factors are identified and multiplied. Finally an “*ADDITIONAL SAFETY FACTOR*” (1.33 for take-off) from the last line of **Table No. 2** is multiplied by the previous result to arrive at an overall factor to be used.

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FACTORS MUST BE MULTIPLIED i.e. 1.20 x 1.35				
CONDITION	TAKE-OFF		LANDING	
	INCREASE IN TAKE-OFF DISTANCE TO HEIGHT 50 FEET	FACTOR	INCREASE IN LANDING DISTANCE FROM 50 FEET	FACTOR
A 10% increase in aeroplane weight, e.g. another passenger	20%	1.20	10%	1.10
An increase of 1,000 ft in aerodrome elevation	10%	1.10	5%	1.05
An increase of 10°C in ambient temperature	10%	1.10	5%	1.05
Dry grass* - Up to 20 cm (8 in) (on firm soil)	20%	1.20	15%*	1.15
Wet grass* - Up to 20 cm (8 in) (on firm soil)	30%	1.3	35%* Very short grass may be slippery, distances may increase by up to 60%	1.35
Wet paved surface	-	-	15%	1.15
A 2% slope*	Uphill 10%	1.10	Downhill 10%	1.10
A tailwind component of 10% of lift-off speed	20%	1.20	20%	1.20
Soft ground or snow*	25% or more	1.25 +	25%* or more	1.25 +
NOW USE ADDITIONAL SAFETY FACTORS (if data is unfactored)		1.33		1.43

Table No. 2: CAA *SafetySense* performance factors table

Looking at the two left hand columns in **Table No. 2** the relevant factors that would apply in this case are “*Wet Grass*” (1.3), “*Soft ground*” (1.25) and “*Additional Safety Factors*” due to unfactored performance data (1.33). Thus the combined safety factor, which the CAA recommends applying, is $1.3 \times 1.25 \times 1.33$, which equates to 2.16. Although the table specifically mentions take off distance to 50 feet, as the two variable factors mentioned apply to the ground roll portion of the take off, a factor of at least 2.16^3 will also apply to ground roll distance.

RWY 11 at EIMH has a slight downward slope but the “*SafetySense leaflet*” cautions “*Do not attempt to use the factors to reduce the distances required in the case of downslope on take-off*”. The parameters for D-EAOB were entered on the Ground Roll performance chart (**Figure No. 1**). The chart predicts that for a paved, level, dry runway, an 840 ft ground roll is required. Applying the CAA guidance documents combined safety factor of 2.16, this indicates a guidance distance of 1,814 ft, assuming that the aircraft lifts off at 47 KIAS.

³ UK CAA, “AIC 127/2006, TAKE-OFF, CLIMB AND LANDING PERFORMANCE OF LIGHT AEROPLANES”, states, “For surface and slope factors remember that the increases shown are to the take-off distance to a height of 50 ft. The correction to the ground run will be proportionally greater”.

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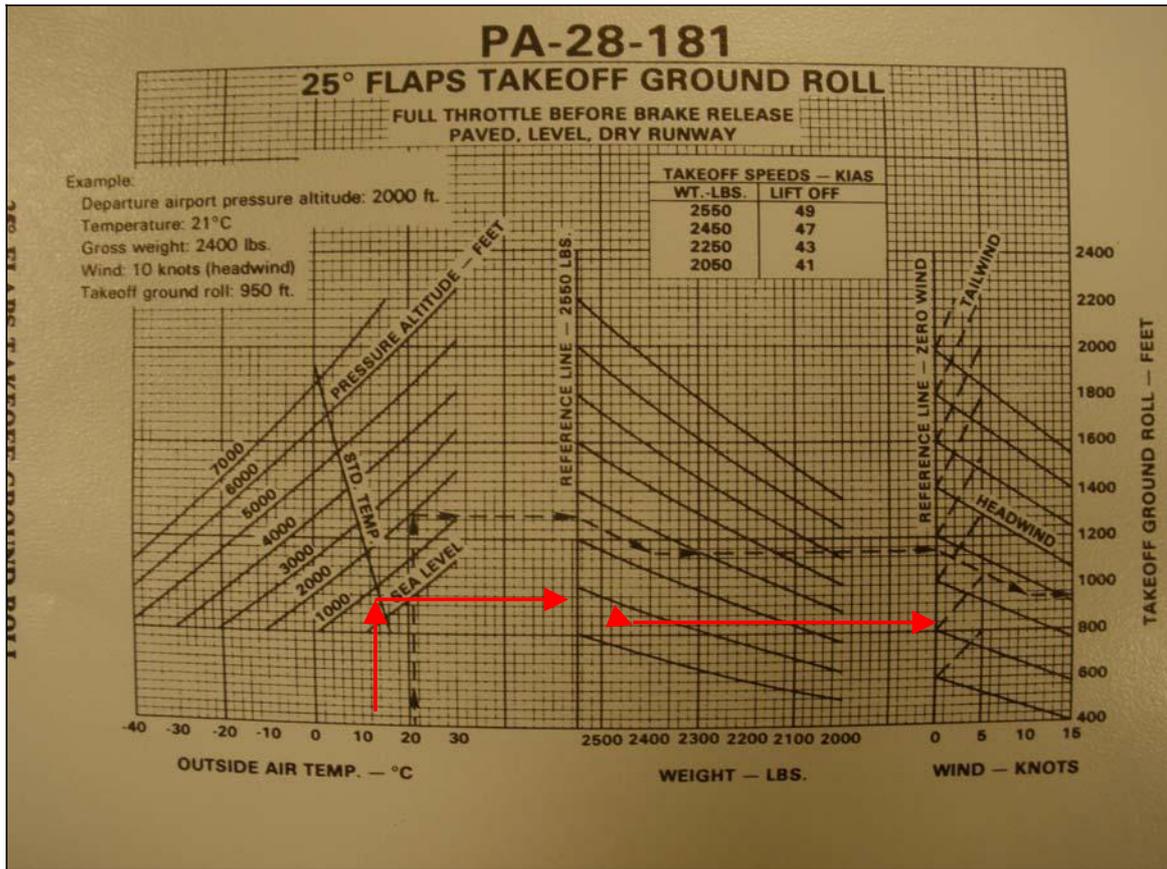


Figure No. 1: Unfactored Ground Roll performance for accident aircraft.

1.9 Aircraft Markings

The aircraft's German registration was painted on both sides of the fuselage. An Irish flag was painted on both sides of the vertical fin.

According to German Law (Luftverkehrs-Zulassungs-Ordnung, LuftVZO), German registered aircraft must have a German flag painted on both sides of the vertical fin. The dimensions must be at least 15 x 25 cm.

The Pilot stated to the Investigation that he didn't really know the origins of the Irish flag marking but that it was probably there for a few years.

2. ANALYSIS

2.1 Wind

15 minutes prior to take-off the Pilot assessed the wind as being a direct crosswind. The aftercast gives the wind as 220°/10 kts with the possibility of gusts to 15-20 kts, which would give a tail wind component between 3 and 7 kts approximately. On site, three hours after the accident, the investigation noted sudden shifts in wind direction up to 45° tail winds accompanied by strong gusts. It is possible that the Pilot experienced a tail wind during take-off rather than the expected direct crosswind. Any tail wind component would have extended the length of the take-off ground roll.

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2.2 Aircraft Weight

According to the Pilot's calculations the take-off weight was 2,435 lbs. "*The Pilot's Operating Handbook and FAA Approved Airplane Flight Manual*" quotes the "*Maximum Takeoff Weight for Normal category operations*" as 2,550 lbs. Thus during take-off the aircraft was at 95.5% of the certified "*Maximum Takeoff Weight for Normal category operations*".

2.3 Take-off Airspeed

The Pilot took off at around 60 KIAS. This speed is typical for a normal take-off in accordance with the procedures given in Section 4 ("*Normal Procedures*") of "*The Pilot's Operating Handbook and FAA Approved Airplane Flight Manual*".

At an aircraft weight of 2,435 lbs and a flap setting of 25°, both the "*Takeoff Performance*" and the "*Takeoff Ground Roll*" charts specify a "*Lift Off*" speed of (just below) 47 KIAS. This is consistent with the instructions for "*Soft Field*" and "*Short Field, Obstacle Clearance*" given in Section 4 ("*Normal Procedures*") of "*The Pilot's Operating Handbook and FAA Approved Airplane Flight Manual*".

The extra time spent on the ground accelerating from 47 KIAS to 60 KIAS resulted in more runway distance being used and less space available to climb and clear obstacles on the take-off flight path.

2.4 Length of Take-off Roll

The manufacturer's performance figures quoted in section 5 of "*The Pilot's Operating Handbook and FAA Approved Airplane Flight Manual*" are for "*paved, level, dry runway*" and "*The Performance Charts are unfactored*". The Pilot must factor the figures from the performance charts to allow for effects such as soft or grass runway surface on take off and landing performance.

Using suggested factors from the UK CAA's "*SafetySense Leaflet 7 Aircraft Performance*", a combined multiplier of 2.16 would apply to the conditions experienced on the day of the accident.

The "*Ground Roll*" performance chart (**Figure No. 1**) predicts that on a paved, level, dry runway, an 840 ft ground roll is required. Applying the CAA guidance documents combined safety factor of 2.16, this indicates a ground roll of 1,814 ft, assuming that the aircraft will take-off at 47 KIAS. Given that the runway length is 1,650 feet take-off roll performance in this case was at best marginal, a situation which was exacerbated by the higher than recommended take-off airspeed and possibly a tail wind.

3. CONCLUSIONS

(a) Findings

1. The Pilot was properly licensed and qualified to carry out the flight.
2. The aircraft was correctly maintained, serviceable and had a valid Certificate of Airworthiness.
3. The aircraft was incorrectly marked according to the law of the State of Registry.

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4. The Investigation could not verify the take-off weight of the aircraft due to the absence of the passengers and baggage.
5. The Pilot's calculated take-off weight of 2,435 lbs was 95.5% of the certified "*Maximum Takeoff Weight for Normal category operations*".
6. The performance charts indicate a take-off airspeed of just under 47 KIAS for an aircraft weight of 2,435 lbs.
7. The aircraft took off at around 60 KIAS.
8. The Performance Charts in the "*The Pilot's Operating Handbook and FAA Approved Airplane Flight Manual*" are unfactored and are only applicable to "*paved, level, dry*" runways.
9. The grass runway was wet and the aircraft's performance was not correctly factored to allow for this.
10. During the take-off roll the aircraft may have been subject to a tail wind component.
11. Once airborne the aircraft failed to climb and accelerate as the Pilot expected.
12. The aircraft's port stabiliser struck an airfield boundary hedge causing significant damage and mis-alignment of the aircraft's tail section.
13. The Pilot made a forced landing in the adjacent field.
14. During the forced landing the aircraft suffered significant damage, which included a fractured nose wheel and a collapsed starboard undercarriage.

(b) Probable Cause

The aircraft failed to climb as the Pilot expected and impacted an obstacle at the airfield boundary.

(c) Contributory Causes

1. The performance figures for the aircraft were not correctly factored for the prevailing conditions.
2. The take-off airspeed for the aircraft weight was higher than that prescribed for a soft field take-off.

4. SAFETY RECOMMENDATIONS

It is recommended that:

The IAA should consider issuing guidance material to pilots making reference, where appropriate, to safety and performance related information that is currently available from a variety of reputable sources such as the UK CAA and FAA websites. Such information in this instance could include: UK CAA Safety Sense Leaflet No. 7 - Aircraft Performance, UK CAA AIC 127/2006 - Take-off, Climb and Landing Performance of Light Aeroplanes, FAA Airplane Flying Handbook and FAA Pilots Handbook of Aeronautical Knowledge. ([SR 16 of 2009](#))

- END -