

AAIU Report No:- 1999/ 001
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Registered Owner: Private

Aircraft Type: Piper Cherokee Six, PA-32-300

Nationality: British

Registration: G-ILTS.

Location: Warren's airstrip, Montague, Gorey,
Co Wexford. N 52375 W006195.

Date & Time (UTC): 12th November 1996 @ 0947 hours.

Synopsis

During take-off from a grass airstrip near Gorey, Co Wexford, the aircraft did not become airborne until near the end of the runway, where it struck a barbed wire boundary fence, breaking two wooden poles in the process. The aircraft continued to fly with a high nose-up attitude for a further 300 metres before the pilot elected to carry out an emergency landing in an adjacent field. The field, which was cultivated and planted with small saplings, had furrows running at right angles to the direction of flight. After an initial heavy impact into the field, the main undercarriage was torn off and substantial damage was caused to the underside of the aircraft, before it finally came to rest. All five persons onboard the aircraft evacuated without injury. Time of impact was 0947 hours approximately. There was no fire.

1. Factual Information

1.1 History of the flight

1.1.1 Background to the accident flight

The passenger, who was seated in the righthand seat of the accident aircraft was the previous owner of G-ILTS and a qualified pilot on type. He had a long standing arrangement with a neighbouring farmer (current owner of G-ILTS) to hire out the aircraft for his use from time to time. On this particular occasion he hired G-ILTS for a flight which entailed flying from York in the United Kingdom, to Gorey, Co Wexford, Ireland, an overnight, and flying out the following day for a mid-week break in Paris. Due to an ankle injury sustained during a farming incident, this passenger was deemed medically unfit to fly the aircraft himself, so he called on the services of a friend, who was also a qualified pilot and asked him to carry out the flight on his behalf.

1.1.2 Positioning Flight

The aircraft initially took off from an airfield in Fadmoor, York in the United Kingdom on the 11 November 1996 with full fuel and four POB. It flew a short 15 minute flight to Fullsutton Airfield York in order to carry out an anti-terrorism clearance check, before departing for Ireland. At 1400 hours, G-ILTS took off from Fullsutton Airfield and routed to Warren's airstrip, Gorey, where it landed at 1545 hours without incident. After parking the aircraft on the ramp, the pilot, who had not previously visited this particular airstrip, decided to confirm for himself the actual length of the airstrip by pacing it out. He measured it at 560 yards (512 metres) and as he knew that G-ILTS required approximately 500 yards (457 metres) for take-off, he was satisfied that runway length available was sufficient for a safe departure. The pilot had noted that in taking-off in a westerly direction, it would entail an initial upslope of 60 yards (55 meters) followed by a gentle down slope of a further 500 yards (457 meters).

The four POB overnighted locally with a friend of the hirer of G-ILTS.

1.1.3 The accident flight

The following morning, the pilot and four passengers went to Warren's airstrip with the intention of departing at 0945 hours for Paris. The pilot had previously filed a flight plan at 0917 hours by fax, through a handling company at Dublin Airport, for Dublin ATC.

A full walkround of the aircraft was completed by the pilot and as he was mainly concerned with the centre of gravity (C of G) limits, he personally supervised the loading of the aircraft himself. In the event, no load sheet or aircraft weight calculations were completed prior to take-off.

After start-up, the pilot carried out an engine check, which included increasing the engine power to about 2000 rpm and checking each magneto in turn; they both operated satisfactorily. In order to confirm the actual wind direction, the pilot taxied the aircraft down the runway to where the windsock was located. His assessment of the wind conditions was mainly that of a crosswind, between 5 and 10 kts. Mindful of the wind conditions prevailing at the time and the fact that extra take-off distance could be gained by using part of the apron area, the pilot elected to take-off in a westerly direction using Runway 26.

Once positioned on the apron, the pilot selected flap at the second notch (25°) and set full engine power of 2700 rpm against the brakes. On break release, the aircraft travelled approximately 35 metres along a short concrete and grass taxiway, before the pilot, commenced an 80° righthand rolling turn to intercept the runway centreline. Continuing his take-off run along the runway, the pilot, on seeing that the indicated airspeed (IAS) had reached somewhere between 55 and 60 kts, averted his attention from the airspeed indicator (ASI), and looked out ahead in order to concentrate on the take-off.

The pilot stated, that at this point an unfamiliar sound was heard coming from the engine, however as the primary engine instruments did not indicate any problems and being mindful of the approaching boundary fence, he committed himself to getting the aircraft airborne. The aircraft bounced twice before finally becoming airborne late into the take-off run (see additional information). It flew for 36 metres before striking a 1.2 metre high livestock restraining boundary fence (with its main undercarriage), which was located at the end of the runway.

After impacting the fence the aircraft continued to fly with a high nose up attitude across an open field for a further 300 metres, before the pilot elected to re-land in an adjacent field. The aircraft initially impacted heavily at a point 55 metres from a ditch, on a bearing of 250°. Both main undercarriage wheels were torn from the aircraft on impact. It then continued on for a further 128 metres, where substantial damage was caused to the underside of the aircraft, before it came to a halt along its original impact heading. All five POB evacuated the aircraft without injury. There was no fire.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor/none	1.	4.	

1.3 Damage to aircraft

Both main undercarriage legs were torn from the wings on initial impact. Subsequent impact of the tail on the ground caused damage to the underside of the rear fuselage and there was also damage to the left side of the fin and rudder. The flaps were distorted, particularly at the trailing edge. The nose wheel tyre had deflated, while the nose undercarriage leg assembly itself remained intact. No damage was caused to the propeller.

1.4 Other damage

A livestock restraining fence, located at the western end of the airstrip was struck by the aircraft's undercarriage, breaking two wooden poles and a section of wire in the process. The fence was made up of bull wire meshing and barbed wire which was attached to 1.8 metre wooden poles, paced approximately 6 metres apart. When the fence was inspected the following day of the accident, a 15 metre section of wire mesh was found rolled forward on the ground in the direction of travel of the aircraft.

Closer examination of the undergrowth revealed a freshly broken wooden stump, approximately 0.3 metres long in the ground. The remaining section of this pole was located in the undergrowth on the far side of the road. A section of barbed wire, which ran along the top of the poles was found broken at this point, with a 1.5 metre length of barbs missing from the actual wire. Approximately 6 meters along the fence line to the left of where the first stump was found, a second fresh fence pole hole was located. A search of the area failed to recover the missing pole.

Damage, in the form of ground penetration marks and the uprooting of newly planted saplings was also caused to the farmer's field where the aircraft came to rest.

1.5 **Personnel Information**

Commander: Male, aged 38 years.

Licence: Commercial Pilot's Licence.

Aircraft rating: Single and multi-engined land planes

Instrument rating: 1st April 1996

Medical certificate: Class I, valid 31st July 1997.

Flying experience:

Total flying: 917 hours

Total on type: 10 hours

Last 90 days: 30 hours

Last 28 days: 14 hours

1.6 **Aircraft Information**

1.6.1 **General**

The Piper Cherokee Six (PA-32-300) is an all metal, low wing, six seater monoplane, with a constant speed variable-pitch propeller. G-ILTS was constructed by the Piper Aircraft Corporation, Vero Beach, Florida, USA in 1979. A Star Annual Check for renewal of a United Kingdom Certificate of Airworthiness (C of A) in the Public Transport Category was completed on the 29 September 1995. It is a requirement of the C of A that the aircraft be operated in accordance with the manufacturers operating instructions and recommendations.

1.6.2 Airframe

The airframe had been maintained in accordance with the approved maintenance schedule and the last inspection (Annual) was carried out on the 2 October 1996 at 4030.50 hours. Total time on the airframe up to the 12 November 1996 was 4051 hours

1.6.3 Engine

The Lycoming engine IO-540-KIG5 was manufactured by Lycoming USA and had been removed from another aircraft G-TOGA as a result of a ground strike at 1335 hours 50 mins. The engine core was overhauled to zero hours on the 5 August 1996 and then fitted to G-ILTS. A number of engine accessories including the magneto's, were not overhauled. The last engine inspection (Annual) was completed at 48.45 hours on the 2 October 1996 and total time on the engine, up to the 12 November 1996 was 69.10 hours, since overhaul.

1.6.4 Variable-Pitch Propeller

The propeller, type HC-C2YK-IBF was constructed by Hartzell in 1979. It had a total of 1106.55 hours up to the 12 November 1996. The last inspection carried out (150 hour) was at 1086.30 hours on the 2 October 1996.

1.6.5 Weight and centre of gravity

Due to the late notification of the accident to the AAIU, Inspectors from the Unit did not arrive at the accident site until 1030 hours on the following day. As all personal baggage and survival equipment had been removed shortly after the accident, it was not possible to determine the exact weight or centre of gravity of the aircraft at time of impact.

Estimated weights, submitted by the pilot following the accident were as follows;

Aircraft basic weight:	2126.0 Lbs	
Crew:	158.0 Lbs	
Passengers:	624.0 Lbs	
Baggage:	65.0 Lbs	
Fuel:	<u>373.5 Lbs</u>	
Total:	3346.5 Lbs	
Aircraft MAUW		3400Lbs
Below MAUW	<u>53.5 Lbs</u>	
	3400 Lbs	3400Lbs

1.6.6 Survival Equipment

A flight plan submitted by the pilot indicated that the aircraft carried survival equipment which included, a total of (5) life jackets and a (6) man dingy. The weight of this equipment (as subsequently estimated by the hirer of the aircraft) was 30 lbs. This figure was included in the weight of 65 lbs which was given for baggage.

1.7 Meteorological Information

The Pilot of G-ILTS phoned into the Meteorological Office at Bracknell, UK at 0845 hours and received a route forecast for the intended flight. The local area forecast conditions for Gorey, were given as follows;

Wind (Direction/Speed).	@ 1000' 020°/30 Kts.
Visibility.	15 Km.
Significant Weather.	Nil.
Cloud.	2-5/8 SC 4000/6000.
Temp.	+6° C.

The actual local conditions as assessed by the Pilot, were as follows:-

Wind (Direction/Speed).	Light N.N.Westerly.
Visibility.	10 Km.
Significant Weather.	Nil.
Cloud.	Overcast.
Temp.	+6° C.

1.8 Aids to Navigation

Not applicable.

1.9 Communications

Not applicable.

1.10 Aerodrome Information

1.10.1 General

The private airstrip is contained within the centre section of a farmers cultivated field. The surface condition at the time of the accident was slightly soft, with lush grass, mown to 4 inches and covered with a morning dew.

1.10.2 Runway Survey

A survey of Runway 26/08 revealed that the total length of the strip is 505 metres long and 25 metres wide. Runway usable length is approximately 450 metres. A hanger and concrete apron area is situated to the right of the threshold of Runway 26. The taxiway connection between the apron and the edge of the runway is partially made up of a concrete ramp.

The length and gradient from the centre of the apron to the centreline of the runway is 35 metres and $+1.72^\circ$, respectively. The initial take-off run along the runway covered an uphill gradient of $+1.36^\circ$ over 175 metres. The overall gradient for Runway 26 is $+0.52^\circ$

1.11 Flight Recorders

Not fitted and not required.

1.12 Wreckage and impact damage

Both main undercarriage legs were torn off on the initial impact in the field of newly planted saplings. The damage to the left side of the fin and rudder was consistent with these surfaces being struck by the left undercarriage leg as it separated from the aircraft. The aircraft then slid on its nose wheel and tail for approximately 128 metres. The initial ground marks indicate that the main load of the landing was taken by the main wheels and that the nose wheel impacted relatively lightly.

The aileron and elevator control surfaces moved fully and freely and were all connected. The rudder was connected but movement was impeded by the impact damage to the left surface of the fin and rudder.

The flaps were also connected, but movement was restricted by impact damage in the area of the inner trailing edge and fuselage fairings. Both fuel tanks remained intact and were approximately 2/3 full.

On closer inspection of the port undercarriage leg, a fresh, rough scrap mark was found on the outside of the leg, which was consistent with a wire strike. The tyre on the same leg bore a deep fresh gash, 6.5 cm long and angled at 45° to the direction of flight. The port wheel was also found to be very loose. When disassembled, it was found that the spacer which should support the inner taper bearing race was missing. This permitted the bearing assembly to move approximately 5 mm along the axle from its correct position and permitted considerable wobble in the wheel when it rotated on its axle.

1.13 Medical and Pathological information

Not applicable.

1.14 Fire

There was no fire.

1.15 Survival aspects

Not applicable.

1.16 Test and Research

Tests carried out at the accident site showed that the propeller appeared to pull through some cylinders very easily. Because of the condition of the aircraft, it was not considered prudent to run the engine and therefore the compression check was done with the engine cold. The values obtained were as follows;

No 1 Cylinder 57/80
No 4 Cylinder 74/80
No 5 Cylinder 52/80
No 2 Cylinder 72/80
No 3 Cylinder 78/80
No 6 Cylinder 72/80

The tests were repeated and consistent repeat values were found.

The magneto's were also checked. Timing on the right magneto was correct, while timing on the left magneto was out by approximately 2°.

When the aircraft was shipped back to the UK, the engine was run on the airframe. No abnormality was noted, but a full power check could not be done due to the set-up used to run the engine.

1.17 Organisational and management information.

The hirer (and previous owner) of G-ILTS had significant experience (approximately 1000 hours) on type and had operated from a number of similar type airfields. Under normal circumstances, he would have operated this particular flight himself, except for the fact that he was classed as medically unfit to fly, due to an ankle injury. His decision to operate to and from Warren's airfield was based on the known runway length of 550 yards and the fact that he had operated from airfields of similar length, without incident.

In discussions with the pilot of G-ILTS, it was noted that he had limited experience of operating to and from marginal grass airfields. He indicated that in being offered a flight such as this, it afforded him the opportunity to gain experience in international flying, which would otherwise be difficult for him to obtain.

He further indicated that his decision process and level of confidence to carry out such a flight, was enhanced by the knowledge that the hirer had amassed a lot of experience in this type of operation, and in this particular aircraft.

1.18 Additional information

1.18.1 Notification of accident

The hirer of the aircraft phoned the Garda Síochána at Gorey at 1100 hours on the day of the accident and informed them that the aircraft was in Richard Warren's field and could not be moved for a couple of days. As he was concerned for the safety of the aircraft, in particular that it might be vandalised, he requested that the Gardaí keep an eye on it during routine patrols. The Air Accident Investigation Unit (AAIU) was notified of the accident by the hirer of the aircraft at 1615 hours on the same day. The hirer stated that the aircraft struck a fence during take-off, and on hearing an unusual sound from the engine, the pilot elected to land back-on into a nearby field. General details and a description of damage sustained to the aircraft was also given.

A phone call by the AAIU at 1630 hours to the Gardaí in Gorey, indicated that they were not aware that the aircraft had actually crashed. Furthermore, the Gardaí stated that the hirer had given no intimation that the aircraft had crashed during the phone call earlier in the day. On request from the AAIU, the Gardaí visited the crash site and statements were taken at Borleigh Manor, Gorey at 1900 hours on the 12th November 1996 from both the hirer and the Pilot in Command of G-ILTS.

1.18.2 Post Accident Interview with Pilot

The pilot of G-ILTS was interviewed at the accident site at 1130 hours on the 13th November 1996. He stated that as an unfamiliar sound was coming from the engine and coupled with the fact that the aircraft just did not feel right, he elected to carry out an emergency landing.

When questioned about the broken fence, he stated that he did not know why the fence was broken, and further stated that he was sure that he did not strike the fence with the aircraft.

1.18.3 Pilot/Hirer Statements

Both the Pilot and the Hirer made signed statements to the Garda Síochána. Copies of these statements were made available to the AAIU a number of days after the accident.

An extract from the Pilot's statement reads; *"The aircraft took off touching the fence on take-off and the aircraft did not sound normal. I carried out an emergency landing straight ahead."*

An extract from the Hirers statement reads; *"The aircraft took-off touching the fence at the end of the runway on departure, the aircraft sounded not quite right and the pilot elected to make an emergency landing in a clear field straight ahead."*

1.18.4 Examination of runway tyre marks

Two deep tyre marks found on the grass runway the following day, confirmed that the aircraft bounced twice before finally becoming airborne. The first tyre mark, located 57 metres out from the boundary fence, and 2.2 metres from the left side of the runway edge on a heading of 250°, indicated that the port main undercarriage wheel came in contact with the ground and travelled a total of 8 metres along the runway before becoming airborne again.

The second tyre mark, which was a further 5 metres on (44 metres from boundary fence) and 3.2 metres from the left side of the runway edge, on a heading of 250°, indicated that the starboard main undercarriage wheel came in contact with the ground for a distance of 8 metres, before the aircraft finally became airborne with 36 metres to run to the fence.

1.18.5 Aircraft Performance

The Piper aircraft Operating Manual VB-792 indicates that take-off distance required, from rest to 50 feet, at maximum permitted take-off weight from a dry tarmac surface, on a uniform runway slope of +0.52°, with wind calm and temperature of +6°C, is 1750 feet/533 metres.

The manual notes that, for operation from a short, dry grass runway, the distances for a dry tarmac runway should be increased by 6.5%. This would increase the take-off distance to 1864 feet/568 metres. The effect of a non-uniform slope and long damp grass cannot be determined from the chart, however it would increase the overall distance required. Furthermore, the above values are based on the C of G being within limits and the engine developing take-off power with lift off @ 62 KIAS (105 ft/sec). If the aircraft was loaded such that it is over weight, or that the weight on the nose was heavy, the take-off distance would increase further.

1.18.6 Wheel Bearings

The aircraft log book indicates that the port wheel bearings were replaced on the 2 October 1996, at 4030 hours total airframe time.

2 Analysis

2.1 An exact calculation of take-off weight and centre of gravity position could not be determined as personal belongings and survival equipment had been removed from the aircraft prior to the arrival of the investigation team.

2.2 No aircraft weight calculations were completed by the pilot prior to take-off. However, estimated figures submitted by him on his accident report form indicate that he believed that the aircraft was 53.3 lbs below MAUW.

- 2.3 The estimated weight given for baggage was 65 lbs. This figure included personal belongings for five people on a mid-week break in Paris, and the survival equipment as stated on the flight plan.
- 2.4 A survey of Warren's Airstrip confirmed that the overall length of the runway was 505 metres. When the turning arc performed by the pilot from the apron to the centreline of the runway is taken into account, and allowing for a safe distance to clear the fence, the usable runway length reduces to approximately 450 metres.
- 2.5 The taxiway connection between the apron and the runway had a gradient of $+1.72^\circ$ over 35 metres.
- 2.6 The initial take-off run along the runway had an uphill gradient of $+1.36^\circ$ over a distance of 175 metres. The overall gradient for the runway was calculated as $+0.52^\circ$.
- 2.7 The runway surface condition at the time of the accident was slightly soft, with lush grass mown to 4 inches with a covering of a morning dew.
- 2.8 The last indicated airspeed (IAS) observed by the pilot during the take-off run was somewhere between 55 and 60 KIAS. The recommended take-off speed at MAUW is 62 KIAS.
- 2.9 Two deep tyre marks found near the end of Runway 26 indicates that the aircraft had difficulty in becoming airborne.
- 2.10 Two cylinders were found to be slightly soft when checked cold at the accident site. Further checks carried out at less than full power in the UK indicated no abnormality. While a full power check could not be completed it is likely that power loss, if any, would be marginal, i.e. in the region of 1%.
- 2.11 The port wheel was found to be loose as a result of a spacer being missing from the wheel assembly. This may have caused the aircraft to veer to the left as indicated by the marks found on the runway. Furthermore, the unfamiliar noise heard by the pilot during take-off may have come from this particular wheel.

3 **Conclusions**

(a) **Findings**

- (i) The pilot was properly licensed, medically fit and adequately rested to conduct the flight.
- (ii) The aircraft had a valid Certificate of Airworthiness.

- (iii) Other than a missing spacer on the port wheel, there was no evidence of any malfunction in the aircraft which could have directly caused or contributed to this accident.
- (v) As no weight and balance calculations were performed prior to take-off, the pilot was unaware of the true field performance of his aircraft during the take-off run.
- (vi) The baggage and survival equipment weight of 65 lbs as stated in the Pilot's Accident Report Form is considered an under estimate of the actual weight onboard the aircraft at the time of impact. It is probable that the aircraft was at, or over the MAUW of 3400 lbs.
- (iv) The aircraft experienced difficulty in becoming airborne as indicated by tyre marks found on the runway.
- (v) The aircraft's failure to reach a safe fly-away speed within the usable runway length available was due to reduced accelerative performance, which was caused by the combined effects of the aircraft being at or over MAUW, the severity of the initial gradient, and the runway surface conditions prevailing at the time of departure.
- (vi) No advantage was achieved by commencing the take-off run from the ramp area. In fact it is possible that due to the severity of the initial gradient, acceleration would have been slower, than if the aircraft commenced its run from the runway threshold.
- (vii) The aircraft finally became airborne 36 metres before the end of the runway and struck the boundary fence with its main undercarriage.
- (viii) The flight profile experienced by the Pilot after impacting the fence was such that the aircraft could not achieve any climb performance and struggled to maintain flight.
- (ix) The decision by the Pilot to re-land the aircraft was the best option taken under the particular circumstances.
- (x) The delayed notification of the accident to the AAIU, and subsequent removal of personal baggage, survival equipment and items of impact damage prior to the arrival of the investigation team, hindered the investigation.

(b) Cause

Failure of the Pilot to ensure that the aircraft was configured at such a weight that would allow for an adequate safety margin when departing from a marginal airstrip.

(c) Contributory Factors

Failure of the Pilot to fully appreciate the effects that runway surface condition and gradient can have on aircraft performance during take-off.

4 Safety Recommendations

4.1 That pilots of General Aviation aircraft should be reminded of the importance of calculating aircraft weight and C of G position, thereby ensuring that their aircraft has adequate performance for the proposed flight. **(SR 3 of 1999)**

4.2 That factors such as wind conditions, runway gradient, surface condition and safety margins be included in the performance calculations. **(SR 4 of 1999)**