



Federal Public Service
Mobility and Transport
Air Accident Investigation Unit

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Safety Investigation Report

ACCIDENT TO PIPER PA-18-95 SUPER CUB REGISTERED OO-KKK IN THEUX ON 16 OCTOBER 2011

Ref. AAIU-2011-25
Issue date: 2012
Status: Final R1

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FOREWORD

This report is a technical document that reflects the views of the investigation team on the circumstances that led to the accident.

In accordance with Annex 13 of the Convention on International Civil Aviation, it is not the purpose of aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the Final Report is the determination of the causes, and define recommendations in order to prevent future accidents and incidents.

In particular, Art. 17.3 of EU Regulation 996/2010 stipulates that a safety recommendation shall in no case create a presumption of blame or liability for an accident, serious incident or incident.

Unless otherwise indicated, recommendations in this report are addressed to the Regulatory Authorities of the State having responsibility for the matters with which the recommendation is concerned. It is for those Authorities to decide what action is taken.

The investigation was conducted by L. Blendeman, H. Metillon and S. Laureys. The report was compiled by S. Laureys.

NOTE:

For the purpose of this report, time will be indicated in UTC, unless otherwise specified.

SYMBOLS AND ABBREVIATIONS

'	Minute
°	Degree
°C	Degrees centigrade
A/C	Aircraft
ACTT	Aircraft Total Time
AGL	Above Ground Level
ASBL	Association Sans But Lucrative (Association without lucrative purpose)
ATC	Air Traffic Control
BCAA	Belgian Civil Aviation Authority
CAVOK	Ceiling And Visibility Okay
CET	Central European Time
DA	Density Altitude
E	East
EASA	European Aviation Safety Agency
EBSP	Airfield of Spa La Sauveniere
FAA	Federal Aviation Administration
FH	Flight Hour
FISO	Flight Information Service Officer
ft	Foot (Feet)
ft/min	Feet per Minute
gal	Gallon
hp	Horsepower
hPa	Hectopascal
in-lbs	Inch Pounds
ISA	International Standard Atmosphere
K	Kelvin
lbs	Pounds
LH	Left-Hand
m	Meter(s)
METAR	Meteorological Aerodrome Report
MHz	Megahertz
Mph	Miles per Hour
N	North
NDT	Non Destructive Test
nm	Nautical mile(s)
NTSB	National Transport Safety Board
O/H	Overhaul
PIC	Pilot In Command
QFE	Pressure setting to indicate height above aerodrome
QFU	Magnetic bearing of the runway
QNH	Pressure setting to indicate elevation above mean sea level
RH	Right-Hand
RPM	Revolutions per Minute
RWY	Runway
SEP	Single Engine Piston rating
S	South
SL	Sea Level
TN	Technical Note
TODA	Take-off Distance Available
TODR	Take-off Distance Required
TORA	Take-off Run Available
TORR	Take-off Run Required
UTC	Universal Time Coordinated
W	West

SYNOPSIS

Date and hour

16 October 2011 at 15:00 UTC

Aircraft

Piper PA-18-95 (ex L-18C), Super Cub
(Annex II, EC216/2008)

Accident location

The airplane crashed just after take-off in a field near the airfield of Verviers/Theux approx 455 meters from the end of runway 06 with its nose southbound. (N 50° 33,354' - E 005°51,761')

Aircraft owner

Royal Verviers Aviation ASBL

Type of flight

Local flight

Phase

Initial climb

Persons on board

2

Abstract

At about 15:00 UTC, the airplane took off from the airfield of Verviers/Theux (EBTX) for a local flight. Reportedly, the aircraft had some difficulties to speed up and to gain height. Just after crossing the highway, nearly bordering the airfield, the aircraft flipped to the right and crashed in a field. Both occupants were killed upon impact.



Figure 1: Piper Super Cub OO-KKK

1. Factual information.

1.1 History of flight.

That noon, the pilot and passenger (who also was a pilot) gathered at the club and made plans to take pictures of a Jodel D9 ('le Bébé Jodel') in flight. The pilot of the Jodel prepared for flight, but due to a misunderstanding, the OO-KKK was booked by another pilot.

After 2 local flights, the OO-KKK finally returned to the airfield at 14:52 UTC and was parked in front of the clubhouse. The aircraft was left secure with all switches in off position (also master and ignition switch), mixture control in idle cut-off position and the fuel tank selector valve on the right fuel tank. Each tank was indicating approximately half full. The elevator trim was left in the landing position, approximately in neutral stand.

The Jodel already being airborne, the pilot and the passenger were eager to take-off with OO-KKK. The passenger rushed to the clubhouse to take the aircrafts documents. He and the pilot flying got in the aircraft and started to taxi. Reportedly, they were very hurried and excited to do the flight and take pictures. The runway in use was runway 06, with the sun in the back.

Reportedly; they started their take-off roll from the middle of the runway. A witness declared that the aircraft had a high angle of attack and the tail wheel was still on the ground when it lifted off. When the aircraft passed in front of the clubhouse at a few meters height, it had some difficulties to speed up and to gain height, although reportedly the engine was running smoothly. Just after crossing the highway, nearly bordering the airfield, the aircraft first turned to the left, followed by a flip and descent to the right after which it crashed in a field. Both occupants were killed upon impact.

1.2 Injuries to persons.

Injuries	Pilot	Passenger	Others	Total
Fatal	1	1	0	2
Serious	0	0	0	0
Minor	0	0	0	0
None	0	0	0	0
Total	1	1	0	2

1.3 Damage to aircraft.

The aircraft was totally destroyed



Figure 2: The crashed airplane

1.4 Other damage.

There was no other damage.

1.5 Personnel information.

1.5.1 Pilot in command (front seat)

Sex: Male
Age: 66 years old
Nationality: Belgian
Licence: Private Pilot License issued on 19 August 2005, last renewal on 03 April 2008. Valid until 07 March 2013.

Rating SEP(Land) valid until 31 March 2012.

Medical Certificate: Class 2 Certificate Issued on 24 February 2011. This certificate was valid until 26 February 2012.

Experience: Total experience around 400 FH among which 300 FH as PIC

Recent experience on PA-18 (last 12 months):
OO-KKK (95 hp): 08:53
OO-LVZ (95 hp): 00:26
OO-VVH (180 hp -glider towing): 19:06
Total: 28:25

1.5.2 Passenger (aft seat)

Sex: Male
Age: 55 years old
Nationality: Belgian
Licence: Private Pilot License issued on 05 September 1992, last renewal on 19 April 2011. Valid until 21 September 2014.

Rating SEP(Land) valid until 28 February 2013.
Rating TMG valid until 30 April 2013

Night Flight
Rating English valid until 28 January 2012.

Medical Certificate: Class 2 Certificate Issued on 18 June 2011. This certificate was valid until 05 July 2012.

Experience: Total experience of more than 1200 FH with extensive experience on PA-18

1.6 Aircraft information.

1.6.1 General description

The Piper PA-18 Super Cub is a two-seat, high wing, single-engine and fixed landing gear landplane, developed from the Piper PA-11. It was the ultimate development of Piper's original aircraft, the J-3 Cub. As the original Cub, the two seats are positioned one in front of the other one (tandem). It was certified with 5 engines:

- 95 hp with a Continental C-90 or O-200;
- 105 hp with a Lycoming O-235;
- 125 hp with a Lycoming O-290-D;
- 135 hp with a Lycoming O-290-D2;
- 150 hp with a Lycoming O-320.

The original PA-18-95 had a single 18-gallon fuel tank in the left wing. An optional 18-gallon tank in the right wing could be installed under the Type Certificate. The military variant of the PA-18-95 was designated the L-18C Super Cub and has a transparent cockpit enclosure instead of a fabric enclosure. Back in civilian use, it was designated PA-18-95 but also PA-19.

The production finally stopped in 1994 after building more than 9000 aircraft. Some aircraft were later modified with a 180 hp Lycoming O-360 engine under a Supplemental Type Certificate.

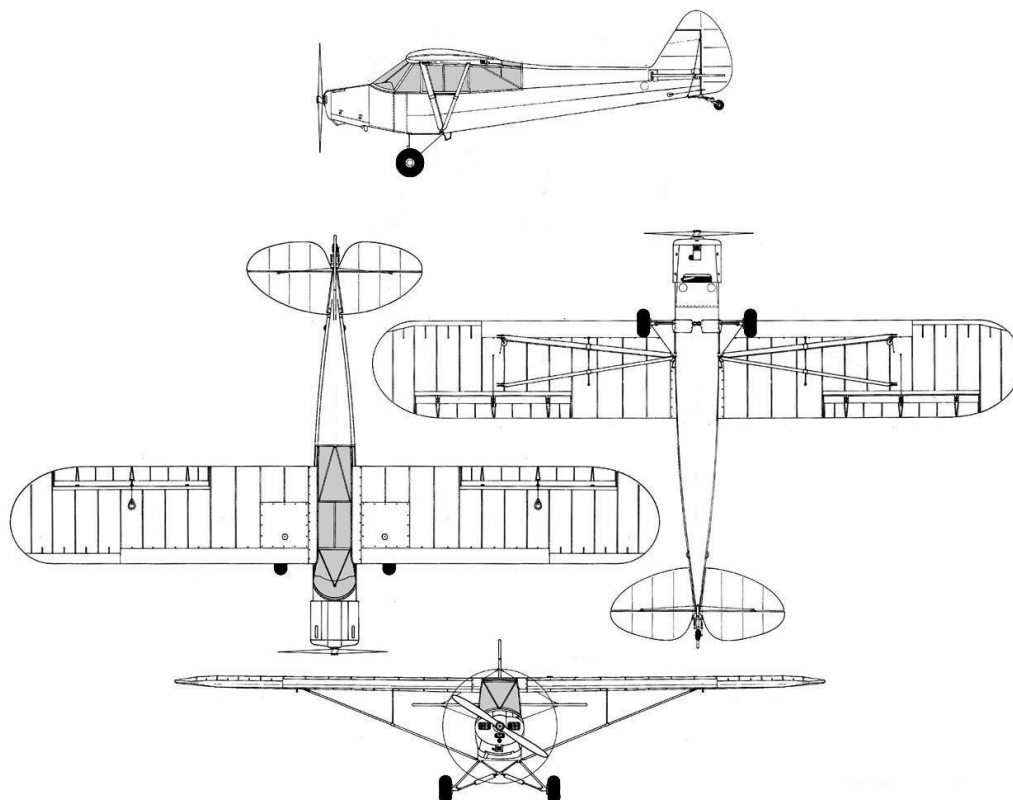
It was first certificated on 18 November 1949 by the US FAA and holds Type Certificate N° 1A2, current revision 38.

Characteristics:

Crew:	2
Length:	22.4 ft (6,7 m)
Height:	6.7 ft (1,8 m)
Wingspan:	35.3 ft (10,66 m)
HP and RPM:	90 at 2475
Wing area:	178.5 ft ² (16,58 m ²)
Standard Empty Weight:	800 lbs (362 kg)
Basic Empty weight:	985 lbs (446 kg)
Max take-off weight:	1,500 lbs (680 kg)
Fuel:	two 18 US gallon tanks – Avgas

Performance (from the 'Aircraft Owner's Handbook P/N 752-398'):

Maximum speed V _{NO} :	112 mph (97 knots)
Cruise speed V _c :	100 mph (87 knots) (75% power mph)
Stall speed V _s :	42 mph (36 knots)
Cruising range:	360 nm at 75% power
Service ceiling:	15,750 ft
Rate of climb (SL):	710 ft/min
Take-off run:	390 ft (119 m)
Take-off over 50 ft barrier:	750 ft (229 m)
Fuel consumption:	5 gal/h at 75% power



1.6.2 Airframe.

Manufacturer:	PIPER
Type:	PA-18-95 (ex L-18C with transparent cockpit enclosure)
Serial number:	18-3155
Built year:	1953
Total flight hours:	8553:51 hours
Owner:	Royal Verviers Aviation ASBL.
Certificate of Registration:	N°3249, issued on May 18, 1983 by the BCAA
Certificate of Airworthiness:	N°3249, initially issued on April 23, 1981 by the BCAA. Last issued on May 23, 2011 by BCAA, valid until March, 2012.

1.6.3 Engine.

Manufacturer:	CONTINENTAL
Type:	O-200-A
Serial number:	285248-R
Total flight hours:	4451:19 hours
Total flight hours since O/H:	2126:19 hours
Engine O/H date:	April 2001

1.6.4 Propeller

Manufacturer:	SENENICH
Model:	M76AK-2-42
Serial number:	23793
Type:	Metal, fixed pitch
Total flight hours:	4136:11 hours
Total flight hours since O/H:	126:40 hours

Reportedly, the propeller with 42" pitch is a compromise between a climb and a cruise propeller.

1.6.5 Maintenance

The last maintenance tasks performed on OO-KKK, as recorded, were:

- "1000 FH" maintenance, performed on 30 March 2011 at 8427:11 ACTT
- "100 FH" maintenance, performed on 29 August 2011 at 8522:37 ACTT.
- "25 FH" maintenance, performed on 25 September 2011 at 8542:44 ACTT.

During the last 1000FH maintenance, the propeller was replaced and a 500FH inspection of the magnetos was performed in accordance with BCAA TN 92-01 R1.

The maintenance tasks were performed by Royal Verviers Aviation ASBL which holds an EASA Part M Subpart F approval.

1.6.6 Weight and balance.

The aircraft was last weighted on February 25, 2006. Total basic empty was weight 985 lbs (5 quarts oil included) and centre of gravity was 15,3 inches from the wing leading edge (= reference datum).

The pilot who flew with the aircraft before the fatal flight declared that the fuel gauge indicated half tanks when he landed.

One can indicate the weight and the centre of gravity at time of take-off on the Weight and Balance graph from the Type Certificate Datasheet.

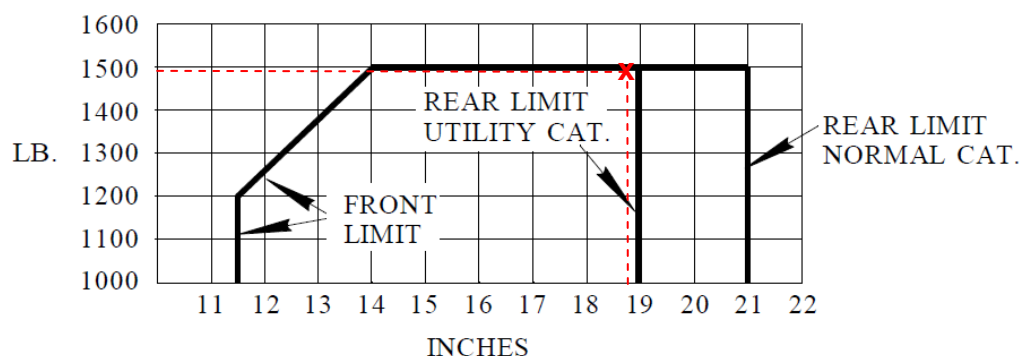


Figure 3: Weight and balance from Type Certificate Datasheet

1.6.7 Incident history.

In the past, OO-KKK was involved in 3 accidents:

In December 1995, the aircraft made an emergency landing after the engine stopped running when climbing in upwind after take-off from EBTX. The pilot managed to control the aircraft but he had to fly under the high voltage lines. He land straight ahead in a field in the environment of the airfield. No damages were found.

In July, 2005, there was a loss of control during a high speed landing on runway 24 of EBTX. When trying to stop the aircraft, it rolled to the right and the right wing touched the ground. The aft longeron and the aileron were damaged. The fuselage also was slightly deformed at the left side of the tail. The deformed parts were removed and replaced. An NDT inspection was performed without any findings.

In 2010, there was a collision of OO-KKK with another aircraft whilst taxiing at low speed. The supports of the right wing were hit causing dents. The supports were removed and replaced.

1.6.8 Flight manual.

An Aircraft Owner's Handbook with P/N 752-398 is still available from the manufacturer. This book contains information on performance, operating and systems but is in no way a substitute for a Flight Manual.

The Flight Manual that was found on board has as reference number AN 01-140DEA-1. This contains general instructions; however there are only figures and tables available for the PA-18-125 (military designation L-21A). The applicable Flight Manual could not be found.

Some relevant extracts:

From SECTION II NORMAL PROCEDURES

TAXIING INSTRUCTIONS.

6. Because of the restricted forward visibility when the airplane is in a three point position, S-turn the airplane while taxiing to provide a clear, unrestricted forward view.

UPWIND TAXIING.

Hold control stick as far to the rear as possible to hold the tail of the airplane down. This holds the tail wheel firmly on the ground to insure proper steering action.

DOWNWIND TAXIING.

Hold control forward to keep the tail from being lifted off the ground as a result of wind pressure building up beneath the elevators.

BEFORE TAKE-OFF. PRE-FLIGHT AIRPLANE CHECK

CAUTION

To avoid "wake turbulence", allow a minimum of two minutes before taking off or landing behind a heavier aircraft. This will permit the lateral displacement of the phenomena of "wing tip vortices"....

...A lighter aircraft penetrating the center of a vortex core would be subjected to vertical airflow having a downward direction on one wing and an upward direction on the other. A light plane will roll very rapidly, the roll being much more than the available control could produce and therefore more than it could counteract.

1. Fasten shoulder harness.
2. Recheck all flight controls for free and easy movement.
3. Recheck stabilizer trim control. Center the position indicator.
4. Altimeter set.
5. Flaps full up.
6. Carburetor heat control OFF.

7. Mixture control RICH.
8. Engine primer in and locked.
9. Adjust cabin heat control if necessary.

Normal take-off



TAKE-OFF.

NORMAL TAKE-OFF.

1. Observe and check for the approach of any aircraft. If none, release brakes and roll into take-off position, airplane lined up with runway.
2. Advance throttle smoothly to full OPEN.
3. When the airplane has gained sufficient speed (35-40 mph), **raise the tail** slightly.
4. When flying speed has been reached, allow the airplane to fly itself off the ground, using only slight back pressure on the control stick.
5. The normal take-off speed for this airplane is approximately 50 mph.

AFTER TAKE-OFF.

1. After the airplane is definitely airborne, retard throttle to 2300 rpm.
2. Trim airplane if necessary.

CLIMB.

The best climb rate is attained at 70 mph indicated airspeed, with the engine at full throttle.

From SECTION III EMERGENCY PROCEDURES

ENGINE FAILURE AFTER TAKE-OFF.

If the engine should fail immediately after take-off, proceed as follows:

1. Lower the nose quickly to maintain airspeed above stalling.
2. Only if time permits, check fuel gauges and fuel selector valve.
3. If landing is inevitable, move throttle to CLOSED.
4. Fuel selector valve OFF.
5. Ignition switch OFF.
6. Master switch OFF unless lights are needed.
7. LAND STRAIGHT AHEAD, changing direction only enough to avoid obstacles. DON'T try to turn back. A crash landing straight ahead, with the airplane under control, is far safer than the chancing of an uncontrolled roll into the ground.

From SECTION VI FLIGHT CHARACTERISTICS

**STALL.
STALL CHARACTERISTICS.**

The stall characteristics of this airplane are conventional and not violent. You can feel a normal stall approaching by the increasing loss in effectiveness of the controls and a “mushy” sinking feeling of the airplane. Increases in control movements are required. When the stall approaches, there is a shuddering of the airplane and a dropping of the nose or the wing. However, because of the excellent stability of the airplane, before it has time to fall off, it will have flown itself out off the stall.

STALL RECOVERY.

The missions for which this airplane was intended demand slow flight, approach, and climb-out speeds which are very close to the actual stalling speed, therefore the stall recovery can be made with a minimum loss of altitude. The airplane can be recovered very readily from a partial stall by reducing back pressure on the control stick or by adding sufficient power to maintain control of the airplane. An excessive amount of altitude will be lost if the control stick is moved quickly too far forward in an attempt to dive the airplane to regain flying speed. The standard procedure in recovering from a stall is as follows:

1. Ease the control stick forward quickly and smoothly. Avoid jamming or snapping the control stick forward abruptly, to prevent an undesirable nose-low altitude. Also if it is moved ahead too slowly, the recovery will not be clean. Do not allow the nose do drop too far below the horizon.
2. At the same time, advance the throttle slowly and smoothly.
3. Apply opposite rudder at the first indication of the dropping of either wing.
4. Use aileron to reduce slipping and skidding. After the nose has been lowered, speed will increase rapidly.
5. After you have reached safe flying speed, raise the nose to level flight with gradual steady back pressure on the stick to resume flight.

CAUTION

Because of the high effectiveness of the elevator at stalling speeds, abrupt or rough use of the elevator can cause an accelerated or high speed stall.

1.6.9 Adjustable stabilizer.

The aircraft is fitted with an adjustable stabilizer having the same function and effect as a moveable trim tab. Linkages pivot the horizontal stabilizer about its rear spar. This is accomplished by use of a jackscrew mounted on the leading edge of the stabilizer. This jackscrew is cable operated with a trim control in the cockpit. Turning the control NOSE UP lowers the leading edge of the stabilizer and generates a downward force on it, causing the aircraft to pitch up. Turning the control NOSE DOWN raises the leading edge of the stabilizer and generates an upward force on the stabilizer, causing the aircraft to pitch down.

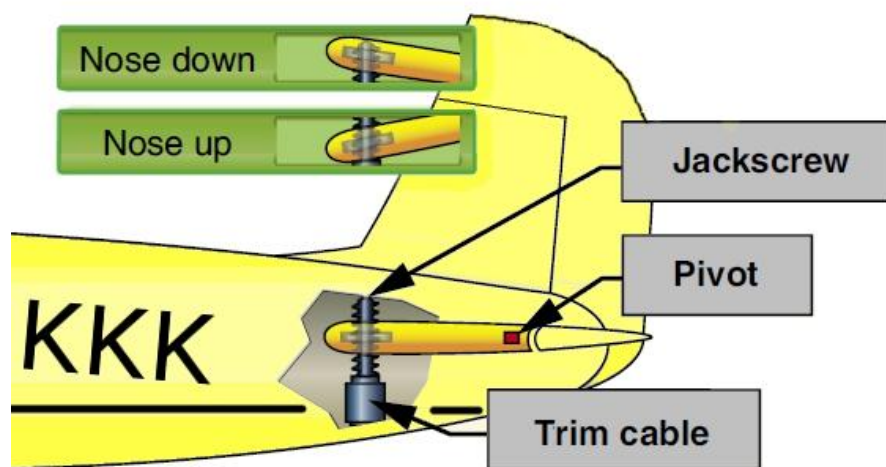


Figure 4: Adjustable stabilizer



Figure 5: Example of a stabilizer in full nose up position. Notice the up-position of the elevator

The stabilizer trim control is mounted on the left side wall at the lower rear of the front seat from where it is also reachable from the back seat. A stabilizer position indicator in the mounting plate of the control indicates the nose attitude of the airplane.



Figure 6: Stabilizer trim control of another PA-18

1.7 Meteorological conditions.

At the time of the take-off, the sun was almost in the west. On Sunday October, 16 the sunset in Liège (30 km of EBTX) was at 16:44 UTC.

The METAR taken at EBSP (8,5 km of EBTX) at the time of the crash is as follows;

At 14:50 UTC

METAR EBSP 161450Z AUTO 20004KT 170V250 CAVOK 14/03 Q1024=

At 15:20 UTC

METAR EBSP 161520Z AUTO 22003KT 170V260 CAVOK 14/05 Q1024=

In other words, between 14:50 and 15:20 UTC parameters were as following:

- Wind: Direction: coming from 200° and varying between 170° and 260°
 Speed: 3-4 knots
- Visibility: CAVOK, +10km
- Clouds: Sky clear
- QNH: 1024 hPa
- Temperature: 14°C
- Dew point: 03°-05°C
- No significant change expected in the next 2 hours.

1.8 Aids to navigation.

Not applicable to this accident.

1.9 Communication.

The aircraft was equipped with a Bendix/King KY-97A communication radio.

There were no reported discrepancies in the communications facilities. During taxiing there was radio contact with AFIS Theux. According to the airfield commander, who was the FISO that day, the pilot's last report was "ready for take-off" before starting to roll.

1.10 Aerodrome information.

EBTX, Verviers/Theux airfield (also called "Aérodrome du Laboru") is located 3,5 km south of the city of Verviers and approx. 400m from the E42 highway between Liège and Sankt-Vith.

Address:

ASBL Royal Verviers Aviation
Route d'Oneux, 79
B - 4800 Verviers

- Coordinates: 503309N - 0055118E
- Elevation: 1099 ft (330 m)
- Runway QFU: 063° / 243°
- Runway dimensions: 732m x 18
- Slope: Runway 06 upslope of 2%
- Surface: grass
- Runway strength: 2000 kg
- Operation hours: MON - FRI: 14:00 (CET) – sunset
SAT, SUN, HOL: 10:00 (CET) - sunset
Outside these periods: prior notice required
24 HRS
- AFIS: "Theux Radio" - 119.000 MHz - INFO only,
no ATC

- Mixed activity (airplanes and gliders).
- Jet aircraft operations not allowed
- Motorway lighting 300m from the end of RWY 06, **locally lowered to 15 ft AGL**
- High voltage line 650m from the end of RWY 06, 200 ft AGL

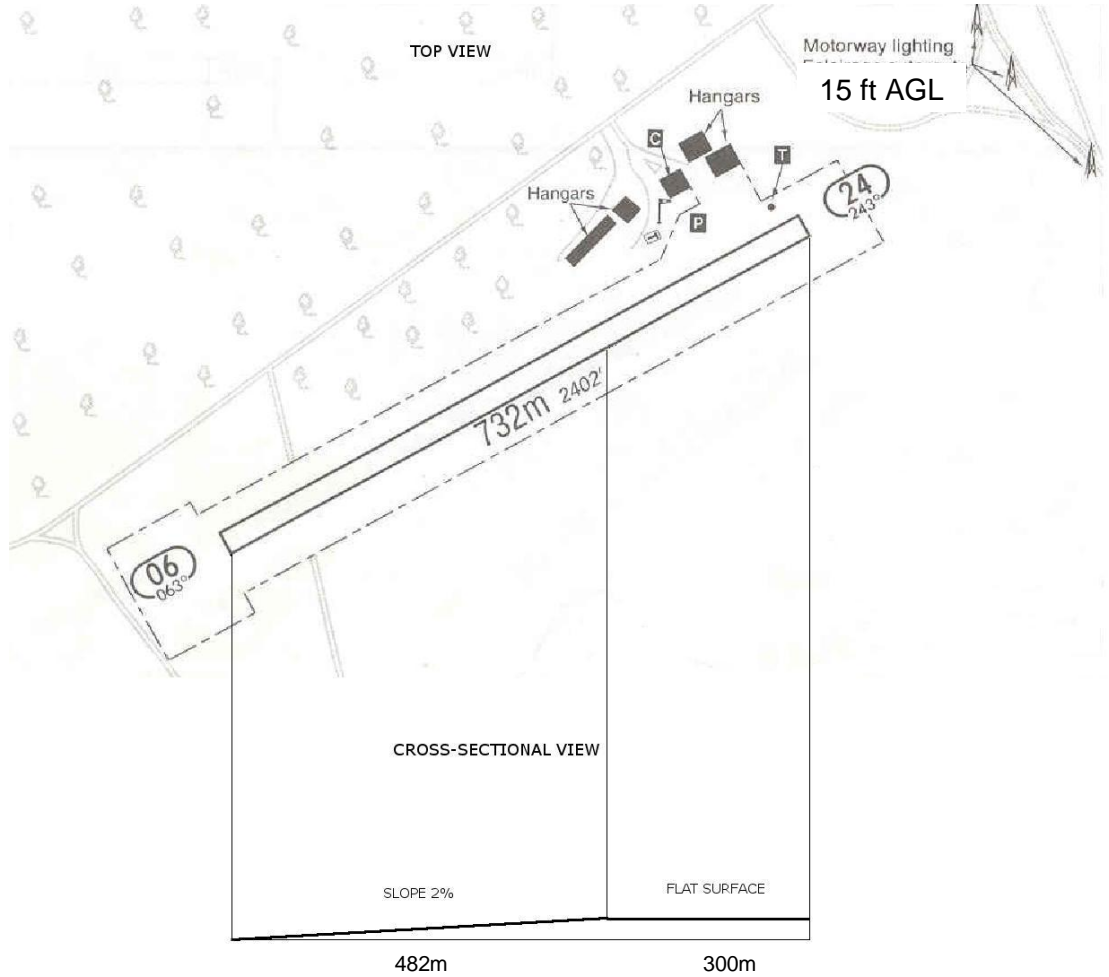


Figure 7: Layout of aerodrome

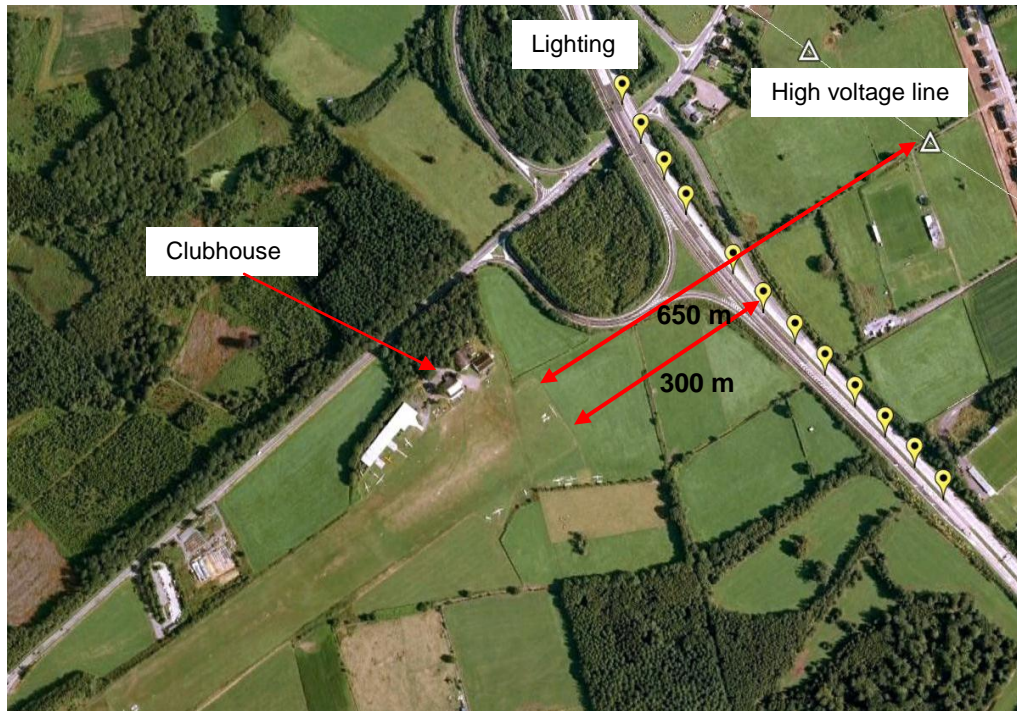


Figure 8: Photo of airfield

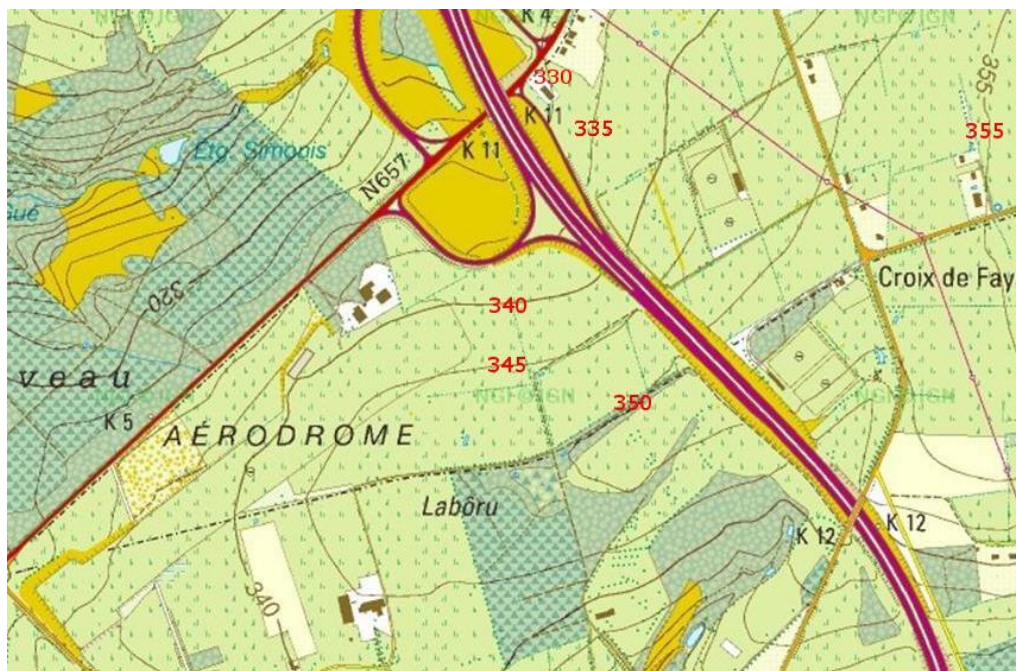


Figure 9: Topographic view of airfield

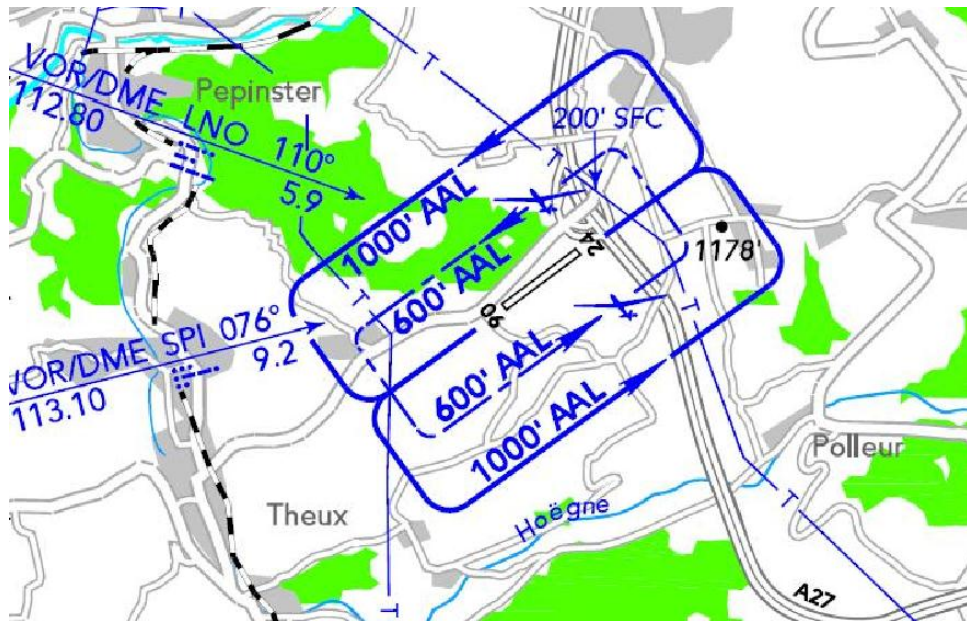


Figure 10: Aerodrome circuits

1.11 Flight recorders.

No flight or voice recorders were installed or required on this aircraft.

1.12 Wreckage and impact information.

1.12.1 Site of the accident.

The airplane crashed just after take-off in a field near the airfield of Verviers/Theux approx 455 meters from the end of runway 06 and approx 820 meters from the estimated runway point where they started with the take-off roll.

(N 50° 33,354' - E 005°51,761')

The aircraft impacted the ground with a pitch angle of 60° relative to the horizontal with its nose toward the south.

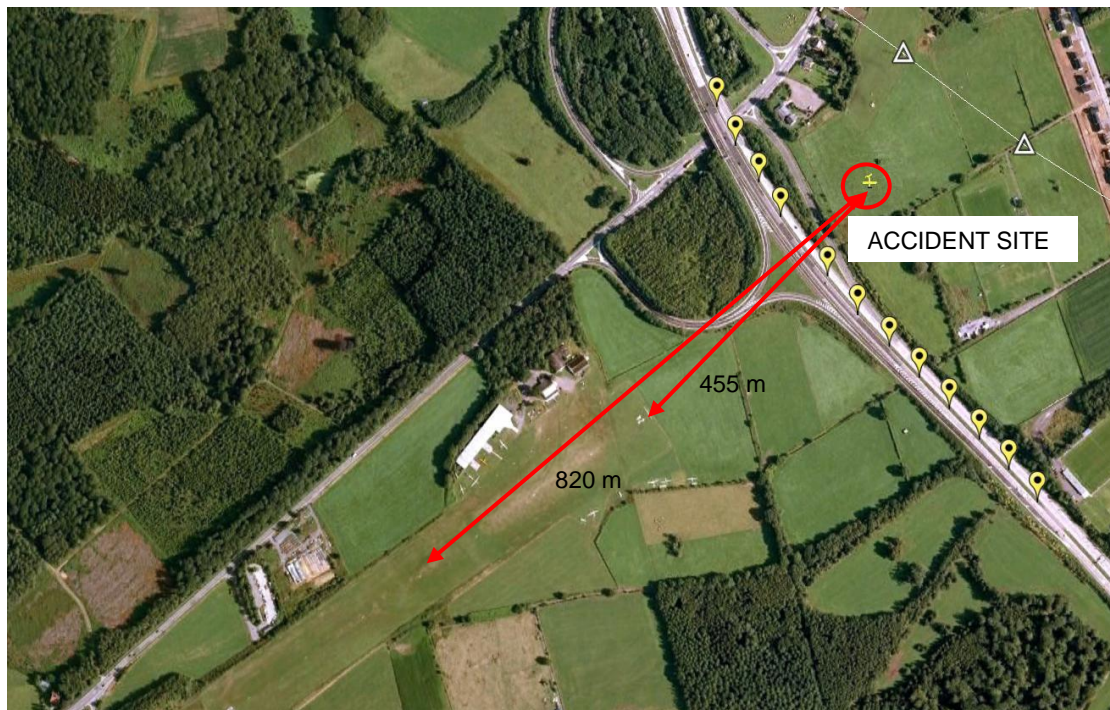


Figure 11: Accident site (with simulation of crashed aircraft)

1.12.1 Condition of aircraft wreckage

The cockpit was crushed and both wings had been partially torn from the fuselage. The whole tail had been broken off with a swing to the right. The propeller blades were completely bended.

Both fuel tanks were still intact and contained fuel.

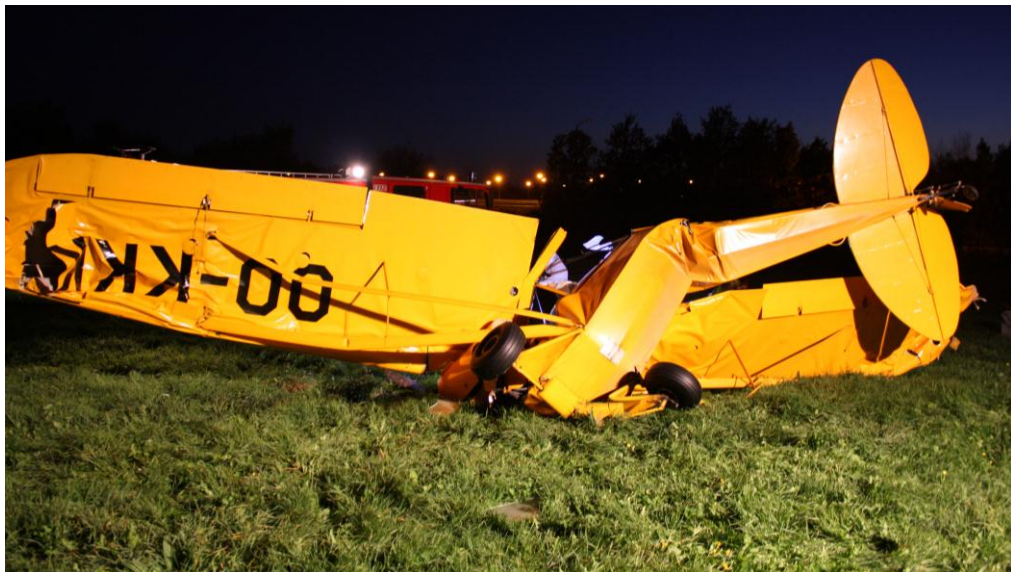


Figure 12: Wreckage

The aircraft wreckage was further examined on 18 October.

Fractures were inspected and it was determined that there was no pre-impact break-up.

The continuity of the control cables and the control linkages were checked.

The stabiliser trim jack screw was found in the full nose up position (leading edge of stabilizer down).



Figure 13: End position of trim jack screw

The engine was investigated. No pre-impact anomalies were found. The ignition system was still working. The float chamber of the carburettor was clean.

Tyre pressure was normal.

Positions of levers and controls in the cockpit

- Battery selector: Spare
- Mixture: Full rich

- Fuel tank selector: LH
- Carburetor heat: Off
- Throttle: $\frac{3}{4}$ open
- Ignition switch: LH magneto

The latter 4 levers are located on the left side of the pilot seat, under the window. However this side was squeezed during impact and found heavily damaged. The positions after the impact weren't reliable anymore.

1.13 Medical and pathological information

Both occupants died instantly from multiple injuries caused by the impact.

1.14 Fire.

There was no fire.

1.15 Survival aspects.

The pilot and the passenger both wore their ventral safety belt. A harness was not installed nor was it required. The safety belt of the pilot withstood the crash, but that of the passenger didn't. It was torn in two between the fuselage attachment point and the buckle.

For the pilot the accident was not survivable because he was crushed between the dashboard and his seat. However, the passenger's seat stayed on its place. The passenger was smashed forward causing its belt to tear. A harness could have increased his survival chances.

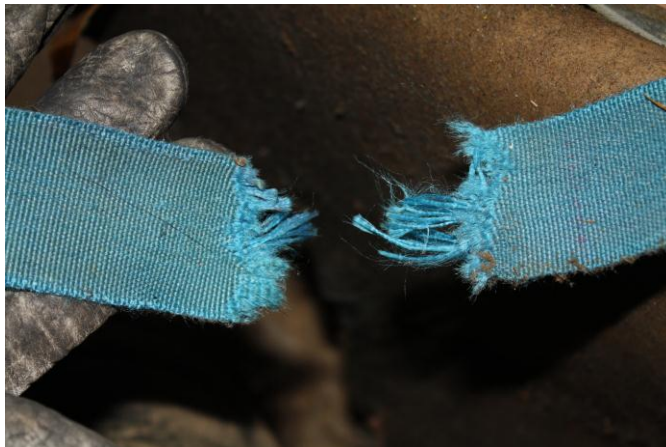


Figure 14: Torn seat-belt of passenger

1.16 Tests and research.

1.16.1 Analysis of required take-off distance

In the available Flight Manual, only the take-off distances for the PA 18-125 are given. However the Owner's Handbook mentions for the PA 18-95 a roll distance of 390 ft or 119m and a take-off (over 50 ft barrier) distance of 750 ft or 229 m. This figure is under standard conditions at sea level with a gross weight of 1500 lbs on a paved runway and zero wind.

Parameters influencing the take-off distance:

- Runway slope:
An uphill slope increases the take-off ground run. Runway 06 has an upslope of 2% for approx. 2/3 of its length. An upslope of 2% means a total take-off distance increase of 15%.

- Aircraft attitude:
When the airplane has gained sufficient speed, the tail has to be raised slightly to further increase speed. If not done properly, the aircraft won't accelerate as much as needed and the take-off distance will increase.
- Runway surface:
Grass increases the rolling resistance and therefore the take-off ground run will be longer. Dry grass can increase take-off run distance by up to 15 %.
- Tyre pressure:
Low tyre pressure will increase the take-off run. However pressure was found normal.
- Wind:
The aircraft was taking off with 3 knots tailwind. Taking off tailwind results in a much longer distance to get airborne. One can find in the literature that 5 knots tailwind increases take-off distance with 25% and a 10 knots tailwind with 55%. Considering these figures, we can multiply the take-off distance with 15% for 3 knots tailwind.
- Density altitude:
An increase in density altitude has a two-fold effect on the take-off: the required true take-off speed will increase and engine power and propeller efficiency will be reduced.

Airfield elevation is 1099 ft, QNH that day was 1024 hPa. Taking into account that with every 28 ft, the air pressure decreases with 1hPa, this means that the QFE on the airfield would have been 985 hPa. In ISA this corresponds with an altitude of 800 ft and a temperature of 13,5° C.

The simplified formula for dry air is:

$$DA = 145442,156 \left[1 - \left(\frac{P/P_{SL}}{T/T_{SL}} \right)^b \right]$$

where

DA = density altitude in feet

P = atmospheric pressure

P_{SL} = standard sea level atmospheric pressure (1013.25 hPa ISA)

T = true air temperature in K

T_{SL} = ISA standard sea level air temperature in K (288.15 K)

b = 0.234969

With atmospheric pressure being 985 hPa and the true air temperature 287,15 (14°C) this gives a result of 845 ft.

As a general rule, the take-off distance is increased by one percent for every 100 feet of density altitude. Because the above formula is used for dry air, the true density altitude will be a bit more as moist air is less dense than dry air. Therefore we will increase the take-off distance by approx. 10%.

If we take into account 15% for the upslope, 15% for the grass runway, 15% for the tailwind of 3 knots and 10% for the density altitude, we finally get a result of:

- Take-off run required: 652 ft (199 m)
- Take-off distance over 50 ft barrier required: 1255 ft (383 m)

This result could be in fact overestimated as the greater part of the runway used is flat.

1.17 Organizational and management information.

Not applicable

1.18 Additional information.

Similar event

On June 19, 1994, a Piper PA-18 airplane, N81TW, was destroyed during take-off from the Hulman Regional Airport in Terre Haute, Indiana, USA. The tower controller who witnessed the accident reported the nose of the airplane appeared to be excessively high. The airplane reached a maximum altitude of about 200 feet. The left wing dipped and the airplane impacted the terrain.

The surviving second pilot stated he was flying the airplane and the other pilot was also on the controls. They were conducting a simulated short field take-off as specified in the pilot's operating handbook. He said they were distracted during the initial portion of the take-off roll when he discovered his seat belt was unfastened. He fastened it and continued the take-off. At 35 to 40 knots he lowered the flaps and the airplane became airborne.

The wreckage was examined by an FAA airworthiness inspector. No evidence of pre-existing airframe or engine malfunction was discovered. The elevator trim jack screw was found in the full nose up position. This report includes a statement from a Piper Aircraft Company engineer saying that the airplane could be controllable with the elevator trim in the full nose up position. However, it would require a significant forward pressure on the stick to maintain a proper climb pitch.

The National Transportation Safety Board determines the probable cause of this accident the pilot-in-command's inadvertent stall of the airplane with the elevator trim position as an associated factor.

2. Analysis.

2.1 Pre-flight and taxi

The pilot flying before the fatal flight, declared no anomalies during his flights. Before leaving the aircraft, he checked that all switches were off (also master and ignition switch), pulled the mixture control to the idle cut-off position and left the fuel tank selector valve on the right fuel tank. Each tank was indicating approximately half full. The elevator trim was left in the landing position, approximately in neutral stand.

The pilot and his passenger of the last flight, were already on the airfield for a couple of hours. They were waiting on the terrace of the airfield, but reportedly, they didn't consume any alcohol.

When the aircraft landed, the waiting passenger rushed to the bar to take the aircrafts documents. He and the pilot flying got in the aircraft and started to taxi. Already gone 14:50 UTC and sunset on 16:44, there wasn't much time left to take pictures of the Jodel with enough light.

From the evaluation of the weight and balance, we can conclude that the aircraft was around its maximum load and the centre of gravity was within limits.

The hurry of the pilots can be an explanation of the full nose-up position of the stabilizer trim. The aircraft was taxiing upwind. A fast taxi can anyhow be considered as an upwind taxi. According to the Flight Manual, in this case one has to hold the control stick as far to the rear as possible to hold the tail of the airplane down. This holds the tail wheel firmly on the ground to insure proper steering action. A full nose-up trim can simplify this action.

Up until the late afternoon, runway 24 was in use due to the wind coming from south-west. However, this was changed because of the low sun hindering the view.

2.2 Take-off

The flight manual asks to do a pre-flight airplane check before take-off. Step 3 is as follows: "Recheck stabilizer trim control. Center the position indicator". This was not done.

Reportedly they departed from the middle of runway 06, probably to save time as the Jodel was already airborne. A witness declared that the aircraft had a high pitch and the tail wheel was still on the ground just before it lifted off. When the aircraft passed the clubhouse at a few meters height, it had some difficulties to speed up and to gain height, although reportedly the engine was running smoothly.

2.2.1 Take-off distance

The runway has a total length of 732 m, which means that they had approx. 365 m at their disposal to take-off when they started in the middle of the runway.

The calculated required take-off distances (see 1.16.1) were:

- Take-off run: 652 ft (199 m)
- Take-off distance over 50 ft barrier: 1255 ft (383 m)

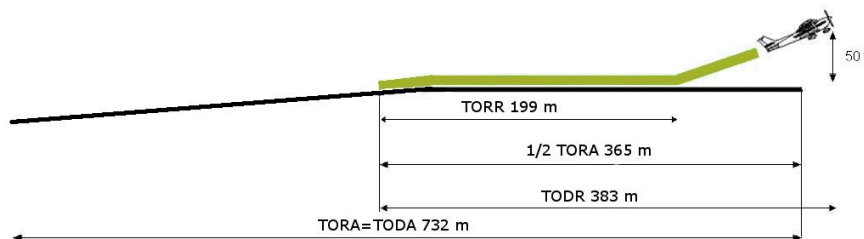


Figure 15: Take-off lengths

The available runway length was thus more than sufficient, the used runway length was sufficient to do the take-off run, but on the limit for the take-off distance over 50 ft barrier.

Some important notes:

- The calculated required distances are overestimated.
- The really used runway length couldn't be verified and is only based on information from witnesses being at the clubhouse.

2.2.2 Take-off speed

The Flight Manual mentions a take-off speed of 50 mph. In the Owner's Handbook we can find a stall speed of 42 mph. For a bank angle of 30° this becomes a stall speed of 45 mph. In general, the take-off speed is 1,3 times the stall speed what would mean 55 mph in this case. Under chapter STALL RECOVERY of the flight manual one can find the statement that "*The missions for which this airplane was intended demand slow flight, approach, and climb-out speeds which are very close to the actual stalling speed*".

2.2.3 Trim setting

During take-off run it is necessary to raise the tail wheel and to level the aircraft in order to reduce the drag and thus to gain speed. With the elevator trim in the full nose up, this requires a significant forward pressure on the stick to maintain a proper climb pitch. If the pilot isn't aware of this and neglects to react immediately the aircraft will establish and remain in the region of reversed command.

2.2.4 Ground-effect

When flying close to the ground, the wing generates less induced drag than around a wing out of ground effect. This makes it possible to lift off at too high a pitch angle, or too soon with a heavy load. Taking off too steeply will cause the angle of attack to be at or near that of a stall, with drag and thrust nearly equal, and thus no chance of accelerating or climbing.

2.3 Engine settings

The magneto selector switch was found on the left magneto, the throttle was $\frac{3}{4}$ open.

With only one magneto selected, the engine can not deliver its full take-off power. However, the damage on the left fuselage side were so extensive that no conclusion can be drawn from the position of the selector, as the selector could have been easily disturbed during the crash. The same goes for the throttle position.

2.4 Wreckage examination

There is no evidence of an in-flight-break-up of the aircraft structure.

2.5 Crash

A witness reported that the aircraft first turned to the left, followed by a flip and descent to the right after which it crashed in a field. These are the characteristics of a stall in a climbing turn. In a turn the stall speed will always be higher than in straight flight. When climbing, the higher wing will stall first because of the higher angle of attack causing the aircraft turning and descending in the direction of the stalled wing.

The initial left turn could have been due one of the following reasons:

- The P-factor of the engine causing the aircraft with a clockwise turning propeller in high pitch attitude to yaw to the left.
- An attempt of the pilot to avoid the high voltage line. At the RH side of the runway axis the landscape climbs, while on the LH side the landscape slightly descends.

3. Conclusions.

3.1 Findings.

- The pilot held the necessary Private Pilot License and rating (SEP land) to perform the flight.
- The aircraft possessed a valid Airworthiness Certificate.
- The mass and the centre of gravity were within the prescribed limits.
- The maintenance records indicated that the aircraft was equipped and maintained in accordance with the regulations.
- The available flight manual contains no figures or tables for the PA-18-95.
- There was no evidence of an airframe failure or system malfunction prior to the accident.
- The weather conditions were adequate.
- The available runway length to take-off was more than sufficient, the used runway length was just sufficient.
- The sides of the cockpit were squeezed during impact which affected the position of the switches on the left side of the pilot seat.
- No pre-impact anomalies on the engine were found.
- The aircraft had a very high pitch during lift-off.
- The stabilizer trim was found in the full nose up position, however for take-off and climb it is recommended to put the control in the neutral position.

3.2 Causes.

The cause of the accident is the improper take-off setting (stabilizer trim in full nose up position) generating a too high initial pitch of the aircraft, which caused a stall during initial climb.

3.3 Contributing factors.

- The nominal take-off speed is close the stall speed.
- The presence of a high voltage line in front of RWY 24. The lack of altitude could have made the pilot to decide to make a turn, what increased the effect of stall.

4. Safety recommendations.

None.