

Ministry of Economic Affairs and Communications

Final Report  
Aircraft Accident Investigation

Piper PA-46 500TP, OE-KDM  
Tartu-Ülenurme, 24.11.2006.a.

Tallinn 2009

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## SYNOPSIS

On November 24<sup>th</sup> at 15:05<sup>1</sup> an accident occurred near Tartu/Ülenurme airport. Austrian registered Piper Meridian PA-46-500TP, operated by *Effektiver Reisen Flugzeugvermittlung GmbH* took off for a private flight to Dresden and collided ca 23 sec later with the wooden terrain 700 m from the end of the runway. Two passengers and a pilot were seriously injured, the aircraft was completely destroyed.

The investigation as carried out by the Investigation Commission under the Estonian Ministry of Economic Affairs and Communications to determine the causes of the accident. Transportation Safety Board of Canada and National Transportation Safety Board (USA) participated in the investigation thru accredited representatives.

The investigation commission determined the pilot's spatial disorientation type I (unrecognized) as a cause of the accident. Dark terrain, the absence of visual horizon and ambient light, the long duty time of the pilot and unfamiliarity with the airport can be considered as contributing factors to the accident.

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<sup>1</sup> UTC is used throughout the report. Local time in Estonia is UTC+2 (winter)

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## 1. FACTUAL INFORMATION

### 1.1. History of flight

On November 24<sup>th</sup> at 15:05 an Austrian registered Piper Meridian PA-46-500TP, operated by *Effektiver Reisen Flugzeugvermittlung GmbH* took off from Tartu/Ülenurme airport for a private flight to Dresden. This was the third flight during that day and seventh during two last days. The aircraft was refueled in Tartu before the flight. There were two passengers and pilot onboard.

The IFR flight plan was filed with IFPS via Internet. At 14:57 the aircraft received the start-up clearance. After taxi to runway 26 and lining up the pilot selected take-off power 1,290 lbs/feet at 2,000 rpm, rolled, rotated at 87 knots and put the landing gear switch to "Gear Up" position. Ca 20 sec later the aircraft collided with the first treetops down on the runway heading. Few seconds later the aircraft impacted the terrain 700 m from the end of the runway.

The location of the accident site is 58°18'25,06"N , 26°40'1,99"E. The accident happened in IMC, there was a dark night during the accident.

Two passengers managed to escape the aircraft after the impact, the pilot was trapped in the cabin because of the aircraft damage and injuries and had to be released by SAR team.

#### 1.1.1. Witnesses statements

According to the pilots statement the take off was routine, power was set 1,290 lbs/feet at 2,000 rpm, all systems operated normally with no warning signals. Pilot rotated at IAS 87 knots, adding few knots extra speed rot a safety because of unfamiliar airport and weather. After becoming airborne he retracted landing gear, but could not recall engaging the autopilot. Pilot was preparing for a left turn to Valga and compensated for a southerly wind from the left. Flaps were retracted for takeoff as recommended by aircraft manual. No stall warning sounded and next thing pilot remembers were treetops hitting the aircraft. He tried to keep wings level on the last portion of the flight.

In the interview the pilot stated that after the crash he could not determine the precise location of the aircraft and estimated the duration of flight for many minutes. In the other interview he claimed to believe that he had climbed to the altitude at least 1000 ft.

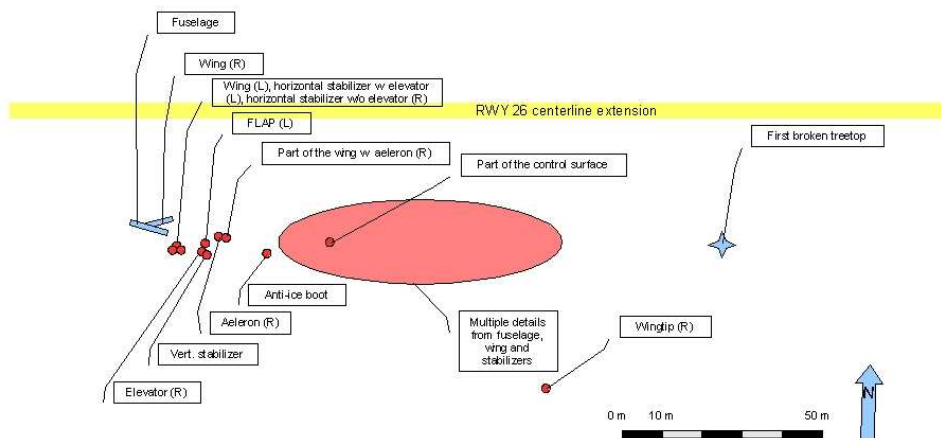
The pilot and the passenger do not recall any sudden and abrupt movements or accelerations. According to the pilot's statement there was no excessive on unusual pressure on controls and the aircraft felt trimmed.

Controller from the Tartu Tower watched the take-off and had last visual contact with the aircraft over the runway end on altitude ca 100 ft.





Picture 2. Impact site



Picture 3. Impact site

All 4 propeller blades were bent and spinner deformed. The spinner was deformed indicating signs of rotation.

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#### 1.4. Other damage

Other damage is limited to broken trees and fuel spill (ca 550l) on the accident site.

#### 1.5. Personnel information

Pilot:	male, 50
Licenses:	CPL/IFR/FI
Medical certificate:	1. class certificate
Experience:	1833 h (last log entry 20.10.2006)

The accident flight was the third flight during that day and seventh during two days. The first flight during the day originated from Malmö to Hagfors and took off at 06:20.

#### 1.6. Aircraft data

##### **Aircraft**

Type:	Piper PA-46-500TP
Registration:	OE-KDM
S/N:	4697111
MTOW:	1999 kg
T/O Distance, Sea Level	2438 ft (743 m)
Climb Rate	1556 fpm (7,9 m/s)
Airworthiness:	Issued 23.11.2005
Hours flown:	1051.5 <sup>2</sup>

##### **Engine**

Manufacturer:	Pratt & Whitney Canada
Type:	PT6A-42A

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<sup>2</sup> Last entry in AC log on 18.Oct. 2006

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S/N: PCE-RM0008  
TSN/cycles: 137 h/88<sup>3</sup>  
Propeller: Hartzell HC-E4N-3Q, E8501B-3.5 blades

PA-46-500TP is a single engine low wing high performance turboprop aircraft, powered by PT-6A-42A turbine engine. The accident aircraft had flown 1051.5 h by 18.10.2006 (last entry in the a/c log) and had new replacement engine (137 h) engine installed and tested on 15 Nov. 2006, 9 days before the accident.

The Engine (MSN PCE-RM0008) was involved in the propeller strike incident on 09 July 2001, removed from the aircraft, overhauled and returned to service on 10 Dec. 2001. On 12 May 2004 the engine was installed on the other aircraft. During the test run the chip detector warning light illuminated and ferrous filaments were found on chip detector plug inspection. The engine was removed and no further tests were carried out.

Aircraft and power plant had no known deficiencies before the flight. The aircraft was certified airworthy and was maintained in accordance with the maintenance manuals.

## 1.7. Meteorological information

IMC prevailed during the accident. At the time of the accident the weather at the Tartu Airport was: wind 200° 10 knots, overcast with cloud base 1300 ft, QNH 1005 hPa, temperature +8°C, dew point +7.4°C, humidity, 95%, visibility 6000 m, rain. It was dark night at the time of the accident.

## 1.8. Aids to navigation

Not relevant

## 1.9. Communication

Usual communication exchange was held on Tartu Tower frequency 132.00 MHz. After receiving clearances the pilot read them back correctly. Pilot was asked by Tower to report passing FL 60. At 15:17 controller at Tartu Tower called repeatedly the aircraft on Tower frequency without replay.

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<sup>3</sup> On 15. Nov. 2006

## 1.10. Aerodrome information

Tartu/Ülenurme (EETU) airport is located 5 NM SSW from Tartu, Estonia.  
Coordinates are 58°18'27"N 026°41'26"E

Runway characteristics:

Elevation:	219 ft
Runways:	26/08
RWY 26 true BRG (mag):	268,44°
RWY dimensions:	1379 X 35 m
Surface:	Asphalt/concrete

The area west from the airport is very sparsely populated and mostly wooded; it has almost no artificial lights to provide visual orientation during dark time.

## 1.11. Flight recorders

The aircraft was not equipped with a flight data recorder or a cockpit voice recorder. Neither recorder was required by the relevant aviation regulations.

## 1.12. Wreckage and impact information

The impact area covers 140 m alongside the flight path of the aircraft. The area is covered with young treed with diameter up to 20 cm and height up to 20 m. The first tree with broken top at 16.5 m AGL was found 140 m before the impact with terrain. After the impact the fuselage has slipped forward ca 5 m before coming to full stop. The flight path and aircraft bank position was clearly determinable by cut off treetops.



**Picture 4. Cut treetops on the accident site. View from the west.**

Parts of fuselage and surfaces were found alongside the impact area. Along the final portion of flight path copped wood characteristic to propeller contact was found. On the lading edges of the wings and horizontal stabilizers the impressions characteristic to the tree trunks were clearly visible.



**Picture 5. Tree impression mark**

The fuselage was found in upright position BRG 175°. Front part of the fuselage was broken in the firewall area. The right wing was broken off backward and was still partly connected to the fuselage. The aileron was found separately. Fuel tank in the right was crushed and some amount of fuel was recovered for analysis.

Left wing and stabilizers were completely separated and found on the impact path.

The position of the flaps could not be determined. Landing gear was not locked on the UP position, but showed no damages characteristic to longitudinal impact, doors were not deformed. The gear switch was in "DOWN" position.

Propeller blades were in different pitch position and bent



**Picture 6. Propeller on the accident site**

The continuity of control wires could not be determined.

ELT was operational and transmitting on investigators arrival.

Switches and controls:

Avionics	ON
Com	ON
Alt	ON
Fuel	Man
Ignition	Man
Dimming	NIGHT
Windshield	Defog
Pitot Heat	ON
NAV lights	ON
Stall Heat	ON
Elevator trim	ON
FD-AP Master	ON

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Yaw	AUTO
DME	NAV1
All other switches	OFF
GEAR	DOWN
Flaps	UP
Condition	RUN
Elevator trim indicator	T/O
Power	Almost idle
Manual overrun	OFF
Defrost	Pulled
Bleed Air	Pushed in
Friction	In rear position
Fuel Cut Off	Pushed in
Cabin Press	Norm
Altimeter	1013, indicating ca 10 ft
ADF	397

The right-seat safety belt upper attachment point was broken off from the fuselage.

### 1.13. Medical and pathological information

Two passengers and pilot sustained serious injuries involving multiple bone fractures and contusions. The pilot's toxicological test revealed no alcohol.

### 1.14. Fire

Not relevant

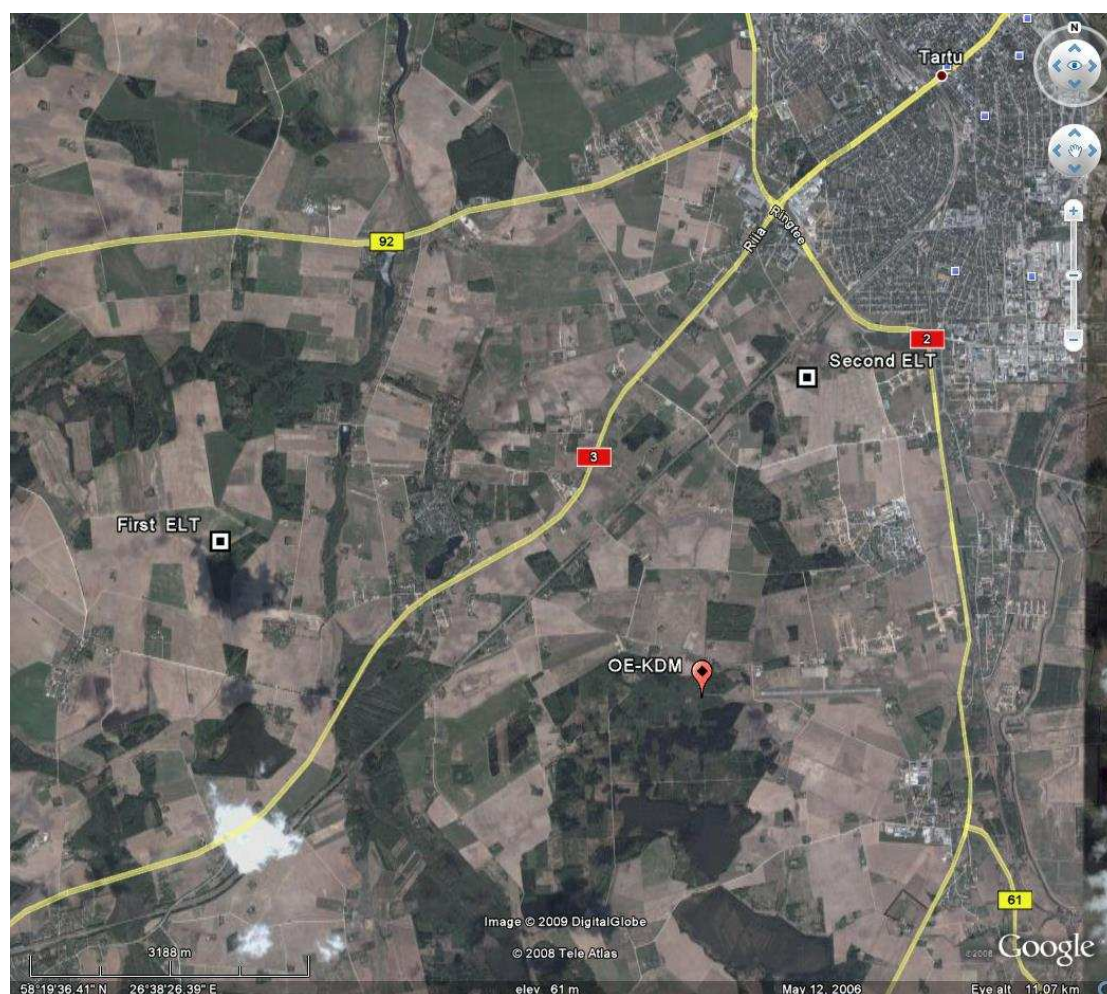
### 1.15. Survival aspects

Tartu Tower was alerted at 15:17, when the pilot did not report passing FL 60 at expected time 15:15 and did not reply to the calls. The call to ACC (Area Control Centre) gave negative result. At 15:25 the airport manager called tower and informed, that pilot alerted Austrian SAR by calling his friend from mobile phone. After that controller alerted MRCC (Marine Rescue and Coordination Centre) and local rescue services.

Although the frequency 121.5 was monitored at Tartu Tower the squelch control suppressed the ELT signal from the. After turning squelch down the ELT signal was detected.

The SAR team arrived to the airport in 5 minutes, but due to the confusion about the wreckage position they were unable to locate it during 20-30 min.

The MRCC resolved the ELT signal position at 15:30 and 15:54. Calculated positions were 3.1 and 2.05 NM off the true position respectively.



Picture 7. Resolved ELT signal positions

## 1.16. Tests and research

The following tests were carried out:

1. Engine examination and components testing at the manufacturer's plant in Canada in the presence of investigators from TSB Canada and Estonia.

Engine teardown report revealed no deficiencies or failures which could bring to the loss of power. The compressor was still turning after the ground impact.

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The engine displayed contact signatures to its internal components characteristic of the engine developing power at the time of impact.

2. Propeller teardown at the manufacturer's plant in USA.

Propeller disassembly report states that propeller had power on during the impact with trees. The propeller was not feathered during the impact. It was impossible to determine the amount of power during the impact.

3. DAU (Data Acquisition Unit) non-volatile memory readout at the manufacturer in USA.

Non-volatile memory contained no data which could be linked to the accident.

4. Fuel sample testing at the certified fuel laboratory of Tallinn Technical University.

Fuel recovered from the wing tank appeared to match all the required standards.

All tests are documented.

## 1.17. Organizational and management information

The flight was operated as private flight.

## 2. ANALYSIS

### 2.1. Aircraft trajectory

The reconstruction of the trajectory is based on following data:

1. Technical characteristics of the aircraft.
2. Pilot's statements.
3. Controller's statements about the last position of the aircraft.
4. Trajectory calculations based on damages to the trees and distances from the impact site.
5. Treetop's cutoff profile.
6. Wreckage examination.
7. Passengers' statements.
8. Eyewitness's statements.

Take-off roll of the aircraft type is ca 750 m, rotation took place at 87 knots IAS ca 1309 m before the impact. Estimating the average speed on takeoff power to 110 knots, average vertical speed 1000 ft/min both up and down and the trajectory as flat curve, it is possible approximately estimate the duration of flight as 23 sec and maximal reached altitude as 193 ft. The estimation corresponds to the controller and eyewitness statement. Absence of perceivable vertical accelerations in passengers' statements corresponds to the flat curved flight path.

The clearly visible flight path thru the treetops indicates the left bank ca 10-12°. Based on distance and broken treetops height the calculated impact angle was 6.8°. In the cutoff plane there is no separate mark of horizontal stabilizer which is indicative to neutral or negative pitch angle. This is coherent with the tree marks on the leading edge of the wings.

The aircraft was controlled and did not stall – there was no stall warning and the pilot felt the aircraft controllable during whole flight. The damage to the aircraft is characteristic to the high-speed impact.

### 2.2. Technical condition of the aircraft.

Analysis of the aircrafts technical condition is based on:

1. Wreckage examination
2. Engine and propeller examination and disassembly reports
3. Pilots and passengers' statements

The preflight inspection carried out by pilot and wreckage examination did not reveal any visible damages which could exist before the impact.

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The engine and engine systems examination did not reveal any pre-impact failures or damages which could cause the sudden loss of power. The pilots statements about the acceleration on take off roll and engine power settings describe a normally functioning power plant. According to the pilot's and passengers' statements there was no warning lights or aural signals in the cockpit. The aircraft was aerodynamically controllable and not stalling.

The examination of the propeller at the manufacturer's plant established that the propeller had no signs of failure or malfunction before the impact. It was not feathered during the contact with trees and it was rotating with power on.

The investigation has found no evidences of technical failure or malfunction in the aircraft, its power plant and systems. It is highly probable that the aircraft and its systems functioned correctly until the impact with trees and terrain.

### 2.3. Pilots spatial disorientation

Pilot's statements about the position of the aircraft differ clearly from the calculated path and impact site. This indicates that he was not clearly aware about the position of the aircraft. Also his statement about the reached altitude of 1000 ft is inconsistent with the investigation findings.

This loss of awareness is indicative to spatial disorientation type I (unrecognized). Spatial disorientation is the mistaken perception of one's position and motion relative to the earth. Any condition that deprives the pilot of natural, visual references to maintain orientation, such as clouds, fog, haze, darkness, terrain or sky backgrounds with indistinct contrast (such as arctic whiteout or clear, moonless skies over water) can rapidly cause spatial disorientation.

Pilots are also susceptible to spatial disorientation during night flight over featureless terrain.

### 3. CONCLUSIONS

#### 3.1. Findings

1. The pilot was qualified to perform the flight.
2. The aircraft was airworthy, properly maintained and refueled with appropriate fuel.
3. The investigation did not reveal any fault conditions or failures in the airframe, power plant or systems which could cause the change of aircraft's trajectory and impart with terrain.
4. The investigation found that the pilot's statements about aircraft's position were inconsistent with the factual data.

#### 3.2. Causes

The investigation determined as a cause of the accident

1. Pilot's inability to maintain necessary altitude and terrain clearance due to the spatial disorientation type 1 (unrecognized).
2. Dark terrain, the absence of visual horizon and ambient light, the long duty time of the pilot and unfamiliarity with the airport can be considered as contributing factors to the accident.

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#### 4. SAFETY RECOMMENDATIONS

No recommendations.

Signed:

Jens Haug

Investigator In Charge

Raivo Kask

Member of the comission

Priit Part

Member of the comission