Investigation report

D2/2009L

Ultralight accident at Lahti-Vesivehmaa aerodrome on 16 January 2009

Translation of the Finnish original report

OH-U502

ATEC Zephyr 2000

According to Annex 13 of the Civil Aviation Convention, paragraph 3.1, the purpose of aircraft accident and incident investigation is to prevent accidents. It is not the purpose of aircraft accident investigation or the investigation report to apportion blame or to assign responsibility. This basic rule is also contained in the Investigation of Accidents Act, 3 May 1985 (373/85) and European Union Directive 94/56/EC. Use of the report for reasons other than the improvement of safety should be avoided.

Because of the nature of this incident, the report does not follow the format specified in ICAO Annex 13. AIB Finland uses the format recommended in Annex 13 for investigation reports published in series A, B and C.

INVESTIGATION NUMBER: D2/2009L **INVESTIGATORS:** Hannu Melaranta
INVESTIGATION COMPLETED: 9 June 2010 Tii-Maria Siitonen

Time:	16 January 2009 at approximately 9:45 (UTC + 2 h)
Place:	Lahti-Vesivehmaa aerodrome (EFLA), Finland
Aircraft type:	ATEC Zephyr 2000
Registration:	OH-U502
Powerplant:	Rotax 912 ULS
Year of manufacture:	2007
Type of flight:	Training flight
Damage to the aircraft:	Major structural damage
Number of persons onboard:	1
Persons:	**Pilot:** Age 49
Licences:	Ultralight Pilot Licence (UPL), valid until 10 December 2013 Recreational pilot medical certificate, valid until 20 June 2012
Flying experience:	**Total flight hours:** 48 hours, 11 minutes, 298 landings **Type in question:** 6 hours, 50 minutes, 33 landings
Meteorological information:	VMC

Translation: R&J Language Service

SYNOPSIS

An accident happened on Friday, 16 January 2009 at Lahti-Vesivehmaa aerodrome in Finland. Shortly after takeoff a two-seater ATEC Zephyr 2000 ultralight aircraft, registration OH-U502, rapidly turned to the left and collided with the ground on an access road that runs parallel to the runway. The pilot, alone in the aircraft, was seriously injured and the aircraft was badly damaged.

On 4 February 2009, Accident Investigation Board Finland appointed Chief Air Accident Investigator Hannu Melaranta and Air Accident Investigator Tii-Maria Siitonen to set up investigation commission D2/2009L, tasked to carry out a D investigation related to this occurrence. Investigators Tuomas Tuisku and Jorma Laine were invited to assist the commission as experts.

All times in this report are in Finnish Standard Time.

1 FACTUAL INFORMATION

1.1 The accident flight

The pilot intended to fly two touch-and-go landings on his own at Lahti-Vesivehmaa aerodrome in the morning and then fly a cross-country flight to Pori with a person who was on his way from Helsinki. The aircraft was plugged into the engine heater before the flight as it had been stored for six days in an unheated hangar. The pilot carried out the daily inspection and topped up the fuel tanks with approximately 40–50 litres of fuel. The pilot detected a few frozen droplets of water on top of the wing, but did not notice any hoarfrost. He warmed up the engine, taxied to in front of the operations building and went inside.

A moment later the pilot returned to the aircraft after which he taxied to the holding position, runway 07, and completed the rest of the pre-flight checks. All indications were normal. Wing flaps were in position one, i.e. at 15 degrees. As per his account, he rotated at approximately 75–80 km/h and liftoff ensued at approximately 85–90 km/h. According to the pilot the aircraft first gently drifted to the left and then, at approximately 50 metres height and 110 km/h airspeed while in a climb, the nose turned rapidly to the left. According to an ultralight pilot, who had observed the flight from the tower, the aircraft was probably at 15–20 metres and near stall speed when the aircraft began turning to the left. The pilot tried to counter the left turn by applying the right rudder and right aileron. This, however, was not sufficient to halt the turn and the aircraft went into a dive. The pilot tried to lift the nose by pulling back on the stick and, at the same time, applying full right rudder. Full throttle was on during the dive.

The aircraft collided with the ground on an access road on the left side of runway 07. The left wingtip hit the ground first and the aircraft turned approximately 180 degrees in relation to the takeoff heading. The pilot remained conscious throughout the occurrence. The person in the tower, having witnessed the course of events, immediately left for the accident site. He quickly helped the pilot out of the aircraft since the smell of gasoline at the site was strong. Another person at the location called the Emergency Response Centre (ERC). First aid was adminis-

tered to the pilot at the site. The Rescue Department applied foam to the smouldering engine. There was no fire.

The Päijät-Häme Police CSI team arrived at the scene at approximately 10:15. They cordoned off the accident site and began to investigate the scene. AIB Finland's investigators arrived at the accident site at approximately 13:00.

Figure 1. The aircraft after the accident.

1.2 Pilot training and flying experience

The pilot had a valid Ultralight Pilot Licence (UPL). He started his classroom training for the licence in June 2008, followed by flight training in July 2008 with a Eurofox 3K aircraft. He received his UPL licence in December 2008. His total flying experience was 48 h 11 min and he had logged 6 h 50 min on the ATEC Zephyr 2000. One month before the accident he had completed type training for the Zephyr 2000 and approximately one week prior to the accident he had completed a check flight which allowed him to fly with passengers.

1.3 Aircraft information

The ATEC Zephyr Model 2000 is a two-seat, low-wing composite structure ultralight aeroplane. The current name of the model is ATEC Zephyr 122. Its maximum takeoff weight is 450 kg. The aircraft type in question had a UA(2)-180 laminar wing profile. The aircraft had a 100 hp 4-stroke Rotax 912 ULS gasoline engine. The aircraft was taken into use in May 2007 and it had altogether 202 flying hours. The aircraft's certificates of registration, airworthiness and insurance were valid.

Instead of traditional cockpit instrumentation, this particular aircraft was fitted with a Dynon Avionics FlightDEK-D180 avionics system. The system was a version 3.0.0 which records engine data but no flight data. The aircraft had an AvMAP GPS receiver with a recording feature. Since, however, the receiver was not on at the time of the occurrence, no data related to the accident flight was recorded to memory.

1.4 Meteorologigal information

At 08:53, the nearest Finnish Meteorological Institute observation station in Pulkkilanharju, Asikkala, recorded the following weather information: temperature -10 °C, barometric pressure 1030.3 hPa and wind 352 degrees at 4.0 m/s. The sky was clear and visibility was good. Crosswind takeoff occurred from runway 07. The maximum permissible crosswind component for this aircraft is 6.0 m/s. According to the Finnish Meteorological Institute, meteorological conditions at Lahti-Vesivehmaa aerodrome closely resembled those at Jokioinen where a weak, three-degree inversion layer had been observed. The inversion layer at Jokioinen was between 300–600 metres but it was impossible to determine the height of a possible layer at Lahti-Vesivehmaa aerodrome. Nevertheless, the presence of a low-level temperature inversion was unlikely.

1.5 Aerodrome information

Lahti-Vesivehmaa aerodrome is located at approximately 20 km north of the city of Lahti. There are three runways. The runway 07/25 that was used for the accident flight is asphalt-covered and its length is 1200 meters and width 30 meters.

1.6 Damage

1.6.1 Injuries to persons

The pilot broke his left ankle and two of his teeth. He was hospitalised for seven days. The pilot's harness restrained him well, preventing any additional injuries.

1.6.2 Wreckage and impact information

Aircraft parts lay scattered between the point of collision with the ground and where the aircraft came to a stop, a distance of approximately 50 metres. The left wing made the first contact with the ground and was totally destroyed. The right wing shifted forward in such a manner that the wing flap lever loosened. The empennage broke into two and was bent downwards to the left. The left main landing gear wheel fell off and the nose gear folded under the fuselage. The propeller hit the ground and came off completely. The engine mount was damaged and the engine partially broke away from the mount. The firewall had partly come loose. The wing flap lever was in position 1, i.e. at 15 degrees. CSI investigators detected a very thin layer of hoarfrost on the surface of the wing prior to the arrival of AIB Finland's investigators.

AIB investigators carried out a more detailed wreckage investigation on 23 January 2009. The investigation found no such fault in flight controls or wing flaps that would have been present prior to the accident.

1.6.3 Other damage

Approximately 40 litres of aviation gasoline leaked onto the ground.

2 ANALYSIS

2.1 The effect of hoarfrost on flight characteristics

The aircraft's wing profile UA(2)-180 is a laminar profile, which was developed for ultralight aircraft in the 1980s. The performance of a laminar profile is based on the fact that the flow in a boundary layer stays laminar at as large a region of profile surface as possible. The surface of a laminar profile needs to be particularly smooth so that the flow stays laminar as long as possible and good aerodynamic characteristics are achieved. Even small amounts of contamination, such as water droplets, insects, hoarfrost or ice, accumulated on the wing surface may change the laminar boundary layer into turbulence and locally separate the flow from the wing surface. The change of the flow into turbulence, and especially the flow separation, degrade the wing's aerodynamic performance by increasing the drag and stalling speed and by reducing lift and the stall angle of attack. Asymmetric local flow separation can also result in roll control problems, for example during lift off.

The aircraft's flight and operations manual mentions that flying in icing conditions is prohibited. The manual also gives mention to degradation in wing flight characteristics due to rain. In the Finnish flight and operations manual, the check to be done before a flight includes a daily inspection. The manual's daily inspection section lists the wing and flight controls. The manual does not specifically mention contaminants, such as frost, nor their degrading effect on the aerodynamic characteristics of the wings, stabilizers and control surfaces. A very thin layer of frost or ice on any wing surface degrades the wing's aerodynamic performance, and particularly ones which have a laminar wing profile. It may be difficult to determine by only visual observation whether the wing surface has a thin layer of frost or ice or not. For this reason the National Transportation Safety Board (NTSB) recommends, for example, that it would be good to ensure the wing surface is free from contamination by touching it by hand before every flight.

A thin layer of hoarfrost and a few frozen water droplets are clearly distinguishable in photographs taken after the accident. The pilot said that he did not observe any frost on the wings when the aircraft was inside the hangar. It is possible that the temperature in the hangar was slightly higher than the outside temperature. In such conditions hoarfrost could have formed when the aircraft was taken outside. Hoarfrost formation could also have occurred during taxiing. According to meteorological information, no such large temperature fluctuations were present below 100 metres that could have caused sudden hoarfrost formation during takeoff or the initial climb.

Figure 2. Hoarfrost and frozen water droplets on top of the wing.

2.2 The stall during the initial climb

The recognition of a gradually developing stall and recovery from one is generally included in flight training. If an aircraft stalls during an initial climb, the stall typically develops suddenly and an inexperienced pilot does not necessarily have time to recognise typical stall warning signs such as buffeting, slackening of flight controls and nose-down pitching. According to the pilot, the flight controls felt stiff as the aircraft was turning to the left. The investigators believe that the stall during the climb developed rapidly, in which case the pilot did not observe the symptoms of an oncoming stall. The pilot's corrective action was erroneous, resulting in a sideslipping turn to the left and a rapid loss of altitude. When the aircraft was in a steep left bank, the full back stick was yet another factor increasing the rate of the turn.

When there are rapid changes of airspeed there is a lag in the speedometer's indication of it; thus the true airspeed during the climb was probably below 110 km/h. The eyewitness, too, estimated that the airspeed was close to stall speed. There was no airspeed indicator calibration card on the instrument column, which would have given the pilot a sense of how accurate the airspeed indicator was. There was no heater element in the Pitot tube.

People who have flown the Zephyr 2000 praise its flight characteristics. Its flight controls are sensitive. The aircraft type has a powerful engine and the rate of climb is exceptionally good. The propeller's torque effect at takeoff requires strong right rudder output. Engine power does not prevent a stall and loss of control at lift off, where the highest angles of attack are normally achieved. During at least one check flight on the Zephyr the aircraft turned a full 180 degrees to the left during a stall.

The pilot had a valid Ultralight Pilot Licence. He had done his flight training on the Eurofox 3K. According to his instructor on the pilot licence course, his flight train-

ing proceeded normally and his action was thorough. His experience on ATEC Zephyr 2000 was 6 h 50 min and 33 landings. His total flying experience was 48 h 11 min. The Zephyr is a higher performance aircraft than the Eurofox. The pilot did not have much experience on the type or total flying experience, which probably contributed to the fact that he did not recognise the stall during the initial climb.

3 CONCLUSIONS

3.1 Findings

1. The pilot had a valid Ultralight Pilot Licence and a recreational pilot medical certificate.

2. The aircraft's certificates of registration, insurance and airworthiness were valid.

3. The pilot did not have much experience on the type or total flying experience.

4. The pilot was seriously injured in the accident.

5. The aircraft was badly damaged.

6. Tests found no faults in flight controls or wing flap systems that would have been present before the accident.

7. Immediately after takeoff the aircraft turned to the left and the investigators believe that it stalled during the initial climb.

8. A thin layer of hoarfrost was observed on the wing after the accident. The aircraft's laminar wing profile is easily degraded by frost or other contamination.

3.2 Cause of the accident

The accident was caused by a rapidly developing stall during the climb, during which the aircraft rolled to the left. The pilot did not recognise that he was in a stall, nor was his corrective action proper. Instead, the aircraft continued to turn and eventually collided with the ground. Contributing factors included the pilot's limited total flying experience and his experience on the type as well as the possible hoarfrost on top of the wing at the time of the accident.

4 SAFETY RECOMMENDATIONS

The laminar wing profile of the ATEC Zephyr 2000 is sensitive to frost and other contamination. The flight and operations manual prohibits flying in icing conditions and gives mention to degradation in wing performance due to rain. While the manual's daily inspection section lists the wing and flight controls, there is no clear mention of contaminants nor their degrading effect on the aerodynamic characteristics of the wings, stabilizers and control surfaces.

1. The investigators recommend that the aircraft manufacturer adds to the flight and operations manual a clear statement saying that before every flight the pilot must ensure that wings, stabilizers and control surfaces are clear of snow, ice, frost and other contamination.