Investigation report

B6/2009L

Ultralight aircraft accident at Kauhava aerodrome on 4 August, 2009

Translation of the original Finnish report

OH-U507

EV-97 EUROSTAR, Model 2006, version R

Onnettomuustutkintakeskus
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Accident Investigation Board

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Translation: R&J Language Service

SUMMARY

ULTRALIGHT AIRCRAFT ACCIDENT AT KAUHAVA AERODROME ON 4 AUGUST, 2009

An accident happened at 19:08 on Tuesday, 4 August 2009 at Kauhava aerodrome. An EV-97 Eurostar, Class B ultralight aircraft was on a training flight when it collided with the ground. The aircraft was destroyed and both persons in the aircraft were killed instantly. On 10 August 2009, Accident Investigation Board of Finland appointed investigation commission B6/2009L for this accident. Investigator Juhani Hipeli was named investigator-in-charge, accompanied by investigators Timo Kostiainen and Erja Savela. Investigator Olli Borg was appointed as an expert to the commission.

On the accident flight, one of the topics being practiced was an emergency landing after engine failure following takeoff. The intention was to turn back and land on the runway in the opposite direction of the takeoff. The simulated engine failure was initiated at 350 feet (107 m) AGL. As soon as the engine was set to idle, they started a descending turn towards the right, into a headwind. During the early phase of the turn the aircraft lost a lot of height. During the final it also lost so much airspeed that the student flight instructor, who, as far as the investigation commission knows, was flying the aircraft, lost control of the aircraft. As a result, the aircraft abruptly rolled to the right and went into an increasingly steep dive, colliding with the ground in a nearly vertical attitude.

The student flight instructor was inexperienced with regard to the planned emergency landing manoeuvre. Moreover, based on his training, he did not have the required competence to fly the known to be difficult manoeuvre. The investigation especially focused on why this particular, often accident-prone, emergency landing manoeuvre was being practiced at all. A safer, and generally recommended, way of executing an emergency landing after takeoff is to land in the sector ahead. The investigation revealed that, in ultralight flight instructor training, such emergency landings during which one turns back to the runway were to be demonstrated to the students. Since the flight syllabus in use does not specifically define the content of instruction, extremely diverse instructor-specific practices had emerged in flight instructor training. The investigation also revealed that Aviation Regulation PEL M2-71, determining the rights of the ultralight student flight instructor, was being interpreted in varying ways by flight clubs that provide ultralight flight training. It is the opinion of the investigation commission that an ultralight student flight instructor rating did not qualify the student flight instructor to act as a flight instructor on the accident flight.

The accident was caused by inadequate flight instrument monitoring while turning back towards the runway, i.e. during a technically demanding manoeuvre. When the airspeed bled off during the turn, the aircraft stalled, resulting in a loss of control. Upset recovery was not possible because of the low altitude. Contributing factors include the prevailing culture in ultralight flight training, in which some flight training organisations or individual flight instructors have instructed students in abnormal and emergency procedures training to turn back towards the movement area in conjunction with simulated engine failures at takeoff, even from very low altitudes. Flight training syllabi do not include instructions for such a manoeuvre. During the accident flight the student flight instructor’s flight experience and flight currency with regard to flying or teaching turn-backs towards the runway were insufficient.

The investigation commission issued six safety recommendations; three to Trafi Aviation (the Finnish aviation authority), two to the Finnish Aeronautical Association as well as one joint recommendation to Finavia Corporation and the Emergency Response Centre Administration.

Trafi Aviation was urged to clarify the Aviation Regulation PEL M2-71 ultralight student flight instructors' rights, so as to make them unambiguous. The second recommendation was that Trafi Aviation lead the preparation of written proficiency standards for the instructors of sport aviation flight instructor courses, and that opportunity for training which provides such proficiency be arranged. Thirdly, it was recommended that Trafi Aviation take action against flying with aircraft exceeding the maximum takeoff weight.

The Finnish Aeronautical Association was encouraged to lead a process in which the syllabi of ultralight pilots and flight instructors would be made more detailed, and that instructions on how to fly manoeuvres as well as vital safety limits and goals for learning be included in the curricula. Secondly, it was recommended that the Finnish Aeronautical Association prepare written guidelines for the flight instructors that supervise student flight instructors in sport aviation.

The following joint recommendation was given to Finavia Corporation and the Emergency Response Centre Administration: When it comes to cooperation between Emergency Response Centres and Rescue Co-ordination Centres, Finavia Corporation and the Emergency Response Centre Administration are advised to update their mutual measures and instructions related to air accidents. A corresponding recommendation was issued on 15 January 2010 with regard to the B2/2009L investigation.

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ABBREVIATIONS

ACC	Area Control Centre
AGL	Above Ground level
AOM	Aircraft Operating Manual
ARCC	Aeronautical Rescue Co-ordination Centre
ATC	Air Traffic Control
CAA	Civil Aviation Authority
CAS	Calibrated Air Speed
CAVOK	Visibility, cloud and present weather better than prescribed values or conditions
CTR	Control Zone
ERC	Emergency Response Centre
ft	Feet
GPS	Global Positioning System
GPL	Glider Pilot Licence
hPa	Hectopascal
kt	Knot(s)
m	Metre(s)
METAR	Aviation routine weather report (in meteorological code)
MSL	Mean Sea Level
MTOW	Maximum Takeoff Weight
NM	Nautical Mile
PPL	Private Pilot Licence
QNH	Altimeter sub-scale setting to obtain elevation when on the ground
SAR	Search and Rescue
SEP	Single Engine Piston

TMA	Terminal Control Area
Trafi	Finnish Transport Safety Agency
UPL	Ultralight Pilot Licence
UTC	Coordinated Universal **T**ime
VFR	Visual Flight Rules

SYNOPSIS

An accident occurred at 19:08 (all times are in Finnish Daylight Savings time: UTC + 3 hours) on Tuesday, 4 August 2009 at Kauhava aerodrome. A privately owned EV-97 Eurostar, Class B ultralight aircraft collided with the ground. The aircraft was destroyed and both persons in the aircraft were killed instantly. The accident occurred during practice of engine failure after takeoff with the intention of turning back and landing on the runway. The aircraft manufacturer is the Czech Evektor-Aerotechnik a.s and the aircraft was manufactured in 2006.

On 10 August 2009, Accident Investigation Board of Finland appointed investigation commission B6/2009L for this accident. Investigator Juhani Hipeli was named investigator-in-charge, accompanied by investigators Timo Kostiainen and Erja Savela. Investigator Olli Borg was appointed as an expert to the commission.

The draft final report was sent for comments to Trafi Aviation (the aviation authority), Finavia Corporation, the Emergency Response Centre Administration, the Finnish Aeronautical Association as well as the parties concerned. Comments were received by 9 June 2010.

The investigation was completed on 16 June 2010.

The material used in the investigation is stored at the Accident Investigation Board of Finland.

1 FACTUAL INFORMATION

1.1 History of the accident flight

1.1.1 Preceding events

The pilot intended to fly a training flight at Kauhava aerodrome on an EV-97 Eurostar ultralight aircraft. The previous week, after a hiatus of approximately two years, he had flown a flight which was logged as an instruction flight with a student flight instructor who was training to become a flight instructor in the Air Force Academy Flying Club. Due to his poor flight currency the pilots had agreed that the student flight instructor would also accompany him on this second flight.

The student flight instructor arrived at the aerodrome at 16:30. Between 17:26–18:11 he instructed his own student pilot on a flight which comprised of seven traffic circuits and landings. During this time the pilot picked up petrol from the petrol station which was put into the aircraft before the flight. Since the flight occurred after the Air Traffic Control (ATC) had closed, no flight plan was filed for the local flight. The planned contents of the flight are not known. According to the person who flew the previous flight as a student, the aircraft was operating normally.

1.1.2 The accident flight

According to an eyewitness, neither the pilot nor the student flight instructor performed an external inspection of the aircraft before the accident flight. According to the eyewitness flight control, trim and flap operational checks were performed in a routine manner. Engine run-up was done at the holding position to taxiway H. This was followed by takeoff from runway 35 at the intersection of the holding position.

According to radiotelephony recordings, the aircraft flew four left traffic circuits. The first one was a standard traffic circuit. The three following ones were flown at 1200 feet (360 m) and they included engine failure practice on the downwind leg, ending in spot landings. According to the pilot's radio call the intention was to fly the first spot landing as a touch-and-go. However, it resulted in a go-around, which the student flight instructor announced on the radio. The second spot landing was flown as a touch-and-go as planned. During the third circuit for a spot landing the student flight instructor called that the landing would end in a stop-and-go, after which they would practice engine failure at takeoff. After the simulated engine failure they intended to turn back and land on the runway in the opposite direction of takeoff. Prior to the takeoff, the student flight instructor called that they would start the simulated engine failure at 500 feet (150 m). The investigation revealed that they had kept the QNH setting on the altimeter, indicating MSL altitude. As a result of this, they were at 350 feet (107 m) AGL at the time.

When the eyewitness heard the student flight instructor's radio call pertaining to the simulated engine failure following takeoff, he became interested enough to walk out of the club house so as to see the manoeuvre himself. Takeoff occurred from runway 35 from a standstill, close to taxiway E. After the aircraft climbed to the altitude from which

they started the simulated engine failure, the engine's noise was no longer discernible when it was set to idle. After this, the aircraft started a right descending turn. According to the eyewitness, the nose of the aircraft dipped fairly low during the onset of the glide. After they had turned approximately 180 degrees, they were at approximately 50 metres with a bank angle of 30–45 degrees. At the end of the turn the aircraft abruptly rolled some more to the right and went into a dive. It eventually collided with the ground at an almost vertical attitude. Observations based on radar recordings support the eyewitness account as regards the aircraft's manoeuvring. The onboard GPS navigator was not turned on during the flight.

Figure 1. The ultralight aircraft was destroyed when it collided with the ground.

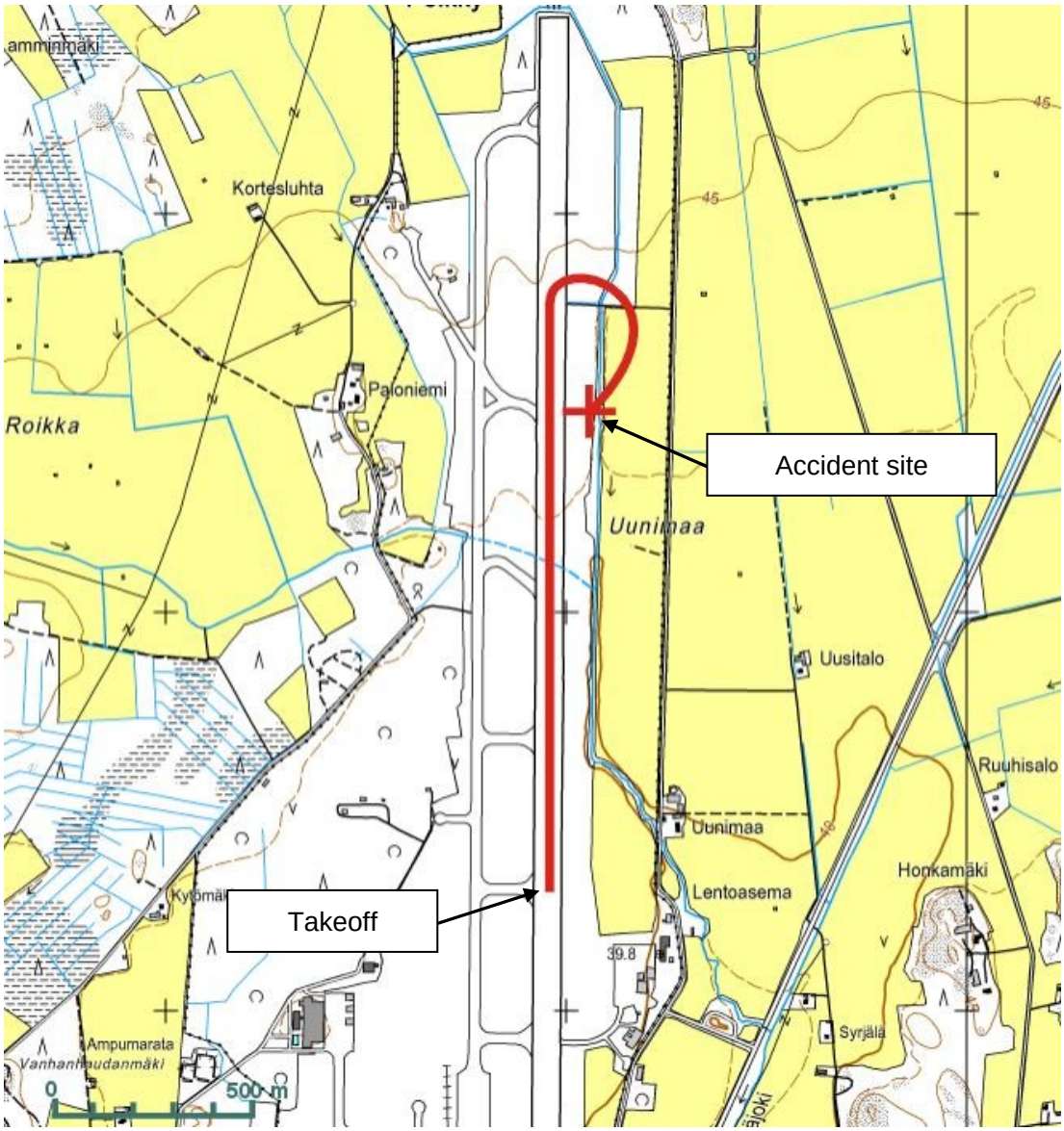

Figure 2. The estimated path of the accident flight (Cadastral index map/Ministry of Justice/National Land Survey of Finland)

1.2 Injuries to persons

Both occupants in the aircraft were killed instantly.

Injuries	Crew	Passengers	Others
Fatal	2	-	-
Serious	-	-	-
Mild/no injuries	-	-	-

1.3 Damage to aircraft

The aircraft was destroyed.

1.4 Other damage

There was no other damage.

1.5 Personnel information

Pilot: Age 38

Licences: Ultralight Pilot Licence (UPL), valid until 19.10.2011

Sport Aviator's Medical Certificate, valid until 19.4.2011

Ratings: Radiotelephone Operator's Certificate, Finnish

Flying experience	Last 24 hours	Last 30 days	Last 90 days	Total hours and landings
All types	0 h 0 min 0 landings	0 h 35 min 3 landings	0 h 35 min 3 landings	46 h 45 min 209 landings
Type in question	0 h 0 min 0 landings	0 h 35 min 3 landings	0 h 35 min 3 landings	46 h 45 min 209 landings

The pilot started his ultralight training in 2006. The following table indicates his flying experience from 2006–2009. The pilot flew all of the flights on the very same aircraft (EV-97, OH-U507).

Flying experience	2006	2007	2008	2009
All types	35 h 40 min	10 h 30 min	0 h 0 min	0 h 35 min
Type in question	35 h 40 min	10 h 30 min	0 h 0 min	0 h 35 min
Type in question as pilot-in-command	6 h 25 min	10 h 0 min	0 h 0 min	0 h 0 min

Student Flight instructor: Age 44

Licences: Ultralight Pilot Licence (UPL), valid until 3.1.2013

Glider Pilot Licence (GPL), valid until 3.1.2013

Private Pilot Licence, PPL (A), valid until 7.10.2013

Sport Aviator's Medical Certificate, valid until 21.12.2010

Medical certificate: Class 2, valid until 15.6.2012

Ratings: Language Proficiency Rating, Finnish, Class 6

Radiotelephone Operator's Certificate, VFR

Radiotelephone Operator's Certificate, English

Single Engine Piston (SEP) Landplane, valid until 31.8.2010

Passenger-Carrying Endorsement for the Ultralight Pilot Permit, issued on 25.3.2007

Student flight instructor, ultralight, valid until 3.1.2013

Training: Ultralight flight instructor course arranged by Finnish Air Sports Institute Ltd, 22.6.2009

Flying experience	Last 24 hours	Last 30 days	Last 90 days	Total hours and landings
All types	0 h 45 min 7 landings	10 h 0 min 33 landings	46 h 10 min 104 landings	287 h 15 min 1063 landings
Type in question	0 h 45 min 7 landings	6 h 10 min 27 landings	43 h 25 min 101 landings	149 h 18 min 713 landings

The student flight instructor started his ultralight training in 2006 and his GPL and PPL training in 2007. The following table indicates his flying experience from 2006–2009.

Flying experience	2006	2007	2008	2009
All types	45 h 30 min	71 h 02 min	110 h 13 min	60 h 20 min
UPL *- EV-97* *- WT9* *- FK9*	45 h 30 min	57 h 28 min	76 h 10 min	43 h 10 min
Type in question	45 h 30 min	54 h 03 min	21 h 30 min	28 h 15 min
Type in question as pilot-in-command	16 h 39 min	54 h 03 min	21 h 30 min	23 h 40 min
As ultralight student flight instructor	-	-	-	6 h 10 min
PPL *- C172* *- PA28*	-	10 h 35 min	33 h 50 min	17 h 10 min
GPL *- SZD-50-3*	-	2 h 59 min	0 h 13 min	-

1.6 Aircraft information

1.6.1 Basic aircraft information

The EV-97 Eurostar is an all-metal, low-wing, two-seat, commercially manufactured Class B ultralight aircraft.

Aircraft:

Type: EV-97 Eurostar, Model 2006, version R

Registration: OH-U507

Registration number: U507

Manufacturer: Evektor-Aerotechnik, a.s

Serial number: 2006 2716

Year of manufacture: 2006

Maximum takeoff weight: 450 kg

Owners:	Privately owned
Operators:	Private persons and the Air Force Academy Flying Club

1.6.2 Airworthiness

The Certificate of Airworthiness was issued on 18.6.2008. Based on an inspection carried out on 23.5.2009, the Permit to Fly was valid until 31.5.2012.

1.6.3 Mass and balance information

The aircraft was weighed on 5.5.2006, at which time the basic aircraft mass was 274.9 kg. Reweighing on 13.5.2006 produced the empty mass of 281.4 kg. The 6.5 kg mass difference is due to equipment installed in the aircraft not required by airworthiness. On the accident flight the equipment and the basic empty mass corresponded to the reweighing mass.

The calculated takeoff mass on the accident flight was 482 kg. The maximum takeoff weight (MTOW) of the aircraft is 450 kg.

Without the abovementioned equipment the centre of gravity was in the middle of the permissible range. Because of the negligible effect of the equipment, their effect on the centre of gravity was not calculated.

1.7 Meteorological information

Kauhava METAR on 4.8.2009:

At 18:50: Wind 010 degrees and 7 knots (variable between 340–050 degrees at 4–12 knots), visibility 40 km, CAVOK, temperature/dew point 22/10 °C, QNH 1021.3 hPa.

At 19:20: Wind 360 degrees and 8 knots (variable between 330–050 degrees at 4–13 knots), visibility 40 km, CAVOK, temperature/dew point 22/10 °C, QNH 1021.5 hPa.

The meteorological conditions met the requirements of the Aircraft Operating Manual (AOM).

1.8 Aids to navigation and radars

Aids to navigation and radars had no effect on the occurrence. Kauhava ATC radar recordings were used to establish the progress of the accident flight.

1.9. Communications

Communications had no effect on the occurrence. The Kauhava ATC radiotelephony recording was used to establish the progress of the accident flight.

1.10 Aerodrome information

Kauhava aerodrome (EFKA) is one of the aerodromes owned by Finavia and is located approximately 2 km north of the City of Kauhava. The coordinates of the aerodrome reference points are 63°07'27'' N 023°03'05'' E and the aerodrome's elevation is 151 feet (46 m). Asphalt-paved runway 17/35 is 2700 metres long and 60 metres wide. The dimensions of the runway strip are 2820 and 300 metres.

Kauhava aerodrome is a military airport with some civilian activity. The military area is at the southern end of the aerodrome, west of the runway. The civilian area is on the east side of the runway, where the Air Force Academy Flying Club's premises are also located.

Kauhava Control Zone (CTR) and Terminal Control Area (TMA) are class G uncontrolled airspace when the ATC is closed. When the ATC is open, the CTR and TMA are class D controlled airspace.

1.11 Flight recorders

There were no flight recorders in the aircraft.

1.12 Wreckage and impact information

Investigation of the accident site and wreckage took place on 5.8.2009. The ultralight aircraft had crashed into the ground close to taxiway B, 104 metres east of the runway centreline in an almost vertical position. The heading of the aircraft had been roughly towards the northeast at the moment of impact. The accident site area is level, grass-covered and bushy on relatively firm ground. After the impact the aircraft had turned right side up, bouncing approximately 2 metres backwards at the same time. The propeller's mark on the ground was clearly discernible. The three propeller blades had dug into the ground, leaving spinning marks when the aircraft moved backwards.

As a result of the crash, the aircraft was destroyed from the nose to the front end of the seats. Both wings' leading edges were crushed. The tail section was bent downwards from the back of the cockpit onwards.

Wreckage inspection at the accident site found the following:

All surface controls were in their places and almost undamaged. Both control sticks were in place, albeit almost completely frozen. The floor bracket of the left rudder tube connection was broken but its left end support was still in place. The right side rudder brackets were intact but the rudder tube connection was bent. The rudder cables were intact and connected to the rudder pedal assembly.

The wing flaps were in place and, apart from minor dents on flap roots, intact. Whereas the right flap was almost fully retracted, the left one hung loose a bit more extended. The flap release button had come loose. The flap handle was not locked into the retracted position.

The throttle and mixture controls were in place. Ignition was in the position BOTH and the key had broken inside the ignition. The altimeter setting was 1022 hPa. The secondary surveillance radar transponder was ON, squawking 2000.

An attempt to take a fuel sample from the tank was made, however, there was no fuel left in the tank because it had broken. Engine oil samples had already been taken by rescue personnel during the evening of the accident.

1.13 Medical and toxicological information

Forensic autopsies were performed on both persons who perished in the accident. It was established that the cause of death was extensive blunt force trauma; the deaths were categorised as accidental.

1.14 Fire

There was no fire.

1.15 Rescue operations and survival aspects

1.15.1 Emergency alerting

A student pilot was waiting for his turn on the grounds of the Air Force Academy Flying Club. He witnessed the accident and immediately called 112, the emergency telephone number. According to the emergency log of the Emergency Response Centre (ERC) of Ostrobothnia, the call came at 19:08:11. As per the emergency log the eyewitness had told that he had seen the aircraft crash into the ground. However, he was not at the wreckage. In addition, the eyewitness had reported that Kauhava ATC was closed.

The ERC launched the rescue operation as ‘232A, air accident, medium-large’. Three ambulance units, four police patrols as well as rescue units from Kauhava and Lapua rescue departments were called to the site. According to the report of the Training Air Wing at Kauhava, its duty personnel were alerted via VIRVE text message at 19:11. In addition, at 19:25 the ERC alerted the air ambulance PETE, standing by at Vaasa.

The accident occurred outside office hours and, hence, Kauhava ATC was not manned, nor was the Training Air Wing rescue detachment in immediate readiness. Therefore, the ERC alone was responsible for launching the rescue operation. The Aeronautical Rescue Co-ordination Centre (ARCC) for South Finland was first informed of the accident at 19:47. This is when the ERC of Ostrobothnia informed Tampere Area Control Centre (ACC) that an eyewitness had reported an air accident at Kauhava. The shift supervisor was told that the aircraft was still missing, but that an aerial Search and Rescue (SAR) operation was in progress.

1.15.2 Search and Rescue operations

Pursuant to the Aviation Act, the ARCC at the ACC shall continue to lead the SAR of a missing aircraft until it is found. After the aircraft is found, leadership transfers to the res-

cue authorities. On 1.4.2009, the Ministry of the Interior published the guide 'Use of aircraft in rescue activities'. According to this guide the person who requires an aircraft, the emergency manager or the police, must ask the ERC in his region to alert an aircraft. In this particular case the ARCC was not immediately informed about the air accident by the ERC; neither did the emergency manager or the police ask the ERC to request an aircraft for an aerial SAR operation. According to the ERC of Ostrobothnia, Kauhava ATC has normally been open during local aviation alerts and it has notified the ARCC as required.

After the Kauhava garrison executive assistance detachment arrived at the accident site, it launched a search in the terrain at around 19:25, together with rescue department personnel that had arrived at the site. It was impossible to detect the aircraft by looking from the edge of the runway. There were bushy thickets along ditches and deciduous trees that were a few metres tall at the accident site, which itself was situated between the runway strip and cultivated fields. Since the accident, the undergrowth has been removed from the area.

Two aerial SAR-trained pilots from the Air Force Academy Flying Club were notified of the incident and they immediately came to the aerodrome. Since the accident site had not yet been found, they decided to launch an aerial SAR operation with a PA-28 aircraft owned by the club. The pilots did not inform the ARCC of this. As per their SAR log, they took off at 19:30. They first checked the possible emergency landing sites on the north side of the aerodrome. Following this, they continued the search with a parallel sweep search pattern beginning from the runway until they found their target at approximately 19:50. The crew of the SAR plane guided the rescue units to the accident site. Arriving at the site, the ambulance crew pronounced both occupants of the aircraft dead. Under police command, the garrison's standby detachment cordoned off the area and began to guard the site.

The rescue mission of air ambulance PETE was called off when the target was found. Nonetheless, the helicopter crew took aerial photographs of the accident site.

Figure 3. The accident site photographed from the air. The red arrow indicates the accident location.

1.15.3 Survival aspects

Both occupants of the aircraft perished immediately at impact. Nothing could be done to save them. Although the cockpit was badly destroyed, the bodies remained in their seats and seat belts. In spite of the fact that the fuel tank broke and fuel leaked into the ground, there was no fire.

1.16 Tests and research

1.16.1 Technical inspection of the ultralight aircraft

The technical inspection of the ultralight aircraft concentrated on establishing the condition of the surface controls, flaps and powerplant.

Aircraft

In addition to observations made at the accident site, the inspection found the following:

The connecting tube between the control sticks was intact, but bent. The right wing aileron control system was intact and functioning. The left wing aileron control system was otherwise intact except for the broken aileron rod end which had broken off from the ball end on the fuselage side.

As for the pitch control, it was found that the elevator push/pull rod, attached to the connecting tube between the control sticks, was bent and broken at the link. As a result of being bent, the front end of the push/pull rod was broken at the ball end. The front end of the push/pull rod had perforated the fuel tank, which resulted in the tank draining practically dry.

The wing flap system was entirely intact and functioning. The control rod pins of both flaps had jumped off their grooves at the flap root, which resulted in the flaps moving freely.

The aircraft had the following equipment, which was specifically mentioned in the reweighing: SSR transponder, turn and bank indicator, attitude indicator, radio and padding as well as a GPS device in addition to the equipment listed in the weighing. The aircraft was not fitted with the Kevlar wheel spats that were mentioned in the manufacturer's weighing list.

Engine and propeller

Aerotecno Oy conducted the technical inspection of the engine with representatives of the investigation commission being present. The inspection established the condition of the engine prior to the accident. To do this, the engine was completely disassembled.

The following includes the most relevant facts from the inspection:

All three propeller blades were broken at the root. Externally, the engine was badly damaged. Among other things, the left intake assembly was torn loose, the oil filter including its mount and the oil pressure sensor had broken loose and the electric starter was broken. The reduction unit and the electronic ignition were fully functional. Fuel-system related equipment was functional and clean. The lubrication system functioned normally. The cylinders and pistons as well as the crank case and crankshaft were fully functional.

There was a clear mark in the crank case on the side of the gear, as if a lathe blade had chipped it (Fig. 4). This mark was left when the rotating gear assembly of the vacuum pump (optional accessory) had hit the crank case at the moment of impact. This mark definitely proves that the engine was running until the collision with the ground. The engine speed had been low, near idle. Due to the propeller speed reduction unit, Rotax 912 series engines do not windmill.

The time between engine overhauls was 1500 hours, or 15 years (Rotax SB-912-041UL). The running time on the engine was 1018 hours, i.e. approximately 2/3 of its cycle. Considering its running time, the engine was in excellent technical condition, apart from incipient camshaft wear. Therefore, the camshaft would have easily lasted the rest of its running time.

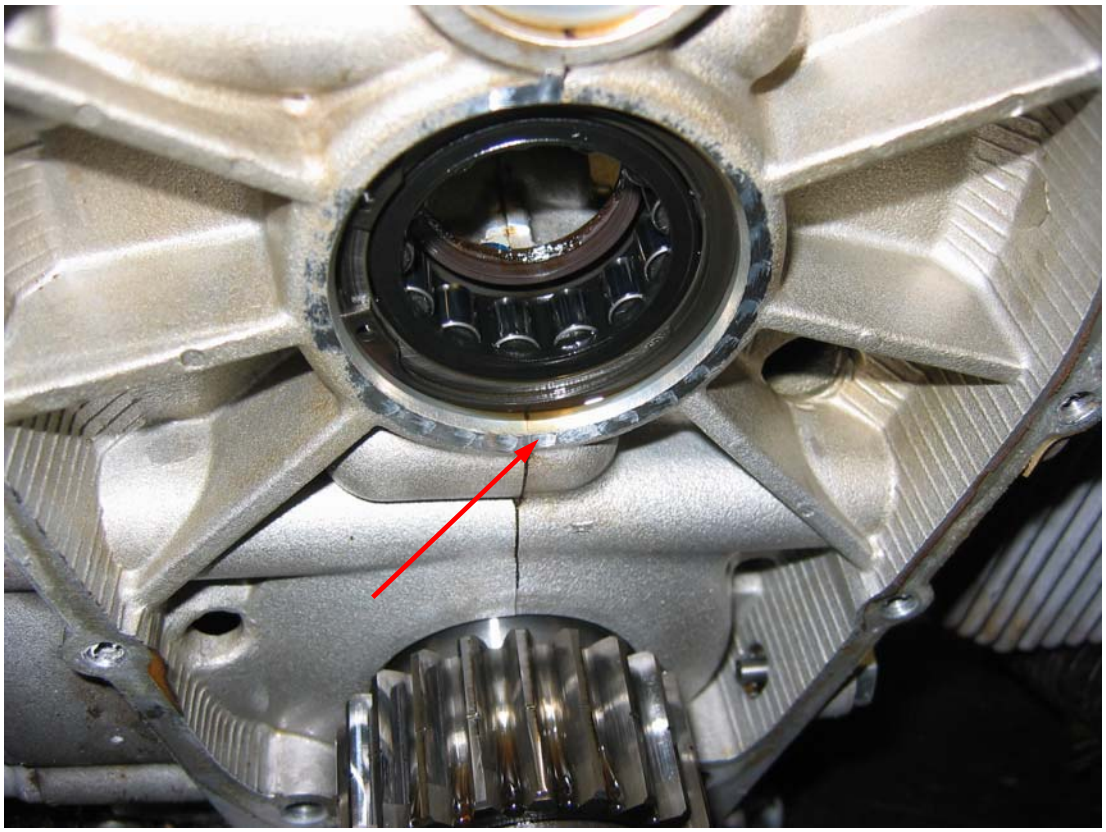

Figure 4. The mark left by the vacuum pump gear assembly on the gear side of the crank case indicates that the propeller axle was spinning at the time of the impact. The red arrow indicates the mark.

Maintenance history

The maintenance history of the aircraft was analysed through maintenance documents. The owners of the aircraft had conducted periodic inspections and annual inspections. Maintenance was carried out in accordance with the manufacturer's maintenance instructions. Engine and gear assembly maintenance had also been done at maintenance facilities certified by the aviation authorities. The most recent periodic inspection was completed on 1.8.2009. This was followed by a test flight in order to establish airworthiness.

1.16.2 The ultralight training background of the pilot and the student flight instructor

Both the pilot and the student flight instructor received their ultralight training in 2006 at the Southern Bothnia Aviation Club. When they applied for an UPL licence, they had flown a little over 30 hours in flight training. Flight training was mainly carried out at Kauhava and they had flown all of their UPL training flights on the accident aircraft. According to Aviation Regulation PEL M2-70 (12.1.2000), which was valid at the time of their flight training, at least 20 flying hours on an ultralight, with a minimum of five hours of solo flying, was required for an UPL licence. The next update (20.12.2007) of the aviation regulation raised the minimum requirement to 25 flying hours, at least 15 of which must

be instruction flights and five solo flying hours. This requirement is still valid in the present regulation, published on 5.5.2009.

According to the aviation regulation, the licence holder is permitted to fly as an ultralight pilot-in-command without charging a fee and to fly solo flights. The restriction on operating as pilot-in-command is the requirement to fly at least two flights on an ultralight aircraft, powered glider or airplane or fly a training flight with an instructor within the past 12 months.

In order to carry passengers on an ultralight aircraft, a Passenger-Carrying Endorsement is required. On 25.3.2007, the student flight instructor had made a logbook entry regarding a skill test for a Passenger-Carrying Endorsement. The pilot did not have a Passenger-Carrying Endorsement.

According to interviews made by the investigation commission, the pilot had decided to restart his ultralight hobby in July of 2009 and had become a member of the Air Force Academy Aviation Club. Since his previous flight had taken place over two years prior, flown on 30.6.2007, he needed to fly a training flight with a flight instructor so as to be reinstated as an ultralight pilot-in-command.

On 28.7.2009, the pilot flew a flight which was logged as an instruction flight. The flight was flown on the accident aircraft at Kauhava. The pilot's logbook entry indicated that he was a student pilot on that flight. According to records, the student flight instructor who perished on the accident flight was pilot-in-command and the flight instructor on that flight. While there are no detailed records as to the contents of that flight, interviews established that the student flight instructor had said that everything went well and that in his opinion the pilot was ready to fly solo. According to logbook entries, that flight lasted 35 minutes and it included three landings.

1.16.3 The training background of the student flight instructor and his instructor experience

The student flight instructor enrolled on an ultralight flight instructor course, organised by Finnish Air Sports Institute Ltd, in 2009. Pursuant to Aviation Regulation PEL M2-71, at least 100 total flying hours and a Passenger Carrying Endorsement are required of those enrolling on the course prior to the beginning of the course. Theoretical knowledge instruction was given at Nummela from 29.1.–1.2.2009 and, according to the curriculum, the 25 flights in the syllabus were to be flown during nine days at Räyskälä from 8.–17.5.2009.

On 7.5.2009, the student flight instructor flew the Eurostar ultralight aircraft (OH-U507), which he co-owned, from Kauhava to Räyskälä. According to the agreement between the owners of the aircraft and Finnish Air Sports Institute Ltd, the aircraft was to be used as one training aircraft on the instructor course. The student flight instructor's flight training at Räyskälä began on 9.5.2009. Poor weather conditions held back the planned schedule. As regards the student flight instructor, the course ended on 16.5.2009. At the time, he had not yet completed the two remaining flights in the syllabus, or the flight in-

structor skill test. The missing flights were instruction practice flight number 7: abnormal and emergency procedures at takeoff, and instruction flight number 8: cross-country flight. Interviews established that the student flight instructor had said that he had to immediately ferry the aircraft back to Kauhava for a periodic inspection. Later, however, it was found that a mistake occurred in the aircraft's flight hour calculation; there had, after all, been no great urgency to maintain the aircraft.

The remaining flights were planned to be flown at Vaasa under the tutelage of an experienced flight instructor who had taught on the course. However, the instructor's ratings had expired and they were in the process of being renewed. In order to avoid undue delay, Finnish Air Sports Institute Ltd contacted the head ultralight instructor of the Air Force Academy Flying Club. He was well known at Finnish Air Sports Institute Ltd since he had acted as their theoretical knowledge instructor for glider training. While he had never enrolled on an ultralight flight instructor course, his ultralight flight instructor rating was based on the glider instructor training received in 1999 and, as per PEL M2-71, UPL licence, required experience as pilot-in-command and a flight instructor skill test. His total flying experience was approximately 900 hours, approximately 100 hours of which as an ultralight flight instructor. The flight instructor in question was identified in the training organisation approval of Finnish Air Sports Institute Ltd and the remaining flights were flown at Kauhava on 13.6.2009.

On 17.6.2009, the student flight instructor passed his ultralight flight instructor skill test at Seinäjoki. The skill test did not include any turns back towards the runway or the movement area in conjunction with simulated engine failures following takeoff. According to the flight training records of the flight instructor course, the student flight instructor flew altogether 24 flights during his ultralight flight instructor training, amassing a total of 13 h 55 min.

1.16.4 Action as an ultralight student flight instructor

On 22.6.2009, the student flight instructor was issued an ultralight student flight instructor rating. Pursuant to Aviation Regulation PEL M2-71, an ultralight flight instructor rating requires that the student flight instructor trains at least two student pilots up to UPL licence. Pursuant to the definition in Aviation Regulation TRG M1-7, training for a pilot licence is called basic training.

Pursuant to Aviation Regulation PEL M2-71, the holder of an ultralight student flight instructor rating is also entitled to provide training for a fee. This must occur under the supervision of a flight instructor approved by the head of training. Said training can include theoretical instruction or flight training for a UPL licence, except for the skill test for the student's first solo flight. According to interviews and queries conducted during the investigation, there are several different interpretations of this Aviation Regulation provision within the sphere of sport aviation. Some interpret it to mean that a student flight instructor is permitted to provide theoretical instruction and flight training to any UPL licence holder, in addition to the two students mentioned in the regulation. Others maintain that student flight instructors are only permitted to instruct the two student pilots specified in the regulation.

The student flight instructor was listed in the training organisation approval of the Air Force Academy Flying Club and a supervising flight instructor was assigned for him. In addition, he was assigned one student to train for an UPL licence. On 25.7.2009, he flew his first flight at Kauhava as student flight instructor with the student pilot in question. Prior to the accident, he had flown altogether seven instruction flights included in the syllabus.

According to his account, the supervising flight instructor was aware of the flights that the student flight instructor and his student were flying, as well as of the phase of training. He was not aware beforehand of the instruction flight that the student flight instructor and the pilot flew on 28.7.2009, or of the accident flight.

1.16.5 Abnormal and emergency procedures training

When it comes to emergency landings recorded in general or sport aviation in Finland since 1981, all fatal accidents were caused by the pilot attempting to turn back to the aerodrome from a low altitude. During the turn, the aircraft stalled, control was lost and the aircraft collided with the ground. According to the studies published by Canadian aviation authorities, a turn-back following takeoff carries a ten-fold risk of death and a five-fold risk of serious injury compared to a straight-ahead landing in the terrain.

According to the information provided to the investigation commission, emergency landing training at takeoff, provided in Finnish PPL (A) licence training or on SEP flight instructor courses, does not include any turns back to the runway or the movement area. Instead, the training emphasises the importance of making a straight-ahead forced landing. According to information provided to the commission, some SEP flight instructor training has included turns back towards the runway from a safe altitude, the point of which has been to demonstrate to future flight instructors how difficult and risky such a manoeuvre can be. A safe altitude in this context means an altitude above the traffic circuit.

By definition, an ultralight aircraft is an aeroplane having no more than two seats, maximum stall speed in landing configuration not exceeding 35 knots (65 km/h) CAS, and a maximum take-off mass of no more than 450 kg for a landplane, two-seater. The low stalling speed of an ultralight is advantageous in forced landings because ultralights can touch down at a very low airspeed and land on short landing strips, such as fields.

The investigation commission reviewed the Ultralight – Powered Glider textbook (Ultrakevytlennon-Moottoripurjelennon oppikirja)[1]. The textbook includes the theoretical knowledge segments of both ultralight and powered glider curricula. On page 26, describing abnormal and emergency procedures at takeoff and the initial climb, the textbook says: ‘The first thing one must do is to promptly push the nose down below the attitude of the best glide angle so as to maintain airspeed. Then, one must select the best glide angle relative to the situation and a suitable spot for landing from the sector straight ahead. Only the largest of obstacles, such as houses, should be avoided. The most important

[1] Torbjörn Bengtström 2008, published by the Finnish Aeronautical Association

thing is to control the aircraft all the way to the ground, even if the landing site seems unsuitable. If the aircraft is at a very low altitude when the engine failure occurs, the greatest mistake is to try to make it back to the airfield!'

Later, on page 38 the list 'emergency landing at takeoff' states: 'When below 120 metres, the safest thing is to land in the sector ahead'. The summary on the following page states: 'If the emergency occurs at a low altitude (e.g. 150–200 m), decisions need to be taken without delay. In reality, one can only make small changes in heading in the search for landing sites. Even a 180–200 degrees turn can prove dangerous or even impossible. When the landing site has been selected, the most important task is to maintain airspeed and correctly control the aircraft.'

The accident aircraft manual's chapter 3.2.2 'Engine failure at takeoff' provides the following instructions:

1. Airspeed	- descend at 110 km/h (60 kt)
2. Altitude	- below 50 m (160 ft): land straight ahead - above 50 m (160 ft): select landing site
3. Wind	- check heading and speed
4. Landing site	- select an area with no obstacles
5. Flaps	- open as required
6. Fuel selector	- OFF
7. Ignition	- OFF
8. Propeller	- turn into horizontal position by using starter
9. Seat belts	- tighten
10. Master switch	- OFF before touchdown
11. Land	

In 2006, according to the flight instructor that was responsible for the training of the pilot and the student flight instructor, a manoeuvre that included a turn-back to the runway or movement area following engine failure at takeoff was demonstrated to both of them in emergency landing training. The flight instructor no longer recalled whether the students actually flew the manoeuvre themselves or whether they only followed gently on the controls while the instructor flew the manoeuvre.

1.16.6 Abnormal and emergency procedures in ultralight flight instructor training

Abnormal and emergency procedures at takeoff are taught on flight number seven of the ultralight flight instructor course. The flight is flown as two separate sorties. The first sor-

tie is an instruction flight during which the flight instructor demonstrates to the student flight instructor the proper manner of control and how to teach the topics of the flight. As on all other flight instructor course flights, the student flight instructor sits in the instructor's seat, i.e. on the right side. The scheduled flight time for this flight is 30 minutes. According to interviews, the student flight instructor rarely has any time to practice the manoeuvres on this flight. The second sortie is an instruction practice flight, during which the student flight instructor plays the role of instructor and practices teaching of a student pilot. The flight instructor plays the role of the student pilot, sitting in the left seat.

The student flight instructor flew his first abnormal and emergency procedures flight, an instruction flight, at Räyskälä on 16.5.2009. According to the flight instructor on that flight they flew no such simulated engine failures at takeoff during which they turned back towards the movement area or runway. All simulations resulted in selecting the landing site from the sector straight ahead. The student flight instructor also flew a few of the manoeuvres himself.

Since the student flight instructor had to suspend the abnormal and emergency procedures and cross-country flight training phase at Räyskälä, he was assigned an instructor from the Air Force Academy Flying Club. The club's flight instructor had no experience on how these flights are carried out in ultralight flight instructor training. He was in contact by phone with the flight instructor course's instructor who was originally scheduled to fly the remaining flights with the student flight instructor. This particular person did not instruct the student flight instructor on his first abnormal and emergency procedures flight on 16.5.2009. The course's flight instructor explained to the Air Force Academy Flying Club instructor how he should carry out the flights. Moreover, he asked him to write and send summaries of how the flights went for the purpose of archiving them at Finnish Air Sports Institute Ltd.

According to the instructor at the Air Force Academy Flying Club, their ultralight training does not include any turns back towards the runway or movement area in conjunction with simulated engine failures at takeoff. He did not question the guidelines he was given and the flight was flown in accordance with the guidance provided by the flight instructor course's instructor. The flight instructor recorded the events of the flight and sent the information to Finnish Air Sports Institute Ltd, as was previously agreed.

As per that document, they first simulated engine failure during the different phases of takeoff. The first simulation occurred right after they started to roll, while the aircraft was still on the ground. The second one was done right after lift-off, and the third from treetop level. Then they began to simulate engine failure at different altitudes. As per the flight instructor's account, the intention was to gradually fly the simulations from increasingly lower altitudes, until the low altitude prevented a turn-back. Then the student flight instructor would have understood from what altitude it was no longer possible to turn back.

On this flight they practiced four such simulated engine failures during which they turned back towards the runway. The first one was started at 500 feet (152 m) AGL by making a headwind turn-back towards the runway. Their notes stated that the remaining altitude

was 175 feet (53 m). The second simulation was started at 400 feet (122 m) AGL, also by making a headwind turn-back towards the runway. The remaining altitude was 50 feet (15 m) and they initiated a go-around from the height of five metres. Then they made two simulations from 350 feet (107 m). When they first made a headwind turn, the remaining altitude was recorded as 'low' and when they made a tailwind turn on the second attempt, they noted that they would no longer have made it to the runway. Both attempts ended in go-arounds. As far as the flight instructor could remember, the student flight instructor had the controls during the manoeuvres. The remainder of the 40 minute-long flight was used in practicing a prepared emergency landing and one spot landing from 1500 feet QNH.

According to the information provided to the investigation commission, the student flight instructor had assumed the practice of calling out loud 500 feet QNH during the climb after takeoff. This was the sign that a turn-back would be possible if there was an engine failure. At Kauhava, this corresponds to 350 feet AGL.

1.16.7 A survey of ultralight training

In order to establish practices related to ultralight training, the investigation commission promulgated a survey to 31 flying clubs that are approved to provide ultralight training as well as to Finnish Air Sports Institute Ltd which trains ultralight flight instructors.

The survey attempted to establish whether it is a common practice to train pilots to turn back towards the movement area with engine emergencies following takeoff. Furthermore, information was requested with regard to flying clubs' possible additional requirements for operating as pilot-in-command or flight instructor, the type of instruction that they allowed for student flight instructors as well as the supervision of the student flight instructors. In addition, the number of the aviation authority's training inspections was one of the questions in the survey. Altogether 32 questionnaires were sent, of which 21 were returned.

Judging by the feedback, most respondents do not instruct student pilots to turn back towards the movement area in emergency landing training. The answers, however, revealed quite diverse views regarding the need and implementation of this training. Due to safety constraints, some organisations do not demonstrate the turn-back at all. Still, some said that flight instructors show their students from what altitude this manoeuvre would be doable. Approximately 25 per cent of the respondents said that they train their students to turn back. Among other things, this practice was justified on the grounds of the excellent climb performance of the ultralights, flight number 12/13E in the ultralight/powered glider training syllabus as well as corresponding PPL training.

The training ultralight flight instructors of Finnish Air Sports Institute Ltd answered that flight instructors must be able to fly this manoeuvre in order to teach or demonstrate it to their students. According to interviews there are also flight instructors at Finnish Air Sports Institute Ltd that neither teach nor demonstrate the turn-back in ultralight flight instructor training.

Most sport flying clubs did not post any specific requirements, in addition to the ones provided by aviation regulations, on operating as pilot-in-command or flight instructor. Approximately one third of the clubs required one refresher flight with a flight instructor after a hiatus of several months (springtime or club proficiency test) from, at least, those pilots that have limited flying experience.

Aviation Regulation PEL M2-71 determines the student flight instructor's right to provide UPL flight training, under supervision and with certain restrictions. Nonetheless, judging by the responses it is safe to say that there are many interpretations to this particular provision. Not even one of the replies mentioned that supervision or the training of the supervisor was based on written instructions.

A little more than half of the organisations that responded to the survey had had a sport aviation training inspection conducted by the aviation authority, or their designated representative.

1.17 Organisational and management information

1.17.1 Government oversight of ultralight aviation

As of 1 January 2010, the Aviation Sector of the Finnish Transport Safety Agency (Trafi) is the Finnish Civil Aviation Authority (CAA) in Finland. The civil aviation regulatory issues, previously handled by the Finnish CAA, were transferred to Trafi Aviation. In this report the Finnish CAA is referred to as Trafi Aviation.

On 25.4.2006, Trafi Aviation and the Finnish Aeronautical Association signed an agreement regarding assistance in sport aviation government oversight. Section 163 of the Aviation Act (1242/2005) was given as the legal basis for this agreement. According to the agreement, the Finnish Aeronautical Association will provide expert services to Trafi Aviation in the supervision of sport aviation activities and training as well as in monitoring the equipment used in said activities. In the agreement, the term sport aviation refers to parachuting, hang gliding and paragliding as well as gliding and powered gliding, ultralight flying, experimental flying and ballooning.

Pursuant to the agreement, the Finnish Aeronautical Association provides assistance in the oversight of ultralight aviation by preparing its curricula. Moreover, it participates in ultralight training inspections and assists Trafi Aviation, if needed.

The Finnish Aeronautical Association provides comments to Trafi Aviation on ultralight construction permits and organises their inspections. The Finnish Aeronautical Association also provides assistance in inspections related to ultralight importing and construction, and organises their type acceptances. In addition, the Finnish Aeronautical Association participates in the preparation of ultralight regulations and guidelines concerning ultralight aircraft.

1.17.2 Organisation of flight training in sport aviation

Aviation Regulation TRG M1-7, which concerns the flight training in sport aviation, was published on 5.5.2009. In addition to ultralight training, it regulates powered gliding and autogiro training as well as ballooning. The previous version of the sport aviation regulation was dated 20.12.2007. Prior to this, regulations pertaining to the different disciplines of sport aviation were dispersed among various aviation regulations.

Pursuant to TRG M1-7, the right to provide flight training requires a training organisation approval issued by the aviation authority. The regulation defines the requirements of the training approval as regards the training organisation personnel and, for example, the premises used in training, internal monitoring, aerodromes and aircraft. This aviation regulation does not apply to differences or familiarisation training.

According to the regulation, the head of training shall bear overall responsibility for training. The head of training must see to it that training follows the terms of the approval as well as valid rules and regulations, the guidelines of the aviation authority and the holder of the training approval. Training must also be provided in accordance with the approved curriculum. The head of training shall monitor progress in training as well as training-related activities. Furthermore, he shall immediately intervene in shortcomings and deviations from regulations as well as terms of the approval and/or the licence holder's own instructions, and take the necessary corrective actions.

Flight training must be organised in accordance with the curriculum approved by the aviation authority. For each aircraft category there must be a chief flying instructor. The chief flying instructor must hold a valid flight instructor licence for his aircraft category when giving flight instruction. In addition, the chief flying instructor is responsible for the supervision of flight instructors and student pilots in his aircraft category.

Only flight instructors or student flight instructors approved for the task by the head of training may provide the kind of training mentioned in the training organisation approval. For a given segment in theoretical knowledge instruction, the head of training may approve a person whose flight instructor or student flight instructor rating is not valid, or some other expert in the field of aviation so long as his credentials, knowledge, skills and aptitude qualify him to act as an instructor. The regulation also contains provisions on the number of recurring flight hours as well as the contents of the recurring flight training for flight instructors.

1.17.3 Ultralight Pilot Licence curriculum

Trafi Aviation approves the UPL curriculum prepared by the Finnish Aeronautical Association. The latest version of the curriculum was approved on 11.11.2008. The curriculum covers the minimum requirements of ultralight and powered glider licence training. The investigation commission became especially acquainted with the following topics in the curriculum: low speed manoeuvring, stall and upset recovery training, abnormal and emergency procedures training as well as loading the aircraft.

Theoretical knowledge instruction

Theoretical knowledge instruction includes a total of 48 hours in the UPL curriculum. According to the curriculum, aerodynamic instruction includes, inter alia, stalling and aeroplane characteristics at the stall, factors affecting stalling speed and aeroplane behaviour, stalling from descending and turning flight, the signs of an approaching stall and stall warnings as well as recovery from the stall.

Topics in basic flight theory include, for example, a gradually and rapidly developing stall, accelerated stall, acceleration coefficient and stall speed in turning flight, a prepared emergency landing and emergency landing following takeoff.

Topics in Flight Performance and Planning include limitations on maximum mass as well as mass and balance calculations on the basis of the AOM and its mass and balance form.

Flight training syllabus

The combined ultralight/powered glider flight training syllabus in the UPL curriculum includes altogether 26 flights as well as the skill test before the first solo flight.

The general instructions of the curriculum state that the required topics are divided into training sessions which, for the most part, make up thematic entities. The contents of an individual flight can be flown on several flights, and the contents of several flights can be combined into one flight. According to the syllabus, exercises 1–14 must be taught before the first solo flight. The syllabus makes no mention as to who shall decide on dividing or combining the contents of flights.

The contents of exercises in the syllabus are listed at bullet-points and in concise listings that describe the topics to be taught. No goals are set for individual flights. Neither does the syllabus indicate the performance values, limitations or instructions for manoeuvres on the flights. Nonetheless, note number 2 in the syllabus states that the AOM's limitations pertaining to manoeuvring, maximum mass and centre of gravity must be followed.

The objective of exercise 10A in the flight training syllabus is to teach the student to recognise critically low airspeed, to maintain control of the aircraft and to recover the aircraft into a normal flight speed. Exercise 10B teaches the stall and stall recovery in different configurations. The topic of exercise 11 is spin avoidance. Accelerated stall and spiral dive, as well as recovery from them are the topics of exercise 14. Note 1 in the syllabus states that students must fly at least one hour of instruction flights on which stall recovery and spin avoidance is practiced.

According to the syllabus, the first abnormal and emergency procedures training occurs on exercise 12/13E. The list of topics for this flight includes, among other things, engine failure following takeoff. Exercise number 15 is the first solo flight in the flight training syllabus. As regards the instructions for the flight, it is stated that all previously taught manoeuvres shall be practices, with the exception of stalls, recoveries, spins, emergency landings and aborted takeoffs.

The topic of exercise 16 includes forced landings without engine power. According to the syllabus the flight includes, for example, the emergency landing procedure, landing site selection, glide distance and the planning of an emergency landing pattern. The syllabus does not elaborate whether abnormal and emergency procedures training includes such forced landings following takeoff where one attempts to turn back towards the runway or movement area.

1.17.4 Ultralight flight instructor curriculum

The ultralight flight instructor training curriculum, prepared by Finnish Air Sports Institute Ltd, is based on Aviation Regulation PEL M2-71. The valid version was approved on 23.9.2009. This curriculum is included in the training organisation approval, issued by Trafi Aviation.

The instructor course shall last no less than 10 days and, according to the curriculum, is divided into two parts. The first part includes a written entrance examination and theoretical knowledge instruction given over two days. The second part includes theoretical knowledge instruction, flight training, an evaluated classroom lesson given by the student, written final exams and a skill test. An approved entry examination is the precondition for attending the second part. The second part lasts 8–10 days. In all, the curriculum includes 28 theoretical knowledge lessons. Theoretical knowledge instruction is mainly concentrated on pedagogy, instruction technique and basic flight theory. For the ultralight flight instructor course there are no entrance requirements that measure the adequacy to become a flight instructor.

When it comes to flight training, the objectives of the course are to become proficient in flight instruction and to hone the student flight instructor's personal flying skills. In addition to the skill test, the syllabus includes a total of 11 flights with varying contents. The first flight is a skill level test; the flight lasts 15 minutes during which time the adequacy of the student flight instructor's flying skills should be established. Some of the flights on the instructor course are flown as single instruction flights, but most of them are flown on three sorties. The first sortie is an instruction flight, the second one is an instruction practice flight, with the flight instructor, and the third sortie is flown as an instruction practice flight, with another student. Flight number 7, which includes abnormal and emergency procedures at takeoff and in flight, is flown on two sorties: first as an instruction flight and then as an instruction practice flight, with the instructor.

The syllabus advises that the flight instructor course amounts to at least 25 flights, totalling at least 13 flying hours. The flight syllabus consists of a single-page table. The contents of each flight are listed in the table in short sentences. There are no objectives or instructions for the exercises. Apart from cross-country flight training, flights last anywhere between 15 to 40 minutes.

1.17.5 Finnish Air Sports Institute Ltd

The Finnish Aeronautical Association is the principal owner of Finnish Air Sports Institute Ltd. The institute is situated at the Räyskälä flying centre. In 2009, Finnish Air

Sports Institute Ltd was the only training organisation in Finland that held a ultralight flight instructor training approval. The flight instructors that are needed to carry out the annual ultralight/powered glider flight instructor course are included in the annex of the training organisation approval. There are no particular proficiency requirements for flight instructor course instructors.

There were 13 students on the 2009 ultralight flight instructor course. At the onset, there were three flight instructors. However, when inclement flying weather slowed the progress of the course at Räyskälä, they had to call in more instructors, up to seven by the end of the week, so as to fly all of the flights included in the training syllabus.

1.17.6 Finnish Air Force Academy Flying Club

The membership of the Finnish Air Force Academy Flying Club is comprised of approximately 170 persons who are engaged in aeromodelling, paragliding and gliding as well as ultralight and SEP flying. The club operates at Kauhava aerodrome. The club has an head of training and chief flying instructors for each discipline of activities. There are three flight instructors for ultralight flying. The student flight instructor who perished in the accident was listed in the club's training organisation approval. A supervising instructor was assigned to him. According to the information provided to the investigation commission, the club has no written instructions pertaining to the supervision of student flight instructors.

1.18 Other information

During the investigation it was repeatedly noticed that maximum takeoff weight limitations for ultralight aircraft are not followed. Pursuant to Joint Aviation Authorities definitions, Aviation Regulation AIR M5-10 limits the maximum takeoff weight for two-seat ultralight landplanes to 450 kg. The payload capacity of ten randomly selected Finnish-registered ultralight types was calculated to be approximately 180 kg. This was based on aircraft manufacturers' weight information. Payload capacity as per the aviation regulation for two-seat ultralight aeroplanes is 175 kg. For example, the accident aircraft's payload capacity with justifiable aircraft equipment was 169 kg and, adding in the 'bare essentials', 176 kg. Allowing for fuel, the total mass of two persons often exceeds the payload, resulting in an overload.

The aircraft operating manual's performance figures are normally based on the maximum takeoff weight. Excessive weight degrades aircraft performance. Takeoff distances become longer, climb and turn performance deteriorates and stalling speeds grow. Moreover, the AOM's cruise and landing performance figures no longer hold true with overweight. Excessive weight affects the manoeuvrability of the aircraft which, in turn, may impact the controllability of the aircraft. Changes may vary from type to type and it is very difficult to precisely predict them. Exceeding the maximum allowable mass in flight stresses the aircraft's structures, possibly to the extent that they endure unpredictable changes. In order to underscore this issue the following warning is in, for example, the accident aircraft's AOM: 'Maximum takeoff weight must not exceed 450 kg!'

2 ANALYSIS

2.1 Background information of the accident flight

After an approximately two years hiatus in flying the pilot had to reinstate his licence privileges by flying an instruction flight with a flight instructor. This flight was flown at Kauhava with the same aircraft a week before the accident. The flying club's student flight instructor, a previous acquaintance to the pilot and a fellow sport aviator, acted as the instructor. They had agreed to fly another flight together, probably at the behest of the pilot. This corresponded with the pilot's careful manner. Even before his hiatus he had been cautious as regards flying-related issues. This may have contributed to the fact that he had begun flying less two years earlier as well as to the hiatus.

The specific contents of either flight are not known. Most probably, the first flight's objective was to regain the pilot's flight currency in handling and controlling the aircraft in general; the flight included three takeoffs and landings. The objective of the second flight may have been to practice takeoffs and landings as well as various simulated engine failures in the traffic circuit.

The contents of the first flight were fully justifiable in reinstating flight currency after a hiatus. After the successful first flight, takeoffs and landings as well as spot landings were the proper topics for the second flight. It is not known whether they planned to include a simulated engine failure at takeoff for the programme of the second flight, or if they included it on the spur of the moment in flight. In either case it was an error in judgement, implying inexperience and ignorance with regard to the difficulty of this type of an emergency landing.

2.2 The accident flight

The first phase of the flight was presumably uneventful. It is not uncommon to end the first spot landing in a go-around instead of making a touch-and-go landing. This was an indication of the pilot's lacking flight currency and the need for more practice. The investigation commission believes that the pilot flew the aircraft himself in the traffic circuit and during spot landings. This is based on the fact that the pilot had to practice landings and spot landings, and that he made the radio calls from the beginning of taxiing to the third spot landing's downwind call.

In conjunction of the third spot landing the student flight instructor called his intention to make a full stop on the runway and to begin the simulated engine failure and emergency landing practice following the takeoff from 500 feet. They planned to turn back and land on the runway.

The investigation commission believes that the student flight instructor flew the aircraft from takeoff after the stop-and-go landing. This premise is primarily based on experience and familiarity with flight instruction as well as on the fact that the student flight instructor himself made the radio calls related to this exercise. Turning back and landing on the runway following a simulated engine failure from low altitude at takeoff is a de-

manding manoeuvre. The pilot was not adequately prepared for this. In conjunction with his flight instructor training, the student flight instructor had flown an instruction practice flight at Kauhava in June 2009. It is highly likely that the student flight instructor wanted to demonstrate the proper way to fly this manoeuvre by flying and simultaneously talking. The pilot was supposed to follow gently on the controls. Following this, he may have been permitted to fly the next manoeuvres himself.

The simulated engine failure was started at 500 feet QNH, which corresponds to approximately 350 feet (107 m) AGL at Kauhava. In view of the intended manoeuvre the altitude was low. When the student flight instructor flew four instruction practice flights, he lost an average of 325–350 feet during the turn-backs. Then the turns were made into the headwind. When they turned into the tailwind they were too low to make it to the runway. The student flight instructor considered 500 feet QNH as his decision altitude as regards a turn-back. The reasoning for this was never established.

According to the eyewitness account, the right turn-back into the headwind began normally. In the beginning of the glide the aircraft's nose dropped fairly low. If the manoeuvre begins from a climb, this is necessary to achieve 60 knots (110 km/h), i.e. the airspeed of the best gliding ratio. Nonetheless, this results in a relatively high loss of altitude, particularly in view of the low initial altitude. Almost simultaneously with the onset of the glide they began a turn at, approximately, a 30–45 degree bank angle. The glide angle was at its steepest in the beginning of the turn, becoming more moderate after this. When the turn continued towards the runway, the aircraft stalled. Simultaneously, it rolled abruptly to the right, probably as a result of an unintended sideslip and collided almost vertically with the ground.

It is normal to flare from a glide when the ground approaches. However, this also results in decreasing airspeed. The stalling speed, at approximately the 480 kg which was the flight mass in use, in a clean configuration (flaps retracted) and in a 30–45 degree turn is 45–51 knots (83–94 km/h). The corresponding stalling speed with flaps in position 1 is 43–48 knots (79–88 km/h). It was impossible to determine what the flap position might have been during the turn which resulted in the accident.

Flying the aircraft from the right seat in a right descending turn, a dynamic process which requires constant application of flight controls, is a demanding manoeuvre and requires good flight currency. The fact that the airspeed and the turn and bank indicators are on the left side of the instrument panel and that there is simultaneously a constant need to look to the right only makes it more difficult. The low altitude causes the relative speed to the ground seem higher, which may make it more difficult for an inexperienced pilot to exercise judgement and control the situation. Without a correctly-timed reduction in bank and increase in engine power, airspeed bleeds off rapidly as the glide angle becomes more gradual.

The investigation commission believes that the student flight instructor was unable to sufficiently monitor airspeed during the demanding descending turn. Due to the low altitude, the glide angle became more gradual and airspeed decreased to stalling speed without him noticing it. The student flight instructor did not perceive the development

early enough; this is why he was no longer able to regain control by applying possible recovery measures from the descent and turn.

2.3 The effect of meteorological conditions

The weather was good for ultralight operations. At takeoff, the 8 knots headwind came slightly from the right, which they properly took into account in the emergency landing practice by first turning into the headwind and then towards the movement area. In this case the wind assisted the turn-back by decreasing the turn radius. In a turn, the change from headwind to tailwind does not affect the aircraft's airspeed-related performance values, such as the stalling speed. After the aircraft had turned approximately 90 degrees, the wind came from abaft the beam, thereby augmenting the glide distance. Simultaneously, this naturally increased the aircraft's ground speed as well.

It is possible that the transition from headwind to tailwind gave the impression of increasing airspeed to the person flying the aircraft, caused by the visual references from the relative speed to the ground. If he was unable to adequately monitor airspeed indication during the manoeuvre, this could have contributed to the flare-out as an attempt to control his airspeed. The investigation commission does not consider the effect of the wind to be a significant contributing factor to the accident.

2.4 Condition of the ultralight aircraft

Technical inspections did not find any fault in the aircraft prior to the accident. The aircraft was airworthy before the accident flight. Judging by the marks on the inside of the engine as well as damage to the propeller, it can be deduced that the engine was running when the aircraft collided with the ground. The investigation commission does not regard the condition of the aircraft as a cause or contributing factor to the accident.

2.5 The pilot's flight experience and flight currency

The pilot had little total flying experience; it amounted to approximately 47 hours. His theoretical knowledge instruction and flight training for UPL licence in 2006 had proceeded normally. He had practiced turn-backs towards the runway in conjunction with simulated engine failures following takeoff. It is not certain whether he was controlling the aircraft at that time. Nonetheless, the investigation commission considers it evident that he did not have any substantial familiarity or currency with regard to turn-backs towards the runway following simulated engine failures.

In 2007, the pilot amassed approximately ten flight hours. Following this, he dropped out of sport aviation for over two years. When he restarted his ultralight hobby, his flying currency, in addition to his scant flying experience, was poor. The pilot had flown all flights on the accident aircraft. Therefore, the type as well as its cockpit layout was familiar to him. Moreover, he was familiar with Kauhava aerodrome and its environs as well as the local conditions.

2.6 The student instructor's flight experience and flight currency

The student flight instructor had started flying in the very same flying club, and the same year as the pilot. While they had enrolled on the ultralight theoretical knowledge course at different times, the same flight instructor at Kauhava had provided ultralight training to both of them. The student flight instructor's ultralight training had proceeded normally. During the first year he flew 45 hours.

The student flight instructor actively pursued his aviation interest, enrolling on glider and landplane training in 2007. While his glider experience remained quite limited, his total flying experience of 290 hours can be considered reasonably good. Since he had flown approximately 150 hours on the accident aircraft, he was familiar with the type. In May 2009, he completed the ultralight flight instructor course and during the past three months he had flown approximately 46 hours, 43 of which on the accident type. His flight currency was good, but his actual flying experience from the instructor seat was modest.

2.6.1 Emergency landings following takeoff

As was the case with the pilot, the student flight instructor's ultralight training in 2006 included turn-backs towards the runway in conjunction with simulated engine failures following takeoff. It is not certain whether he was controlling the aircraft at that time. The investigation could not establish whether the student flight instructor had practiced turn-backs on his solo flights prior to the ultralight flight instructor course. Still, the investigation commission regards it probable that he had little experience with turn-backs in conjunction with simulated engine failures before the flight instructor course.

During the flight instructor course the student flight instructor received contradictory instructions for two flights involving abnormal and emergency procedures following takeoff. During the course's flying segment at Räyskälä the simulated engine failure instruction flights did not include any turn-backs towards the runway at all. The content and implementation of the second flight at Kauhava was totally different. The unmistakable aim of this flight was to establish from how low it would still be possible to turn back towards the runway from the initial climb. The instructions were received from another flight instructor at Finnish Air Sports Institute Ltd. It can be stated that the course's flight instructors did not share uniform training principles. The investigation commission believes that the absence of written guidelines is the main reason for this.

On the basis of his training, the student flight instructor did not have the ability to act as an instructor with regard to turn-backs. During his instruction flight he was not taught to instruct or to fly turn-backs and, therefore, his experience from the instruction practice flight cannot be considered sufficient. On the EV-97 ultralight aircraft the airspeed indicator as well as the turn and bank indicator are on the left side of the instrument panel. It takes a lot of practice to fly the aircraft from the right seat in situations in which the pilot must also constantly and precisely control airspeed and sideslip.

It is the opinion of the investigation commission that, as regards the student flight instructor, there were serious shortcomings in the flight instructor course's abnormal and

emergency procedures training. In flight instructor training there should be no instructor-specific differences as to the content of instruction flights, or how things are taught. In this case the student flight instructor, having successfully completed the flight instructor course, was left with a misguided impression with regard to the principles of teaching abnormal and emergency procedures. Moreover, when it comes to turn-backs, he was definitely unprepared for simultaneous flying and teaching.

2.7 Ultralight training curriculum

The investigation commission regards the UPL theoretical knowledge curriculum, published by the Finnish Aeronautical Association on 11.11.2008, as sufficient. When it comes to the flight training syllabus the investigation commission considers it a clear shortcoming that the syllabus is only a list. While the syllabus lists the topics included in different exercises, it does not explain how or why they are intended to be flown. From the standpoint of flight instruction it would be reasonable to establish a goal for each flight. This would make it easier for flight instructors to evaluate their students in view of the goal as well as their capacity to advance in training.

Since several different types of aircraft are used in ultralight aviation, it is clear that the syllabus cannot be tailored to suit all aircraft types' performance figures. Nevertheless, the syllabus should provide students and flight instructors with the basis for recommended altitudes, bank angles and airspeeds as well as important flight safety-related questions. This would improve standardisation and safety in ultralight flight training compared to the present situation, in which the contents and implementation of flights easily become instructor-specific.

2.7.1 Ultralight emergency landing training

The second edition of Ultralight – Powered Glider textbook, published by the experimental and ultralight committee of the Finnish Aeronautical Association in 2008, does not clearly explain how to make an emergency landing with an ultralight aircraft following engine failure at takeoff. The investigation commission believes that it might cause problems to combine ultralight and powered glider theoretical knowledge instruction in a single textbook. In particular, their different characteristics, for example in glide performance, would require, at least here and there, clearly segregated instructions. The present altitudes provided for abnormal and emergency procedures apply to powered gliders, but they should not be used as such with ultralight aircraft. Because of varying conditions, pilot and aircraft performance, the takeoff profile in use as well as the length of the available runway, it is risky to post a minimum altitude that allegedly guarantees a successful turn-back. Neither should the minimum turn-back altitudes given in aircraft AOMs be directly applied to practice because they often represent manoeuvres flown by well-prepared and experienced test pilots in ideal conditions.

Judging by the results of the questionnaire, some of the clubs that provide ultralight training continue to teach turn-backs to their students. Then again, others said that they expressly disallow it. Turn-backs were justified by the fact that in PPL training, too, students are instructed to turn back after engine failures following takeoff. The investigation

commission made some inquiries and, according to the results, modern PPL training or SEP flight instructor training does not include turn-backs towards the runway in such situations.

It would probably be impracticable to categorically ban turn-backs towards the movement area, taxiway or runway. Yet, it would be beneficial to have a policy with regard to emergency landing practice in conjunction with simulated engine failures following takeoff, in contrast to practice that aims at selecting the best landing spot from safe altitudes, such as those used in spot landing practice. It is the opinion of the investigation commission that, during takeoff or initial climb, when the aircraft is below traffic circuit and cross-country flight altitude, it is the safest thing to teach only how to carry out an emergency landing in the sector ahead with as small changes in flight direction as possible. If there is a desire to teach turn-backs to ultralight pilots, there should be more training in manoeuvring at low-airspeed or in departure-prone areas of the flight envelope so as to improve flight safety. This being the case, turn-backs in emergency landings should also be included in skill tests.

2.8 Ultralight flight instructor training

2.8.1 Ultralight flight instructor training curriculum

The student flight instructor met the entrance requirements set for the ultralight flight instructor course's students. According to the curriculum, the goal of flight instruction is to achieve proficiency in flight instruction and hone the students' personal flying skills. According to the present model, the flying skills of students admitted to flight instructor training are not evaluated prior to the flight instructor course. The first flight on the course includes an assessment of the skill level; no students have been barred from attending the ultralight flight instructor course on the basis of this flight.

It is the view of the investigation commission that the students must possess good flying skills as well as proper pilot and flight instructor qualities in order to achieve the goals of the present curriculum within a little over one week's flying. Their entry-level skills should be established before the onset of the course. If students have shortcomings in their personal flying skills, the present time reserved for the course is too short to train them to become flight instructors.

With regard to the flight instructor course's flight syllabus the investigation commission identifies the same shortcomings as in the UPL flight syllabus. The syllabus is mainly a bullet-point listing of the topics that should be flown on a given flight. While it lists the topics, it does not elaborate on them, nor does it explain how and why the exercises should be carried out. Flight number 7 is a good example of this. According to the syllabus the intention is to practice, among other things, abnormal and emergency situations at takeoff and in flight. Still, there is no mention as to what abnormal and emergency procedures are to be practiced, or how they should be practiced. The content of the flight does not indicate whether the intention is to teach students to turn back towards the runway or, solely, practice forced landings in the sector ahead. Moreover, there is no mention regarding relevant altitudes or other performance figures, for that matter.

The investigation commission believes that, for the sake of flight safety and standardisation in training, flight instructor courses' syllabi should include goals and, at a minimum, thematic guidelines and instructions for the practical implementation of manoeuvres.

2.8.2 Proficiency requirements for flight instructor course instructors

There are no proficiency or training requirements for flight instructor course instructors. When the student flight instructor was unable to fly two flights included in the syllabus, Finnish Air Sports Institute Ltd assigned him a flight instructor who had not completed an ultralight flight instructor course; nor had that instructor ever instructed as flight instructor at Finnish Air Sports Institute Ltd. At the time he had little personal ultralight experience and experience in ultralight flight instruction. He did not have the sufficient capacity to teach the instruction practice flight assigned to him which included abnormal and emergency procedures. To teach flight instructors is a special duty which, as per the investigation commission, requires above-average competence and a sufficiently long experience as a flight instructor on the type in question. The investigation commission believes that there should be written proficiency standards for flight instructors selected to teach on sport aviation flight instructor courses, and that opportunity for training that provides such proficiency be arranged.

2.9 The rights of a student flight instructor and his supervision

The Air Force Academy Flying Club had properly added the student flight instructor's name to the teaching approval and a supervising flight instructor was assigned to him. The supervisor was aware of the training progress of the student flight instructor and that of the student pilot that was assigned to him. The supervising instructor was not aware of any other flight training the student flight instructor was carrying out or planning.

It is the view of the investigation commission that the supervising flight instructor should be aware of all instruction his supervisee intends to carry out. When it comes to flight instruction, student flight instructors should only be permitted to provide basic training, i.e. train two student pilots up to the UPL licence, as provided by the aviation regulation. Any continued or recurring training would only be provided by fully rated flight instructors. The rating of the ultralight student flight instructor did not qualify him to operate as the flight instructor on the flights he flew with the pilot. Guidelines for cooperation between the student flight instructor and his supervisor, as well as the tasks and responsibilities of the supervising flight instructor should exist in written form. These guidelines should also be included in the flight instructor course curriculum.

2.10 Government oversight in ultralight aviation and aviation regulations

Notwithstanding the investigation commission's remarks in this report regarding certain problems also with aviation regulations, the commission believes that the entity of ultralight aviation regulations is comprehensive and up to date. Judging by the questionnaire conducted during the investigation, government oversight has also been satisfactory in the form of training inspections carried out at flying clubs.

During interviews it was repeatedly mentioned that the maximum takeoff weight of ultralight aircraft is often exceeded when operating with a two-person crew. This is caused when the payload capacity of ultralight aircraft is not sufficient for the combined weight of a two-person crew and the fuel load. After the initial weighing, the aircraft's equipment list may be augmented by devices that make flying easier, which only further reduces the payload capacity. The excessive weight degrades aircraft performance and negatively impacts flight safety. The investigation commission got the impression that enough attention is not payed to excessive weight even in flight training. The impression was formed bacause training flights are flown with aircraft that exceed the maximum takeoff weight and mass and balance calculations are normally only required for cross-country flights. This practice probably relies on a requirement in Aviation Regulation TRG M1-7. If the aircraft exceeds the MTOW the captain cannot justify his decision by having used standard weights for persons.

It would be possible to avoid flying with excessive weight, and to improve flight safety, by calculating the weight and balance for each flight by using true values. The calculations provide reliable loading parameters for each individual flight. The investigation commission holds that the aviation authority must intervene in the practice of flying with excessive weight, prevalent in ultralight operations.

2.11 Rescue and survival aspects

Emergency alerting

Judging from the eyewitness report, the ERC personnel assumed that the target was either in sight or, at least, easy to find. According to the ERC, during previous aviation alerts the Kauhava ATC has been open and their air traffic controllers have alerted the ACC and the ARCC.

Aerial searches should not be launched without ARCC command and ATS coordination. From the standpoint of the ARCC, the ERC should immediately report any aviation-related accidents to them. No harm is done if the ARCC receives word of the same accident through several channels. ERCs cannot rely on reports being made by air traffic controllers because flight operations at aerodromes outside ATC hours are typical. While it is not always necessary to search for the accident aircraft, the ARCC is better prepared to do so if they receive word of an accident early enough.

Search

The accident occurred in the movement area and was seen by an eyewitness. Still, it took approximately 40 minutes to locate the accident site. Had Kauhava ATC been open and the Training Air Wing rescue service been in operational readiness, the target would probably have been located sooner. Air traffic controllers would have been in a position to more precisely locate the crash site visually and rescue personnel would have arrived at the site in a matter of minutes.

It is fully understandable that the Air Force Academy Flying Club's SAR-trained pilots decided to launch an aerial search. Still, they could have contacted Tampere ACC, in which case the ARCC for South Finland would have also been notified of the accident and the launching of the aerial search. This being the case, the ARCC would have been in the position of operating in accordance with their command responsibilities.

Rescue

As a result of the trauma sustained in the collision with the ground, the crew perished immediately. Any delays in launching a SAR operation or alerting the ARCC were irrelevant in this situation with regard to the aircrew's survival aspects.

3 CONCLUSIONS

3.1 Findings

1. The aircraft's Certificate of Registration and Permit to Fly were valid.

2. The pilot had a valid UPL licence and a Sport Aviator's Medical Certificate.

3. The pilot's total flying experience was 47 hours. In addition to his limited experience, his flight currency was poor, due to a hiatus in flying of over two years.

4. The student flight instructor had a valid UPL licence as well as a GPL licence and a PPL licence, including the required medical certificates.

5. The student flight instructor's total flying experience was 290 hours. He had flown approximately 200 hours on ultralight aircraft. While his flight currency was good, his experience with flying from the instructor's side was limited.

6. Neither the Ultralight – Powered Glider textbook, which is used in UPL theoretical knowledge instruction, nor the EV-97 AOM provide unambiguous instructions on how to execute an emergency landing during an engine failure following takeoff.

7. The listing that describes the content of abnormal and emergency procedures practice, included in the UPL flight syllabus, contains a mention on simulated engine failure following takeoff. More precise guidelines or instructions are not included.

8. During their UPL training flights the pilot and the student flight instructor had flown turn-backs to the runway in conjunction with simulated engine failures following takeoff.

9. The flight syllabus of the ultralight flight instructor course, organised by the Finnish Air Sports Institute Ltd, includes abnormal and emergency procedures at takeoff and in the air. More precise guidelines or instructions are not included.

10. On the flight instructor course, during the student flight instructor's first abnormal and emergency procedures flight, they did not fly any turn-backs in conjunction with simulated engine failures. Instead, all forced landings were planned in the front sector.

11. During the flight instructor course at Räyskälä, the student flight instructor did not have the time to fly all of the flights included in the course. The remaining flights were the instruction practice flight for abnormal and emergency procedures and the cross-country instruction flight.

12. In order to complete the student flight instructor's flight syllabus, the Finnish Air Sports Institute Ltd assigned him with an ultralight flight instructor from his own flying club at Kauhava. While the instructor had never enrolled on an ultralight flight instructor course, his ultralight flight instructor rating was based on glider instructor

training and, as per the aviation regulation, UPL licence, required experience as pilot-in-command and a flight instructor skill test.

13. During an abnormal and emergency procedures instruction practice flight at Kauhava, four such simulated engine failures were practiced which resulted in a turn-back towards the runway. The starting altitudes were 500 feet, 400 feet and 350 feet QNH.

14. The flying club's flight instructor had never taught turn-backs on ultralight aircraft in conjunction with simulated engine failures following takeoff. He received instructions for the flight from a flight instructor who had taught on the ultralight flight instructor course.

15. There are no proficiency or training requirements for flight instructor course instructors.

16. The investigation commission believes that there should be written proficiency standards for flight instructors selected to teach on sport aviation flight instructor courses and that opportunity for training that provides such proficiency be arranged.

17. Once the student flight instructor completed the flight instructor course's flight syllabus, he passed his ultralight flight instructor skill test. The skill test did not include any turns back towards the runway or movement area in conjunction with simulated engine failures at takeoff.

18. The student flight instructor's name was added to the Air Force Academy Flying Club's teaching approval. A supervising flight instructor and a student pilot to train for an UPL licence were assigned to him.

19. Pursuant to Aviation Regulation PEL M2-70, after a hiatus in flying of approximately two years the pilot had to fly an instruction flight with an instructor. On 28.7.2009, the pilot and the student flight instructor flew the flight which was logged as an instruction flight.

20. Pursuant to Aviation Regulation PEL M2-71, the holder of an ultralight student flight instructor rating is entitled to provide training for an UPL licence. This must occur under the supervision of a flight instructor approved by the head of training. Training organisations interpret this provision in many different ways.

21. It is the opinion of the investigation committee that an ultralight student flight instructor rating did not qualify the student flight instructor to act as a flight instructor on the flights he flew with the pilot.

22. It is the view of the investigation commission that student flight instructors should only be permitted to provide basic training, i.e. train two student pilots up to the UPL licence, as provided by the aviation regulation. Any continued or recurring training would only be provided by fully rated flight instructors.

23. The investigation commission believes that the entity of ultralight aviation regulations is, on the whole, comprehensive and up to date.

24. Judging by the questionnaire conducted during the investigation, government oversight has also been satisfactory in the form of training inspections carried out at flying clubs.

25. The pilot and the student flight instructor had agreed to fly yet another flight together before the pilot's solo flights. The second flight in question was the accident flight on 4.8.2009.

26. The supervising flight instructor, assigned to the student flight instructor, was not aware of the flights the pilot and the student flight instructor had flown on 28.7.2009 and 4.8.2009.

27. The investigation commission believes that the guidelines for cooperation between the student flight instructor and his supervisor, as well as the tasks and responsibilities of the supervising flight instructor should exist in written form.

28. The weather conditions were good for ultralight operations.

29. During the course of the third spot landing the student flight instructor called that they would fly a simulated engine failure and emergency landing practice following the takeoff and that their intention was to turn back and land on the runway.

30. After the spot landing they halted the aircraft on the runway. Then the student flight instructor called on the radio that they would practice a simulated engine failure from 500 feet (150 m) QNH.

31. The investigation commission believes that the student flight instructor took the controls with the intention of performing a demonstration.

32. Once they reached 350 feet (107 m) AGL, the student flight instructor set the throttle on idle and started the manoeuvre by promptly pushing the nose down and initiating a right turn.

33. A turn-back from a low altitude is a demanding manoeuvre. When the engine is set on idle in a climb, the nose must rapidly be pushed into a glide. Simultaneously, a sufficiently steep turn back towards the runway must be initiated.

34. On the EV-97 the airspeed indicator as well as the turn and bank indicator are on the left side of the instrument panel. The student flight instructor's experience, especially, with regard to flying and instructing the turn-back from the right seat was insufficient.

35. The student flight instructor was probably unable to sufficiently monitor airspeed. Due to the increasingly gradual glide angle, airspeed decreased to stalling speed.

36. The aircraft stalled and, simultaneously, rolled abruptly to the right. It collided almost vertically with the ground.

37. As a result of the trauma sustained in the collision with the ground, the crew perished immediately.

38. Judging by the inspection of the engine as well as the marks left in the terrain, the engine was running when the aircraft collided with the ground.

39. The aircraft and its systems were fully operational prior to the accident.

40. The aircraft exceeded the maximum takeoff weight of 450 kg by 32 kg. The centre of gravity was in the permissible range.

41. During the course of the investigation it became apparent that the maximum takeoff weight is commonly and consciously exceeded in ultralight operations.

42. There was an eyewitness to the accident. In addition, Kauhava ATC radar recorded most of the progress of the flight.

43. The accident occurred outside office hours and, hence, Kauhava ATC was not manned. The eyewitness immediately called the ERC after having observed the accident.

44. It took approximately 40 minutes from the alert to locate the accident site.

45. The ARCC was informed of the occurrence 39 minutes after it happened.

46. Any delays in launching a SAR operation or alerting the ARCC were irrelevant in this situation with regard to the aircrew's survival aspects.

3.2 Probable cause

The accident was caused by inadequate flight instrument monitoring while turning back towards the runway, i.e. during a technically demanding manoeuvre. When the airspeed bled off during the turn, the aircraft stalled, resulting in a loss of control. Upset recovery was not possible because of the low altitude.

Contributing factors include the prevailing culture in ultralight flight training, in which some flight training organisations or individual flight instructors have instructed students in abnormal and emergency procedures training to turn back towards the movement area in conjunction with simulated engine failures at takeoff, even from very low altitudes. Flight training syllabi do not include instructions for such a manoeuvre. During the accident flight the student flight instructor's flight experience and flight currency with regard to flying or teaching turn-backs towards the runway were insufficient.

4 SAFETY RECOMMENDATIONS

4.1 Measures implemented during the investigation

The Finnish Aeronautical Association has begun to prepare written instructions for the operation of supervising flight instructors.

The Finnish Air Sports Institute Ltd has decided to complement its ultralight flight instructor course material by making it more detailed and adding flight safety-related features in it. This is done with the intention to standardise and increase the safety of training.

4.2 Safety recommendations

1. Aviation Regulation PEL M2-71 defines the rating of a student ultralight flight instructor. Pursuant to it, the holder of an ultralight student flight instructor rating is entitled to provide training for an Ultralight Pilot Licence. This must occur under the supervision of a flight instructor approved by the head of training. Training organisations interpret this provision in many different ways.

The investigation commission recommends that Trafi Aviation clarify the content of the Aviation Regulation, making it unambiguous.

2. Student flight instructors in sport aviation operate under the supervision of a flight instructor approved by the head of training. There are no regulations for the operation of supervising flight instructors.

The investigation commission recommends that the Finnish Aeronautical Association prepare written guidelines for the instructors that supervise student flight instructors in sport aviation.

3. The contents of individual flights in the UPL syllabus and ultralight flight instructor course syllabus are only presented as short, bullet-point listings. This results in non-standardised training in which the manoeuvres and required skill levels on flights vary by flight instructor.

The investigation commission recommends that the Finnish Aeronautical Association lead a process in which the syllabi of ultralight pilots and flight instructors be made more detailed, and that instructions on how to fly manoeuvres as well as vital safety limits and goals for learning be included in the curricula.

4. Teaching flight instructors is a special duty which requires above-average competence and sufficiently long experience as a flight instructor on the type in question.

The investigation commission recommends that Trafi Aviation lead the preparation of written proficiency standards for the instructors of sport aviation flight instructor courses, and that opportunity for training which provides such proficiency be arranged.

5. If an aircraft is missing, the Aeronautical Rescue Co-ordination Centre is in charge of Search and Rescue flights. The Emergency Response Centre of Ostrobothnia informed the Aeronautical Rescue Co-ordination Centre for South Finland of the air accident 39 minutes after an eyewitness reported it to them. The aircraft and its crew were still missing at that time, but pilots in the local flying club had launched an aerial Search and Rescue operation on their own initiative. The Emergency Response Centre should notify the Aeronautical Rescue Co-ordination Centre of all air accidents reported to it.

The investigation commission recommends that Finavia Corporation and the Emergency Response Centre Administration update their mutual measures and instructions related to air accidents. A corresponding recommendation was issued on 15 January 2010 with regard to the B2/2009L investigation.

6. The maximum mass of ultralight aircraft is often exceeded when operating with a two-person crew. The excessive weight degrades aircraft performance and negatively impacts flight safety. That the maximum mass is exceeded is common knowledge among ultralight operators.

The investigation commission recommends that Trafi Aviation take action against the flying of aircraft exceeding the maximum takeoff weight.

In Helsinki 16.6.2010

Juhani Hipeli

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