Statens haverikommission
Swedish Accident Investigation Board

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Report RL 2010:03e

Accident to aircraft SE-GUP at Uddevalla
Rörkärr airfield, Västra Götaland county,
on 1 June 2009

Case L-06/09

SHK investigates accidents and incidents with regard to safety.
The sole objective of the investigations is the prevention of similar occurrences in the future. It is not the purpose of this activity to apportion blame or liability.

This report is also available on our web site: www.havkom.se

Statens haverikommission (SHK) Swedish Accident Investigation Board

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Statens haverikommission
Swedish Accident Investigation Board

2010-03-23 L-06/09

The Swedish Transport Agency

SE-601 73 NORRKÖPING, Sweden

Report RL 2009:03e

The Swedish Accident Investigation Board (Statens haverikommission, SHK) has investigated an aircraft accident that occurred on 1 June 2009 at Uddevalla Rörkärr airfield, Västra Götaland county, involving an aircraft registered SE-GUP.

In accordance with section 14 of the Ordinance on the Investigation of Accidents (1990:717) the Agency herewith submits a report on the investigation.

The Swedish Accident Investigation Board will be grateful to receive, by October 1, 2010, at the latest, particulars of how the recommendations included in this report are being followed up.

Carin Hellner Roland Karlsson

Stefan Christensen

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Report RL 2010:03e

L-06/09
Report finalised 2010-03-23

Aircraft; registration and type	SE-GUP, Cessna F 172 H
Class, airworthiness	Normal, valid ARC[1]
Registered owner/Operator	Uddevalla Flying Club
Time of occurrence	1 June 2009, at about 17:49 in daylight Note: All times are given in Swedish daylight saving time (UTC + 2 hours)
Place	About 150 m north-north-east of Uddevalla Rörkärr airfield, Västra Götaland county (posn. N58° 22.2' E011° 46.7', 36 metres above sea level)
Type of flight	Private
Weather	According to SMHI's analysis: Wind north-east 5-7 knots, visibility >10 km, cloud 0-1/8 altocumulus with base at 6000-8000 feet, temperature/dew point 25/7°C, QNH 1020 hPa
Persons on board:	1
crew members	0
Passengers	
Injuries to persons	1 fatal
Damage to the aircraft	Completely destroyed
Other damage	Limited damage to a clover bank. Approximately 50 litres of aviation fuel leaked out on to the ground.
Commander/Pilot:	
Sex, age, licence	Male, 69 years, PPL(A) licence
Total flying time	755 hours
Flying hours previous 90 days	19.5 hours, all on type
Number of landings previous 90 days	17

The Swedish Accident Investigation Board (SHK) was notified on 1 June 2009 that an aircraft with registration SE-GUP had an accident at 17:49 hours on that day at Uddevalla Rörkärr airfield, Västra Götaland county.

The accident has been investigated by SHK represented by Carin Hellner, Chairperson, Stefan Christensen, chief operations investigator, Roland Karlsson, operations investigator and Urban Kjellberg, investigator of Rescue Services.

SHK was assisted by Liselotte Yregård as a medical expert.

The investigation was followed by Ulrika Svensson, Swedish Transport Agency.

Summary

The flight was a private flight to search for an injured roe deer in the vicinity of Uddevalla Rörkärr airfield. When the aircraft was in a position of a left hand base leg to runway 21, the aircraft stalled and collided with the ground after entering a spin.

[1] ARC –Airworthiness Review Certificate

Causes of the accident

When the flaps were selected fully down the aircraft speed reduced to below the stall speed and the aircraft began a spinning movement before impacting the ground. The flying altitude was too low to correct the spin.

It is recommended that the Swedish Transport Agency should:

- inform licence holders of the risk of trim changes and speed loss resulting from the lowering of flaps to their maximum position *(RL2010:03 R1),*

- strive to ensure that aircraft in the light aircraft category are equipped with safety belts that provide increased personal protection in the case of accidents, without limiting the freedom of movement of the pilot and passengers *(RL2010:03 R2).*

1 FACTUAL INFORMATION

1.1 History of the sequence of events

The pilot intended from the air to search for a roe deer that was believed to have been injured in a road accident and to be in the vicinity of the Uddevalla Rörkärr airfield. A person with a hunting licence who was in the area had gone to the flying club and asked the pilot of the accident aircraft and another person who was helping to refuel the aircraft if they had seen the roe deer. The hunter suspected that the roe deer could be in the area north-east of the airfield and near to the brook that runs in an east-west direction at that location. Neither the pilot nor the other person had however seen any roe deer at that time. The pilot, who earlier on the same day had performed two flights in the local area, offered to search for the deer from the air, using the aircraft. The pilot took off from runway 21 at Uddevalla Rörkärr airfield and turned left round the hill that lies to the east of the airfield, thereafter flying in a westerly direction at low speed and at a low height along the side of the brook. When the aircraft was about 400 m north-east of runway 21, witnesses observed that the engine speed increased and the aircraft began to climb. Immediately afterwards the aircraft was seen to turn to the left and continued in a descending turn, after which it impacted at a steep angle with the ground at the edge of the brook, with its nose facing in a north-north-easterly direction.

The pilot was severely injured in the accident. Ambulance personnel arrived at the accident site 16 minutes after the alarm had been given, and the rescue services arrived four minutes later. The ambulance personnel immediately started cardiopulmonary resuscitation, but despite this and expert treatment in hospital the pilot died the same day.

The accident occurred at position N58° 22.2' E011° 46.7'; about 36 metres above sea level.

1.2 Injuries to persons

	Crew members	Passengers	Others	Total
Fatal	1	–	–	1
Serious	–	–	–	–
Minor	–	–	–	–
None	–	–	–	–
Total	1	–	–	1

1.3 Damage to the aircraft

Completely destroyed.

1.4 Other damage

Limited damage to a clover bank. Approximately 50 litres of aviation fuel leaked out at the accident site.

1.5 Personnel information

1.5.1 Pilot

The pilot, male, was 69 years old at the time and had a valid PPL (A) licence.

Flying hours			
previous	24 hours	90 days	Total
All types	7	19.5	755
This type	7	19.5	

Number of landings this class previous 90 days: 17.
Flight training on class carried out on: 29 June 1982.
Latest PC (Proficiency Check) carried out on 17 April 2008.

1.5.2 Injuries to persons

The pilot died after the accident. The forensic examination showed that the pilot had suffered extensive skull and brain injuries, injuries to the internal organs in the form of lung damage, heart injuries and trauma to the aorta along with skin damage. The cause of death was assessed to be skull and brain injuries.

Forensic chemical analysis of samples in respect of alcohol and drugs gave negative results, i.e. no substances were found.

During the forensic examination it was not possible to establish with any certainty whether the shoulder harness was used during the accident flight.

1.6 The aircraft

Fig. 1. Cessna FR 172 H, SE-GUP. Photograph with the permission of Derek Heley.

The aircraft	SE-GUP
Manufacturer	Reims Aviation, France
Type	Cessna F 172 H
Serial number	F172-0672
Year of manufacture	1969
Gross mass	Max. authorised take-off/landing mass 1,045/1,045 kg, actual approx. 886 kg
Centre of mass	Within permitted limits

Total flying time	6,193.5 hours
Number of cycles	
Flying time since latest inspection	59.1 hours
Fuel load	129 kg

Engine	
Manufacture	Rolls-Royce
Engine model	O-300-D
Number of engines	1
Total operating time, hrs	2377.6
Operating time since overhaul	203.2

Propeller	
Propeller manufacturer	Mc Cauley Propeller Systems
Propeller running time since basic inspection	1860.4 hours
Propeller	507.6 hours

The aircraft had an ARC valid until 30 April 2010.

1.7 Meteorological information

According to SMHI's analysis: A minor high pressure ridge covered southern Sweden.

Wind north-east 5-7 knots, visibility >10 km, cloud 1/8 altocumulus with base at 6000-8000 feet, temperature/dew point 25/7°C, QNH 1020 hPa. It was daylight at the accident.

1.8 Aids to navigation

Not applicable.

1.9 Radio communications

Not applicable.

1.10 Aerodrome information

Uddevalla Rörkärr airfield had the status of a non-licensed aerodrome in AIP AD[2] 1.1 and was described in the KSAB[3] Svenska Flygfält (Swedish Airport Manual). The airfield has a grass runway in the direction 030/210 degrees, called 03/21 and measures 655 x 30 metres. The height of the airfield above sea level is 38 metres.

1.11 Flight recorders and voice recorders

Not installed. Not required.

[2] AIP AD – Aeronautical Information Publication Aerodromes
[3] KSAB – Service company owned by the Royal Swedish Aero Club (KSAK)

1.12 Accident site and aircraft wreckage

1.12.1 Accident site

The site of the accident is located about 150 metres north-north-east of the beginning of runway 21 at Uddevalla Rörkärr airfield, Figures 2 and 3, in Västra Götaland at position N58° 22.2′, E011° 46.7′, 36 metres above sea level.

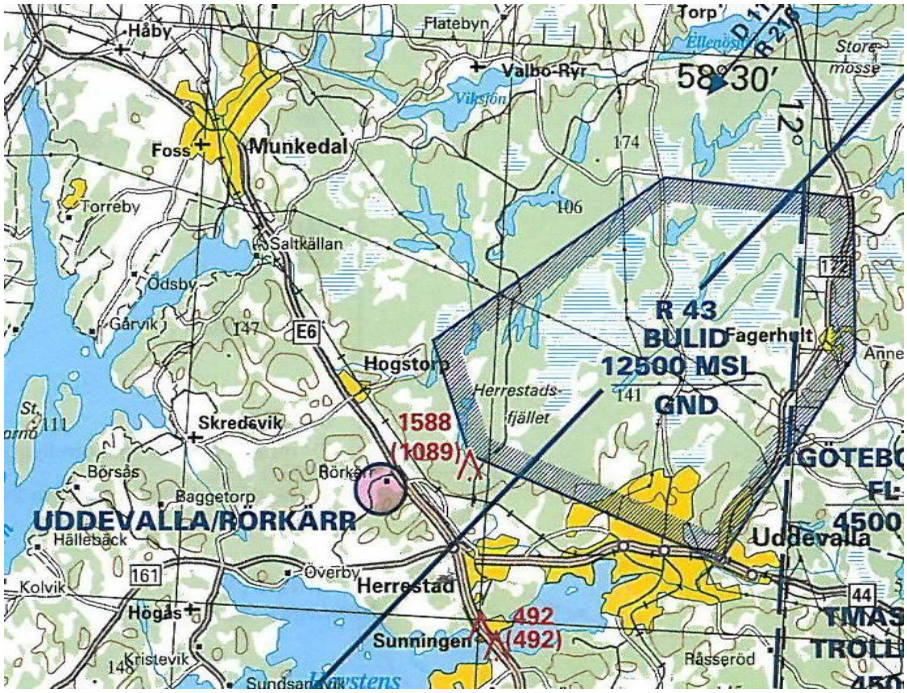

Fig. 2. Uddevalla Rörkärr airfield. Part of a map taken from the KSAB Swedish Airport Manual.

Fig. 3. The accident site.

1.12.2 Aircraft wreckage

The wreckage of the aircraft lay upside down on the field, north of the edge of the brook, with the nose in an almost southerly direction. The aircraft's nose wheel had been torn off and lay in the bottom of the brook, Figure 4.

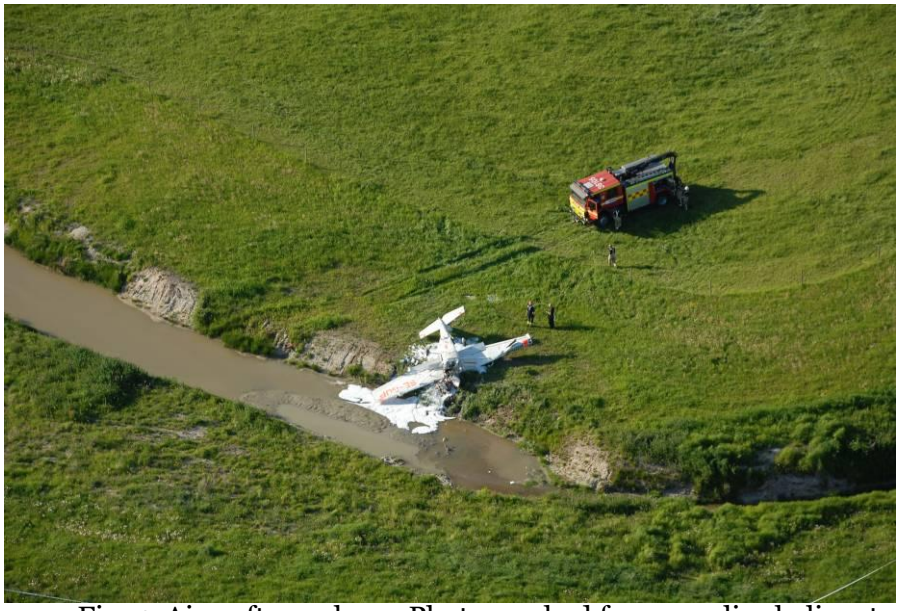

Fig. 4. Aircraft wreckage. Photographed from a police helicopter.

The front part of the aircraft and the engine installation were severely deformed. The engine had broken away and laid on the north bank of the brook, to the left of the direction of flight at impact. The propeller was still attached to the engine and one blade was visible, while the other was embedded and hidden in the ground. The visible outer part of the blade was bent backwards in the direction of flight and laid up against the front edge of the left wing, see Figure 5. The propeller blade had cut an approximately 20 mm deep gash in the front edge of the wing.

Fig. 5. Engine and propeller blade.

Some parts of the aircraft, including parts of the exhaust system, parts of the Perspex windscreen and parts of the wheel fairings, laid about 20 metres away from the aircraft in the direction of flight. The front edge of the

right wing was indented along about 2 metres from the wingtip toward the fuselage. The depth of the damage was about 10 centimetres.

The left landing gear had detached from its fastening to the fuselage. The firewall had been pushed about 10 cm backwards. The fuselage was broken behind the cabin. In this area there was creasing all around, see Figure 6. The pilot's seat mounting rail on the left side had detached from its floor fixing, while the rail on the right side and longitudinal latching mechanism were undamaged. The shaft of the right hand control column was broken off.

Inspection of the controls and circuit breakers in the cabin showed that:

- The wing flaps were fully down and the indicator on the instrument panel showed 40 degrees down.
- The throttle, mixture and carburettor heat controls were fully in.
- The fuel selector was set to BOTH.
- The priming pump was pushed in and locked.
- The carburettor heat control was set to OFF.
- The start/magneto key was in the LEFT position.
- The electrical master switch was in its ON position.
- No circuit breakers had tripped.
- The altimeters were set to 1018 hPa and showed 310 and 350 feet respectively.
- The communications radio switch was set to ON and the set frequency was 123.55 kHz.
- The ADF[4]was set to 460 kHz, switched to OFF and the VOR[5]was set to 117.8 MHz and switched OFF.
- The transponder was set to code 7000 and switched OFF.

The aircraft elevators and rudder could be moved to their maximum control positions using the control column at the left pilot's position. The rudder could be moved over its full travel from the outside of the aircraft.

The safety belts at the two pilot positions were of the three-point type and consisted of two parts, a lap belt and a shoulder belt to be placed diagonally across the chest from a securing point in the ceiling behind the pilot, to a securing point on the lap belt. The belts can be fastened separately. The lap belt at the left pilot's seat had been cut, but the fastenings to the aircraft structure were undamaged. The shoulder belt on the left side was complete and the fastenings undamaged.

[4] ADF – Automatic Direction Finder, radio navigation instrument
[5] VOR – Omni Directional Radio Range, radio navigation instrument

Fig. 6. Aircraft wreckage

1.13 Medical information

The pilot had undergone the prescribed medical examinations with approved results, the most recent having been in the spring of 2008.

The pilot had high blood pressure which was well controlled by medicine. His psychological and physical condition was good and the pilot had, according to information received, no problem sleeping the night before the accident.

Cardiopulmonary resuscitation was started at the accident site. Extensive medical treatment was applied on arrival at the hospital, but despite this the pilot died from his injuries.

1.14 Fire

There was no fire.

1.15 Survival aspects

1.15.1 General

A type EBC-102A emergency transmitter was installed in the aircraft. This was activated by the crash. The aircraft also contained a portable emergency transmitter of Kannad 406 PLB type. This was not activated by the crash.

The pilot's shoulder belt was not connected when the ambulance personnel arrived at the accident site.

1.15.2 Actions by the rescue services

Several emergency telephone (112) calls came in to the SOS centre in Gothenburg from people who saw the accident from various places some distance away. The first call was answered at 17:49, and after about one minute transferred to the ARCC, Search and Rescue centre, in Gothenburg.

The SOS centre sent an alarm to the first ambulance at 17:52, and at the same time alerted three road ambulances and an ambulance helicopter from Säve airport in Gothenburg. A road ambulance was the first unit to arrive at the accident site, at 18:05, 16 minutes after the first answered 112 call. The ambulance helicopter arrived at the accident site at 18:19.

The SOS centre, which is also responsible for sending an alarm to the local district rescue services, sent an alarm to the fire station in Uddevalla at 17:53. The rescue services arrived at the accident site about 4 minutes after the first ambulance.

The pilot, who was hanging upside down in the aircraft wreckage, was removed by the ambulance and rescue services personnel working together. The patient was taken by ambulance to the hospital in Uddevalla. In order to increase the possibility of emergency treatment the ambulance crew were reinforced by a doctor and nurse from the ambulance helicopter.

In connection with the rescue efforts the amount of fuel being released from the aircraft wreckage was limited and the site secured against fire. Booms were laid out to trap any fuel that got into the brook.

1.16 Tests and research

1.16.1 Examination of the aircraft engine

The engine was examined under SHK supervision in an authorised aircraft engine workshop. The purpose of the examination was to perform functional testing of the ignition system, check the carburettor and look for mechanical damage in the engine.

The engine had crushing and fracture damage to certain external components in connection with the impact, see Figure 7.

The engine oil filter was damaged and had broken free from its mounting. Both the silencers and the air cleaner housing had crush damage.

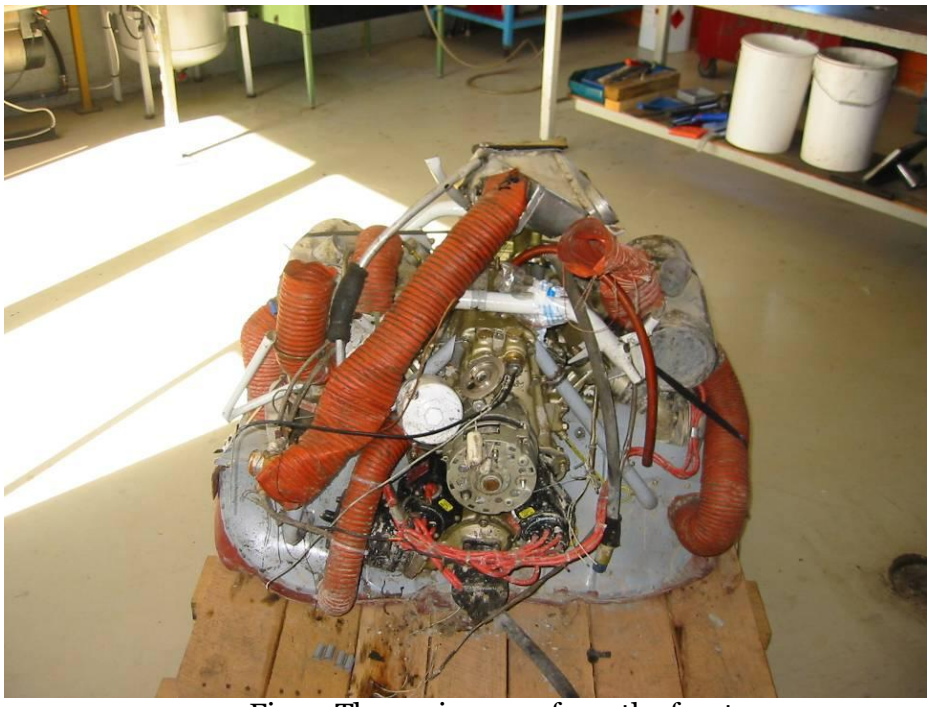

Fig. 7. The engine seen from the front.

Both the engine magnetos, Figure 8, were tested on a test bench at various speeds, between zero and the maximum permitted speed. The start pulse function was also tested. Both magnetos delivered powerful sparks to all the ignition cables at all speeds, and the start pulse function operated normally.

Fig. 8. Magnetos.

The spark plugs on the underside of the engine were removed and functionally tested at both atmospheric pressure and at increased air pressure. The spark plugs had deposits of lead, carbon and rust in the area around the electrodes. Five of the spark plugs operated normally during the tests. One spark plug also had a grey-brown deposit of soil between the electrodes and did not generate a spark. After the soil had been blasted off, this spark plug also functioned properly.

The inside of the carburettor throat was contaminated with clay. The main jet was free from contamination, as was the float chamber. The carburettor was removed and pressure tested without remark. The float was free to move and the float valve sealed properly. No other damage to the carburettor was noted.

The insides of the cylinders were inspected using a boroscope. The cylinder bores had a coating of surface rust. No damage to the valves was noted.

The propeller blades were bent back at 60 and 30 degrees respectively with respect to the direction of flight.

1.16.2 Witnesses to the events

The events were witnessed by several people near to the accident site. The locations of the witnesses are shown in Figure 9.

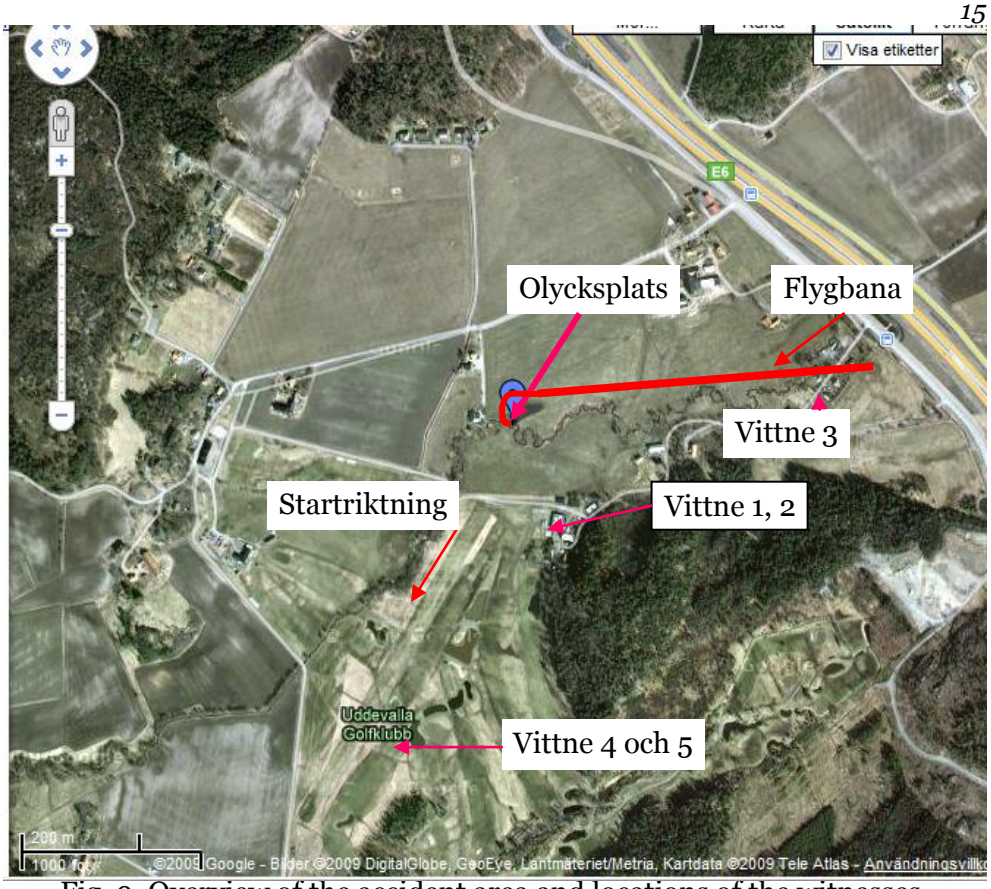

Fig. 9. Overview of the accident area and locations of the witnesses.

Witness 1

The witness was a photographer and had been a friend of the pilot for many years. Earlier that day they had made two flights together, with the purpose of taking photographs from the air, with one flight before and the other after lunch. Together they fully refuelled the aircraft from the flying club fuel installation, at about 17 – 17:30. While they were refuelling, a small van towing a trailer drove up to the flying club. The van driver, who was a hunter, stated that a roe deer had been injured on the road passing to the north-west of runway 21 and asked if the two men at the club had seen an injured roe deer. They had not, but the pilot of the accident aircraft offered to "take the machine" and search the area. He asked the witness if he wanted to go too, but he declined the invitation. The pilot was seen to take off from runway 21 and turn left after take-off.

The witness lost sight of the aircraft behind the hill, but came back into view at a low height from the east and flew along the side of the brook. When the aircraft was just about north of the flying club the witness heard the engine speed increase and the aircraft climbed a little before returning to level flight. Just after this it began a left turn. The aircraft was slightly nose up and the turn changed into a descending spiral to the left, after which the aircraft impacted with the ground at the edge of the brook, with its nose facing north. Clay and water from the brook splashed up on the impact and then there was silence. The witness ran up to the aircraft on the south side of the brook and called the name of the pilot, but received no answer. He was by then 10 metres from the aircraft and could see that the pilot was bleeding heavily from the face and head.

Witness 2

The witness's parents' home was east of the airfield, at the bottom of the hill, and this was where he had been brought up. The family owned hunting

land around the airfield. The witness had received information that a roe deer had been injured by traffic on the road north-east of the airfield, and he went to the flying club to start to search for the animal. Two people were there, the pilot and witness 1. Witness 2 said that he thought that the animal was somewhere beyond the brook to the north of runway 21 and to the north-east, up to the road. Neither the pilot nor witness 1 had seen any roe deer, but the pilot offered to take the aircraft and search from the air. The aircraft was parked next to the refuelling installation, from where the pilot was seen to taxi out and take off from runway 21. The aircraft turned left after take-off and continued round the hill, but soon came back from the north-east and followed the line of the brook.

The witness stated that the aircraft rocked and its height was estimated to be somewhat higher than that of landing aircraft at an equivalent distance from the airfield, on a descent to land on runway 21. The witness estimated the height to have been 50-70 metres. As the aircraft approached runway 21 it began a left turn at quite a steep bank, which became a descending spiral towards the ground, after which the aircraft impacted the northern bank of the brook. The witness thought that the aircraft was about to turn to continue the search on the other side of the brook towards the E6 motorway. Although the witness could not see the brook, he realised immediately that the aircraft had crashed into it and ran in that direction. However he could not cross the brook where the aircraft was, so he continued towards the nearest house on the other side of the runway. The witness could see the pilot hanging apparently lifeless and bleeding in the inverted aircraft and realised that the most important action was to call the rescue services.

He could not however contact the rescue services by mobile telephone, so he ran into the house and borrowed a landline telephone. It turned out that the alarm centre had already received an alarm.

Witness 3
The witness, who was in a house north-east of the airfield, stated that the aircraft flew very low over the roof, lower than the aircraft that generally made approaches to runway 21.

Witness 4
The witness, who was on a golf course east of the runway, at the tee for the 11th hole, stated that the aircraft, after taking off from runway 21, turned to the left at a low height. Just before it flew behind the hill the engine "died", while the aircraft was still in sight. After this the engine went back to normal and the aircraft disappeared from view. When it reappeared the witness heard that the engine "coughed" during its final turn, the spiral. The time was 17:45 – 17:50. The aircraft flew lower than normal and the witness thought that it was trying to return to the airfield to land. When the accident occurred the witness telephoned to SOS and then went to the wreck. The pilot wheezed and moved his arm when he was called.

Witness 5
The witness was on a golf course east of the runway, at the tee for the 11th hole, the same location as witness 4. The witness stated that the engine went quiet while the aircraft was on its way round the hill. It flew quite low, somewhat above tree-top height, but the aircraft was visible above the hill, but no higher. Just before the accident it turned to the left and then all was quiet. The witness ran to the accident site where there was already a woman

and a man. The pilot was hanging by his lap belt, but his back was free. The pilot gurgled and moved an arm when he was called. The shoulder strap was not fastened. The ambulances had driven to the flying club and ended up on the wrong side of the brook. The witness guided them to the airfield using a mobile phone.

1.16.3 Aircraft SE-GUP checklist

Among other things, the aircraft checklist had two headings for EMERGENCY and ENGINE FAILURE. The following actions were given in the checklist:

EMERGENCY

1 FLY THE AIRCRAFT
2 Look for a place to land
3 Find/correct the fault

ENGINE FAILURE

1 Speed	80 MPH
2 Tank selector	Both
3 Mixture	Rich
4 Carburettor heat	On
5 Magnetos	Best
6 Priming pump	Locked

1.16.4 Flying with the flaps extended

According to a flying instructor with long experience on the type, 40 degrees of flap is normally only used at the end of a landing approach, when it is certain that the runway can be reached if an engine failure occurs. The selection of flaps takes place with the aid of a rocker switch on the instrument panel. The rocker switch, that is spring-loaded, is pressed down or up and held in that position until the desired flap position has been achieved. The rocker switch automatically returns to its neutral position when released.

The flying instructor also stated that extension to 40 degrees flap causes a significant change in pitch trim. If the pilot does not at the same time compensate for this with the pitch trim control, the aircraft nose rises, the aircraft climbs and the speed reduces.

With flaps fully down in level flight, it is more difficult to maintain the aircraft speed, due to the high drag, and the aircraft throttle must be considerably altered in order to maintain the intended speed and height.

1.16.5 Inadvertent spin

The aircraft Flight Manual defines six actions that must be taken if the aircraft enters an inadvertent spin:

- Throttle to idle.
- Keep the ailerons neutral.
- Give full opposite rudder.
- Push the control column gradually forward until the rotation stops.
- Return the control column to neutral as soon as rotation stops.
- Climb the aircraft straight ahead with a smooth movement.

1.17 Organisational and management information

Not applicable.

1.18 Other aspects

1.18.1 Equal opportunities aspects

Not applicable.

1.18.2 Environmental aspects

Damage caused by the release of fuel from the aircraft wreckage was limited by, during the rescue efforts, placing single-use booms in the watercourse and spreading decontamination agent on the area of ground that was contaminated.

2 ANALYSIS

2.1 The flight

It has been possible to establish the route of the aircraft after taking off from runway 21 and just before the accident relatively well with the aid of witness information. The accident occurred after about three minutes of flight. SHK assesses, guided by the witness information and the accident sequence, that the flying altitude just before the left turn of the aircraft that led to the accident was 80-100 metres. The aircraft course before the accident sequence was about 265 degrees, as deduced from the marks on the ground and the position of the wreckage, the direction of flight was about 010 degrees on impact with the ground. The aircraft thus performed a left turn of about 255 degrees before impact.

Witness information also indicates that the speed was close to stalling when the accident sequence began, since the aircraft was seen to “wobble” and the nose was high.

The intention of the pilot just before the accident sequence began may either have been to turn and fly back along the edge of the brook in the opposite direction, or to land on runway 21.

SHK considers it likely that the pilot consciously decided to apply full flap, since the control has to be continuously pressed until the desired flap position is obtained. SHK also finds it unlikely that the pilot flew with flaps fully down during the search, since maintaining both the speed and altitude would have been more difficult in that configuration and it would make uncomfortable flying.

If it was the intention of the pilot to turn to the left and fly in the opposite direction, the action of selecting full flap would not have been logical. The height margin to the hill south-west of the accident site would during a left turn be small, and thus a reason to climb, but it seems unlikely that a pilot would select full flap before a planned climb.

The witnesses certainly observed a slight climb and throttle increase before the descending turn began. This climb can however be explained by the nose rising in association with full flap selection, and the throttle increase could indicate that the pilot wanted to compensate for the reduction in speed that occurred due to the increased drag when the flaps went down.

In the opinion of SHK the most likely situation was that the pilot had ceased to search for the roe deer and intended to land on runway 21. The witness observations indicate that the aircraft altitude, just before the start of the descending turn, was greater than usual for an aircraft intending to land on runway 21. The intention of the pilot when setting full flap could therefor have been to increase drag so as to achieve a greater rate of descent and come down to a normal approach angle to the airfield, without the speed being unacceptably high.

In connection with lowering the flaps and climbing, however, the speed reduced so far as to come below stalling speed, whereupon the aircraft dropped its left wing and entered a spin. During this turn the aircraft was influenced by an increasing tailwind, which exacerbated the situation.

SHK thereby considers it likely that the aircraft entered an inadvertent spin and that the height available for recovery from this critical flight situation was insufficient. It is however reasonable to assume that the pilot, who was well acquainted with this type of aircraft, started the flight manual procedure for recovering from an inadvertent spin. The first action in this case is to close the throttle and then stop the aircraft rotation, set the ailerons to neutral and then stop the descent by opening the throttle and using the elevator.

Examination of the aircraft's propeller and engine indicated that the engine was running and probably delivering power when the aircraft impacted the ground. It was also found that the collision with the bank of the brook took place with the wings almost horizontal, which could indicate that the pilot had managed to level out and had started to try to climb.

It was however not possible to discover the position of the throttle at the moment of impact. When the aircraft wreckage was examined, the throttle was certainly fully pushed in, i.e. at full throttle, but the engine had broken away from its mountings and was lying beside the fuselage. This movement had caused the throttle control to be pulled into its full forward position, whatever position it may have been in at impact.

2.2 Examination of the engine

2.2.1 Possible engine problems

Some of the witness information indicated that engine problems could have arisen during flight. If the pilot experienced an engine problem during flight he should have carried out the checklist items for the type of problem that was encountered. The emergency checklist for engine problems, see Section 1.16.3, indicates six different actions that the pilot should take.

The airspeed was probably less than the 80 mph stated by the checklist, but the witness observations indicate that the engine speed increased, which would indicate that the pilot, apart from climbing, also tried to achieve the recommended speed in the case of an engine problem. The carburettor heat was switched off, but the recommendation in the flight manual states that this should be used when there is a risk of ice build-up in the carburettor between ambient air temperatures between 0˚C and minus 20˚C. The ambient air temperature at the time of the accident was 25˚C and thus there was no need for preheated air to be supplied to the carburettor. The other actions in the engine failure checklist had been carried out. The setting of the magneto key to the LEFT position would indicate that the pilot, in connection with an engine problem, in accordance with the checklist switched between the RIGHT and LEFT positions of the magneto selector and found that it was most suitable to use the LEFT position.

2.2.2 Technical examination of the engine

SHK therefore had both the aircraft magneto ignition systems examined. The examination showed that both systems worked properly when bench-tested. The deposits of lead and carbon on the spark plugs were of normal extent for an engine that had run about 60 hours since its last inspection, which was the case for this particular engine. The layer of soil on one of the spark plugs had probably been deposited during the impact, when soil and clay were sucked into the engine. No technically related explanation has been found for why the magneto selector was in the LEFT position when the

aircraft was inspected at the accident site. The maximum available power from an aircraft engine of this type is somewhat reduced if it is run with only one ignition system switched on. In the opinion of SHK, this did not have any significant effect on the accident.

The clay contamination in the carburettor throat probably occurred in the accident sequence when the aircraft first struck the brook and thereafter its bank. The engine had rotated a number of turns between its contact with the water surface and the bank of the brook, and thus probably sucked in contaminants through the induction system, when such items as the air filter and air hoses were damaged at the first impact. The fuel supply to the engine from the wing tanks takes place by gravity, and the engine has no fuel pump. Since the carburettor was otherwise undamaged it seems clear that the fuel supply to the engine functioned properly.

According to the aircraft engine workshop that examined the engine the corrosion damage that was apparent on the cylinder bores had taken place after the accident. This damage was considered to be normal when considering the presence of contaminants that were found in the carburettor and on the spark plugs, and the time that had elapsed between the accident and the technical examination.

The propeller was rotating on impact with the ground, and the damage to the propeller blades had occurred during the accident. The blades had bent backwards in relation to the direction of flight, probably due to the aircraft forward speed being high relative to the propeller rotation speed. The blade that had bent the most had first hit the ground and braked the aircraft movement and engine rotation. Both breaking and rotational forces had been applied to the engine during the accident and caused it to break free to lie beside the aircraft wreckage.

The technical examinations together show that the engine was probably running and providing power at the time of the accident. Due to the damage to the propeller, SHK finds it probable that the power output was low when the aircraft impacted the ground.

2.3 Damage to the aircraft

The damage to the aircraft wheel fairings, the location of the nose wheel in the brook's course and the absence of marks on the southern bank of the brook indicate that the aircraft impacted with the ground at a dive angle of about 60 degrees. The slope of the ground on the north side of the brook channel is about 30 degrees from vertical. The aircraft thus impacted with the ground almost at right angles in relation to the horizontal axis of the aircraft.

The direction of movement of the aircraft relative to the north edge of the brook channel was assessed, using the damage on the right front edge of the wing as a guide, as having been about 30 degrees.

2.4 Survival possibilities

The cabin structure of the aircraft was relatively undamaged after the accident. The pedal mountings and fuel tank selector panel were however damaged and had shifted about 10 cm back from their normal positions, but not to such an extent that they would have caused serious crushing

danger to the pilot. It was concluded that the broken shaft of the right side control column was caused by the foldable backrest of the right hand pilot's seat striking the control column wheel during the collision of the aircraft with the ground.

The pilot was initially alive following the accident and received expert medical attention, both before and after reaching the hospital, but died despite this, at the hospital as a result of extensive skull and brain injuries.

SHK's investigation indicates that the pilot was not correctly strapped in with both the lap strap and shoulder strap during the accident flight, having only the lap strap fastened. It cannot be excluded that the injuries suffered by the pilot would have been less extensive if the pilot had been correctly strapped in with both lap and shoulder straps fastened. The skull injuries to the pilot probably came about as the result of a violent impact with the controls on the instrument panel during the collision with the ground. It was assessed that these injuries would have been limited if the pilot had used the shoulder strap.

According to the assessment made during the forensic examination it cannot be ruled out that there was a possibility of survival if the pilot had not suffered such severe skull and brain injuries.

SHK notes that the fixing points for the shoulder straps, particularly the upper one in this aircraft category, must for reasons of strength be located in unfavourable positions in respect of the comfort of pilots and passengers. In certain cases shoulder straps pass very close to the throat and neck, which can be experienced as uncomfortable and itself lead to injury in the case of a crash. It can thus happen that shoulder straps are adjusted incorrectly or not used at all by pilots and passengers in the front seats during take-off and landing.

SHK therefore considers it important that aircraft in this category are equipped with safety belts of another type that will increase the use of protection by the pilots and passengers occupying the front seats.

3 CONCLUSIONS

3.1 Findings

a) The pilot was qualified to perform the flight.
b) The aircraft had a valid ARC.
c) The flight was unplanned and its purpose was to search for an injured wild animal.
d) According to witnesses the flight was performed at a low altitude and at low speed.
e) No technical faults were found in the aircraft.
f) Examination of the engine did not reveal any faults or incorrect operation.
g) The aircraft wing flaps were fully down.
h) The pilot did not use the shoulder strap.

3.2 Causes of the accident

When the flaps were selected fully down the aircraft speed reduced to below the stall speed and the aircraft began a spinning movement before impacting the ground. The flying altitude was too low to correct the spin.

4 RECOMMENDATIONS

It is recommended that the Swedish Transport Agency should:

- inform licence holders of the risk of trim changes and speed reduction resulting from the lowering of flaps to their maximum position *(RL2010:03 R1),*

- strive to ensure that aircraft in the light aircraft category are equipped with safety belts that provide increased personal protection in the case of accidents, without limiting the freedom of movement of the pilot and passengers *(RL2010:03 R2).*