Statens haverikommission
Swedish Accident Investigation Authority





Final report RL 2020:04e

Accident at Varberg/Getterön Airport on 5 May 2019 involving the powered sail-plane SE-USN of the model SF 25 C, operated by a private individual.

File no. L-53/19

29 April 2020

SHK investigates accidents and incidents from a safety perspective. Its investigations are aimed at preventing a similar event from occurring in the future, or limiting the effects of such an event. The investigations do not deal with issues of guilt, blame or liability for damages.

The report is also available on SHK's website: www.havkom.se

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Content

General observations

The Swedish Accident Investigation Authority (Statens haverikommission – SHK) is a state authority with the task of investigating accidents and incidents with the aim of improving safety. SHK accident investigations are intended to clarify, as far as possible, the sequence of events and their causes, as well as damages and other consequences. The results of an investigation shall provide the basis for decisions aiming at preventing a similar event from occurring in the future, or limiting the effects of such an event. The investigation shall also provide a basis for assessment of the performance of rescue services and, when appropriate, for improvements to these rescue services.

SHK accident investigations thus aim at answering three questions: *What happened? Why did it happen? How can a similar event be avoided in the future?*

SHK does not have any supervisory role and its investigations do not deal with issues of guilt, blame or liability for damages. Therefore, accidents and incidents are neither investigated nor described in the report from any such perspective. These issues are, when appropriate, dealt with by judicial authorities or e.g. by insurance companies.

The task of SHK also does not include investigating how persons affected by an accident or incident have been cared for by hospital services, once an emergency operation has been concluded. Measures in support of such individuals by the social services, for example in the form of post crisis management, also are not the subject of the investigation.

Investigations of aviation incidents are governed mainly by Regulation (EU) No 996/2010 on the investigation and prevention of accidents and incidents in civil aviation and by the Accident Investigation Act (1990:712). The investigation is carried out in accordance with Annex 13 of the Chicago Convention.

The investigation

SHK was informed on 5 May 2019 that an accident involving a powered sailplane with the registration SE-USN had occurred at Varberg/Getterön Airport, Halland County, the same day at 11:15 hrs.

The accident has been investigated by SHK represented by Helene Arango Magnusson, Chairperson, Tony Arvidsson, Investigator in Charge, and Gideon Singer, Operations Investigator.

Frank Stahlkopf has participated as an accredited representative on behalf of the German Federal Bureau of Aircraft Accident Investigation (Bundesstelle für Flugunfalluntersuchung, BFU).

Germany’s accredited representative has been assisted by Robert Böttcher, acting as adviser from the type certificate holder Limbach Flugmotoren GmbH.

Magnus Axelsson has participated as an adviser for the Swedish Transport Agency and Hannu Melaranta has participated as an adviser for the European Union Aviation Safety Agency (EASA).

The following organisations have been notified: EASA, the European Commission, BFU and the Swedish Transport Agency.

Investigation material

Interviews have been conducted with the pilot, the passenger, two witnesses, the chairperson of Varbergs flygklubb[1], the pilot's two powered sailplane pilot instructors, the instructor during the proficiency check and the person responsible for maintenance of the aeroplane.

A meeting with the interested parties was held on 6 November 2019. At the meeting SHK presented the facts discovered during the investigation, available at the time.

[1] Varberg Flying Club.

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Aircraft:	
Registration, type	SE-USN, Scheibe powered sailplanes
Model	SF 25 C
Class, airworthiness	Normal, Certificate of Airworthiness and valid Airworthiness Review Certificate (ARC)[2]
Serial number	44342
Owner	Varbergs flygklubb
Time of occurrence	5 May 2019, 11:15 hrs in daylight Note: All times are given in Swedish daylight saving time (UTC[3] + 2 hours)
Location	Getterön, Halland County, (position 5707N 01214 E, 2 metres above mean sea level)
Type of flight	Private
Weather	According to SMHI's analysis: wind approx. south-west/10 knots, visibility >10 km, no cloud under 2,000 feet, temperature/dewpoint +9/+3°C, QNH[4] 1011 hPa
Persons on board:	2
Crew members including cabin crew	1
Passengers	1
Injuries to persons	1 person with serious injuries, 1 with minor injuries
Damage to the aircraft	Substantially damaged
Other damage	None
Pilot in command:	
Age, licence	37 years, SPL[5], with TMG[6] rating
Total flying hours	39 hours, of which 20 hours on type
Flying hours previous 90 days	2 hours, all on type
Number of landings previous 90 days	6, all on type

[2] ARC – Airworthiness Review Certificate.
[3] UTC – Coordinated Universal Time.
[4] QNH – barometric pressure at mean sea level.
[5] SPL – Sailplane Pilot Licence.
[6] TMG – Touring Motor Glider.

SUMMARY

The intention of the flight was to carry out a shorter flight with take-off and landing at Varberg/Getterön Airport. Aside from the pilot there was one passenger on board.

Take-off proceeded normally up to the point that the aeroplane had become airborne, when the engine suddenly shut down. The pilot attempted to restart the engine. Shortly after this, however, the left wing hit the ground. Based on the available video evidence and information from witnesses, SHK concludes that the aeroplane lost so much speed that it ended up in a stall, resulting in an increasing vertical speed.

The aeroplane suffered substantial damage to both its fuselage and wings. The pilot suffered serious injuries, while the passenger escaped with minor injuries.

During the technical examinations of the engine, it was possible to establish that one of the metal plates that drive the pump diaphragm in the fuel pump had come loose. The investigation of the riveting of the drive plates showed that the flattened rivet head had not been sufficiently expanded. In view of this, SHK has concluded that the engine failure was caused by one of the drive plates having come loose as a result of faulty assembly.

The engine failure occurred despite the engine having recently been at an overhaul. However, the investigation indicates that the fuel pump in question was not approved for installation in the engine. Consequently, SHK determines that a contributing cause of the accident was that the aforementioned non-approved fuel pump was not replaced by the maintenance organisation in conjunction with the engine overhaul and that this was not detected by either the flying club, the technician who reinstalled the engine following the overhaul or by the Swedish Soaring Federation’s airworthiness organisation (SFF CAMO). In summary, SHK determines that the safety barriers, which aim to ensure that only approved, safe and reliable components are installed in aircraft, have not functioned in this case.

It is SHK’s opinion that the engine failure resulted in a serious accident because the pilot had limited experience, training and mental preparedness to deal with the situation in accordance with the emergency checklist.

Safety recommendations

The Swedish Soaring Federation is recommended to:

- In cooperation with the Swedish Transport Agency, produce a training plan in order to increase knowledge of the regulations pertaining to life-limited components for sailplanes technicians, airworthiness reviewers and the person responsible for the continuing airworthiness of an aircraft, see chapter 2.5.3. *(RL 2020:04 R1)*
- In cooperation with the Swedish Transport Agency, develop procedures for airworthiness reviews, see chapter 1.6.8 and 2.5.2. *(RL 2020:04 R2)*
- Inform pilots of the importance of repeating the emergency checklist before each flight, see chapter 1.1.2, 1.6.10 and 2.2. *(RL 2020:04 R3)*

1. FACTUAL INFORMATION

1.1 History of the flight

1.1.1 Circumstances

The intention was to take off from Varberg/Getterön Airport and to conduct a short flight over Falkenberg before flying back to Varberg.

The pilot planned to conduct the flight under visual flight rules (VFR[7]) with a passenger on board.

The preparations in advance of the flight included obtaining information about the weather in the form of a TAF[8] and METAR[9] from nearby airfields and information from the airfield's own weather station. No technical remarks concerning the aeroplane were noted. The pilot filled up with 30 litres of fuel prior to take-off.

The pilot had flown two types of powered sailplanes during his training. He had only flown the model in question (SF 25 C) for two hours since the beginning of June 2018. One of these hours was a proficiency check with an instructor, the second was performed on his own. Both flights were performed in the middle of April 2019.

According to SMHI's analysis, the wind was approximately south-westerly, which corresponded to a crosswind from the right in relation to runway 12. The wind speed was 10 knots.

1.1.2 Sequence of events

Following refuelling and going through the checklist prior to engine start, the aircraft began taxiing to the holding point for runway 12. The pilot has stated that the warm-up and engine run-up were completed without remark. Checks of flight control deflection and that both on board were properly strapped in were conducted prior to lining up on runway 12 for take-off.

No run-through of the emergency checklist for engine failure was conducted.

The pilot's recollection is that take-off proceeded normally up to the point that the aeroplane had become airborne, when the engine suddenly shut down. The pilot has stated that he may have panicked in that situation. He then attempted to restart the engine by pressing the start button.

[7] VFR – Visual Flight Rules.
[8] TAF – Terminal Aerodrome Forecast.
[9] METAR – aerodrome routine weather report.

The passenger has stated that the engine suddenly started turning over more slowly after the aeroplane had become airborne, at an estimated height of 20–30 metres. The pilot then attempted to restart the engine. The passenger's perception of this was that the pilot made a slight left turn and that they lost height. Shortly after this, the left wing hit the ground. The aeroplane then yawed to the left and came to a stop at the edge of the airfield, to the left of runway 12, with its nose facing the direction of travel (see Figure 1).

The passenger filmed the flight. Also the video indicates that the engine failed shortly after the aeroplane had become airborne and that an attempt was then made to restart the engine.

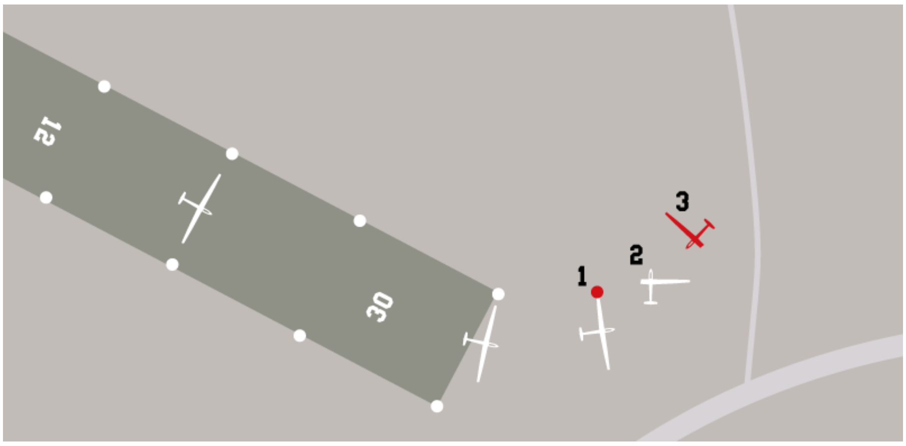

Figure 1. Final stage of the sequence of events. 1: Left wing hits the ground. 2: Front section of the powered sailplane hits the ground. 3: Final position.

The accident occurred at position 5707N, 01214E, two metres above mean sea level.

1.1.3 Additional information

Two witnesses to the occurrence have been interviewed and have stated the following.

The witness who observed the take-off from the flying club's refuelling facility perceived the take-off to be normal up until lift-off, at about one third of the runway and until the aeroplane had reached a height of 20 to 25 metres above the ground. The witness then lost sight of the aeroplane, but suddenly heard the engine stop. He looked up again and saw then that the propeller was rotating slowly. His perception of this was that the pilot was attempting to maintain height and that it looked wobbly. The wind was blowing from the right in the aeroplane's direction of flight and his perception was that the aeroplane turned to the left with the wind and lost height. The left wing hit the ground, slightly before the front section of the fuselage.

The second witness was approaching in a car along the road at the end of runway 12 and her perception was that it suddenly became totally quiet when she was at the level of the aeroplane. She saw that it wobbled in the air at an estimated height of 25 to 30 metres above the ground. She then saw the aeroplane hit the ground in the rear view mirror.

1.2 Injuries to persons

	Crew members	Passengers	Total on board	Others
Fatal	-	-	0	-
Serious	1	-	1	-
Minor	-	1	1	Not applicable
None	-	-	0	Not applicable
Total	1	1	2	-

1.3 Damage to the aircraft

Substantially damaged.

1.4 Other damage

None.

1.4.1 Environmental impact

None.

1.5 Personnel information

1.5.1 Qualifications and duty time of the pilot

Pilot in command

The pilot in command was 37 years old and had a valid SPL licence with operational and medical eligibility.

Flying hours				
Latest	24 hours	7 days	90 days	Total
All types	0	2	2	39
On type	0	2	2	20

Number of landings, on type last 90 days: 6.
Type rating concluded on 30 July 2018.
Proficiency check conducted on 13 April 2019 on SF 25 C.

1.6 Aircraft information

SF 25 C is a two-seat, single-engine shoulder–winged powered sailplane (see Figure 2) that is constructed from wood and metal. It has a fixed central main wheel and spoilers on the upper surface of the wings.

Figure 2. The motor powered sailplane in question. Photo: Christer Lannestam.

1.6.1 Powered sailplane

TC-holder	Scheibe-Aircraft-GmbH
Model	SF 25 C
Serial number	44342
Year of manufacture	1984
Gross mass (kg)	Max load: 648, current: 618
Centre of gravity	Within limits.
Total flying time (hours)	6 390
Flying time since latest inspection (hours)	13
Type of fuel uplifted before the occurrence	91/96 UL
Engine	
TC-holder	Limbach Flugmotoren GmbH
Type	L 2000 EA
Number of engines	1
Serial number	1391
Operating time since latest inspection (hours)	102
Operating time since latest overhaul (hours)	2
Propeller	
TC-holder	MT-Propeller Entwicklung GmbH
Type	MT 150 L 90-1A
Serial number	12075
Total operating time (hours)	899
Operating time since inspection (hours)	45
Deferred remarks:	None

The aircraft had a Certificate of Airworthiness and a valid ARC.

1.6.2 Engine

The engine installed in the aeroplane, an L 2000 EA, is a four-cylinder, air-cooled four-stroke horizontally opposed piston engine with a single magneto and carburettor.

1.6.3 Mechanical fuel pump

The fuel pump is of the flexible diaphragm type and located at the front on the right side of the engine's crankcase (see Figure 3). A worm gear on the crankshaft drives a gearwheel that moves an eccentric shaft. The eccentric shaft drives a push rod that moves a linkage system that drives the diaphragm.

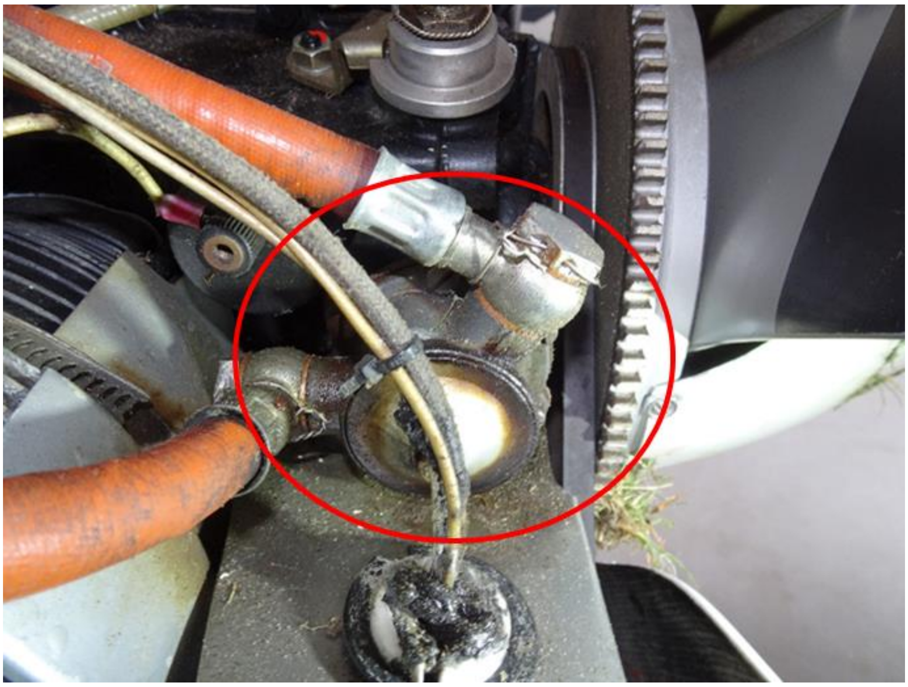

Figure 3. Mechanical fuel pump mounted on the engine, manufactured by APG.

Diaphragm pumps contain a pump chamber the volume of which increases or decreases through the deformation of a flexible membrane, similar to the operation of a piston pump. There is a non-return valve at both the inlet and outlet ports in the pump chamber in order to force the fuel to run in one direction. By pulling the diaphragm to the bottom, the volume inside the pump chamber increases, which decreases the pressure. This allows the fuel to be drawn into the pump from the tank (thanks to atmospheric pressure which acts on the fuel in the tank). The movement of the diaphragm back to the other, upper deadlock is achieved by a diaphragm spring, which results in the fuel in the pump chamber being forced through the outlet and into the carburettor.

The diaphragm is mounted on a rod with a metal plate on either side of the membrane. The metal plates and the diaphragm are held together by the rod being deformed plastically so that it exerts pressure on both sides, this is known as riveting (see Figure 4).

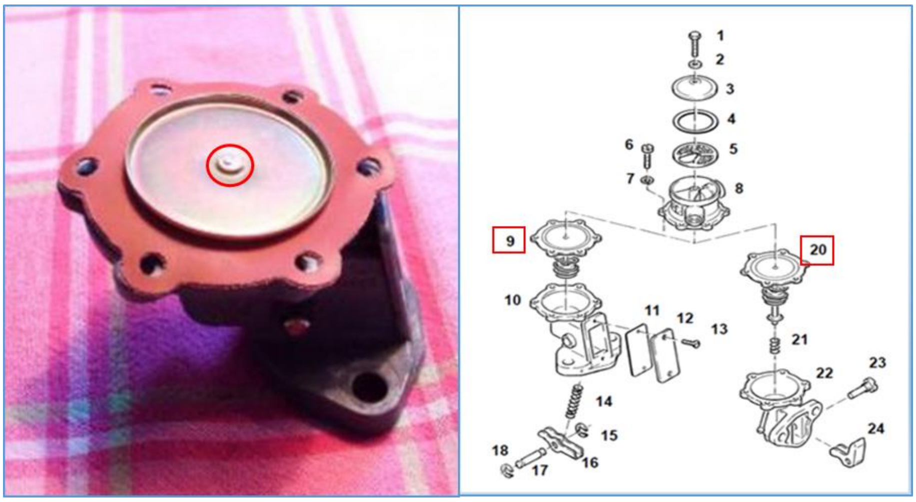

Figure 4. Left image, reference image of a new diaphragm. The flattened rivet head is seen in the middle of the circle. Image: SAUER. Right image, exploded-view drawing of mechanical fuel pump (APG). Numbers 9 and 20 are the diaphragm with diaphragm spring. Image: Limbach Flugmotoren GmbH.

1.6.4 Repair manual for the engine

According to the repair manual from the type certificate holder for the engine, Limbach Flugmotoren GmbH (Limbach), replacement of all rubber and plastic components is mandatory during an overhaul of an engine of the L 2000 EA model. This requirement also includes the mechanical fuel pump. The fuel pump manufactured by APG that was mounted to the engine at the time of the occurrence is no longer supplied by the type certificate holder and is, according to Technical Bulletin 72 (TB72) from 2006, replaced by a pump from another manufacturer, BCD, with a different part number. The technical bulletin is not in itself mandatory to follow, but the type certificate holder no longer supplies any spare parts for the APG fuel pump.. Consequently, there are no part numbers for these parts listed in the maintenance data for the aeroplane model.

1.6.5 The maintenance organisation's engine overhaul

The investigation shows that the engine had been on engine overhaul shortly before the event. Varbergs flygklubb had received offers for an overhaul from both the type certificate holder Limbach and from Sauer Flugmotorenbau GmbH (Sauer). Sauer was known to the flying club for doing engine overhauls on powered sailplanes. The company also stated on its website that they did overhauls on Limbach engines. The current engine model was also included in a list of the engines that Sauer overhauled. Sauer offered to do the job in three weeks and at a favorable price, which is why the choice of maintenance organisation fell on them. The website also contained information that Sauer was authorized to carry out maintenance work from both the German aviation authority (LBA) and EASA. However, no closer verification of what permits the maintenance organisation actually had was made. The flying club had though obtained references regarding the maintenance organisation from other people and knew of other flying clubs that had their engines overhauled by Sauer.

The investigation shows that Sauer was authorized to perform piston engine maintenance, but that at the time of the current engine overhaul, the maintenance organisation did not have authorisation to perform an overhaul of the current engine model and issue an Authorised Release Certificate, EASA Form 1[10], for the overhaul. The authorisation was instead limited to conducting repairs and maintenance.

According to the maintenance organisation's documentation of the overhaul, an overhaul was made of the mechanical fuel pump. However, this did not appear on the spare parts list that the flying club received in conjunction with delivery of the engine. However, for the investigation, the maintenance organisation has presented another spare parts list, which states that a repair kit has been used for the pump and that parts of the mechanical fuel pump, including the diaphragm, have been replaced. The part number specified for the repair kit is, however, a part number from Volkswagen and not a part number that is included in the maintenance data from the type certificate holder Limbach.

According to the maintenance organisation the engine was checked and tested after the overhaul and all values were normal. The engine was thus in no case afflicted with any obvious defects when it was sent back to the flying club.

1.6.6 Documentation of the engine overhaul

The documents that accompanied the engine on its return to Varbergs flygklubb following the overhaul were an engine running protocol, a test report, a spare parts list with the parts that had been replaced and a Certificate of Conformity issued on 12 March 2018. No EASA Form 1 had been issued.

Sauer has stated to SHK that the flying club was informed by e-mail that the organisation was not able to issue an EASA Form 1. The maintenance organisation has also sent a copy of an e-mail to the flying club dated 6 January 2018, in which it informs the flying club that it is not able to conduct an overhaul with EASA Form 1, and that they will instead supply the engine with a Certificate of Conformity, which in the e-mail is described as a document that is similar to an EASA Form 1 (see appendix page 38).

[10] EASA Form 1 – Authorised Release Certificate (cf. Commission Regulation (EU) No 1321/2014 of 26 November 2014, Annex I (Part-M), M.A.613(a)).

The flying club has stated that they do not remember that this has been pointed out to the club and the club has not this e-mail saved. This is strange according to the flying club. The e-mail should have been included in the mail thread regarding the procurement that has been saved. However, they have stated that, even if the club should have received the e-mail, it is most likely that the club's representative would not have reacted to the fact that it was not possible to issue an EASA Form 1.

The Certificate of Conformity that was issued following the engine overhaul is not included in the maintenance organisation's MOM[11] and was also not approved by a competent authority.

1.6.7 Installation of the engine in the powered sailplane

The Certificate of Conformity was accepted as a valid certificate of release to service by the technician responsible for installing the engine following the overhaul and was documented in the Engine Log Book. After installing the engine, the technician issued a certificate of release to service after maintenance dated 18 April 2018.

1.6.8 The airworthiness review of the powered sailplane

Varbergs flygklubb, which owns SE-USN, had entered into a so called limited contract concerning execution and responsibility for certain tasks linked to the aircraft's airworthiness with the Swedish Soaring Federation's Continuing Airworthiness Management Organisation (SFF CAMO[12]). According to the Swedish Soaring Federation, this limited contract entails the owner retaining responsibility for the airworthiness of the aircraft.

The contract sets out the undertakings that the continuing airworthiness management organisation (SFF CAMO) has made in relation to the owner. One of these undertakings is to conduct an airworthiness review and issue an Airworthiness Review Certificate (ARC).

During the airworthiness review that was conducted by the approved inspector on 15 May 2018, it was noted that the engine and the magneto has undergone maintenance since the last review. However, it was not discovered that the required certificate to release, i.e. an EASA Form 1, was not included in the documentation relating to the overhaul of the engine.

1.6.9 Flight manual

According to the flight manual for the aeroplane (Flight Manual and Maintenance Manual SF 25 C – Falke with Limbach L 2000 EA 1) the rotation speed during take-off shall be approx. 38 knots (70 km/h). According to the same manual, the recommended climbing speed is

[11] MOM – Maintenance Organisation Manual.
[12] CAMO – Continuing Airworthiness Management Organisation.

49 knots (90 km/h). It is also pointed out that the climbing speed shall not be lower than 46 knots (85 km/h).

The manual states that the stall speed is around 35 knots (65 km/h) and is dependent on the mass of the aeroplane.

The take-off distance to rotation at the weight in question has been calculated by SHK as 130 metres. The total distance in order to be able to fly over a 15 metre-high obstacle has been calculated as 330 metres.

1.6.10 Emergency checklist

The emergency checklist on board included the following actions in the event of engine failure:

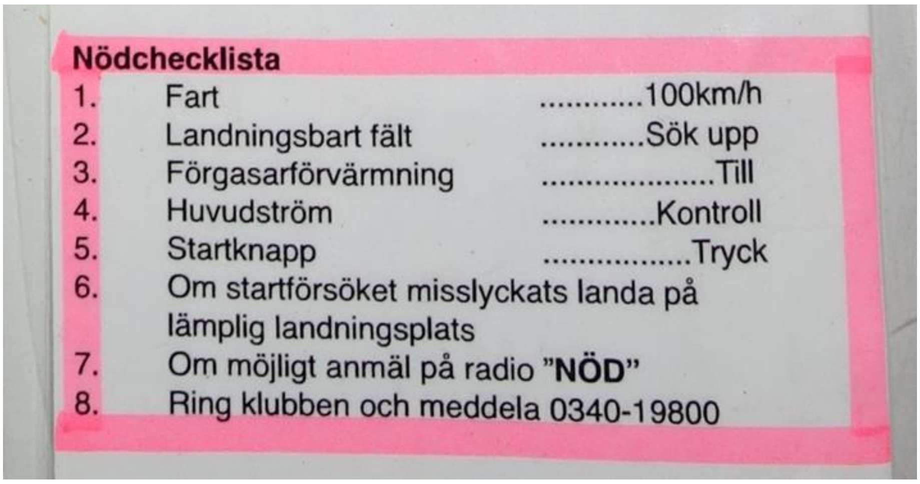

Figure 5. Image of the emergency checklist on board.

1.7 Meteorological information

According to SMHI’s analysis for Varberg Airport, the weather conditions at the time of the accident were as follows:

Wind approx. south-west 10 knots, visibility more than 10 km, no cloud under 2,000 feet, temperature/dew point +9/+3°C, QNH 1011 hPa.

The accident occurred in daylight.

1.7.1 The airfield’s weather station

At 11:15 hrs, the airfield’s weather station registered an average wind direction of 190 degrees and a wind speed of between 8 and 11 knots.

1.8 Aids to navigation

Not relevant.

1.9 Radio communications

Not relevant.

1.10 Aerodrome information

Varberg/Getterön Airport is a non-instrument aerodrome approved by the Swedish Transport Agency. The airfield has an approved management function, aerodrome manual and a safety management system.

The airfield is included in both AIP[13] Sverige/Sweden and KSAB[14], Swedish Airfields.

The airfield (see Figure 6) has two grass runways named 12/30, with the dimensions 560 x 40 metres and 06/24, with the dimensions 600 x 50 metres, respectively. Runway 06/24 is closed for noise and environmental reasons and may only be used in emergencies and by the Voluntary Flying Corps if there is a specific need to do so.

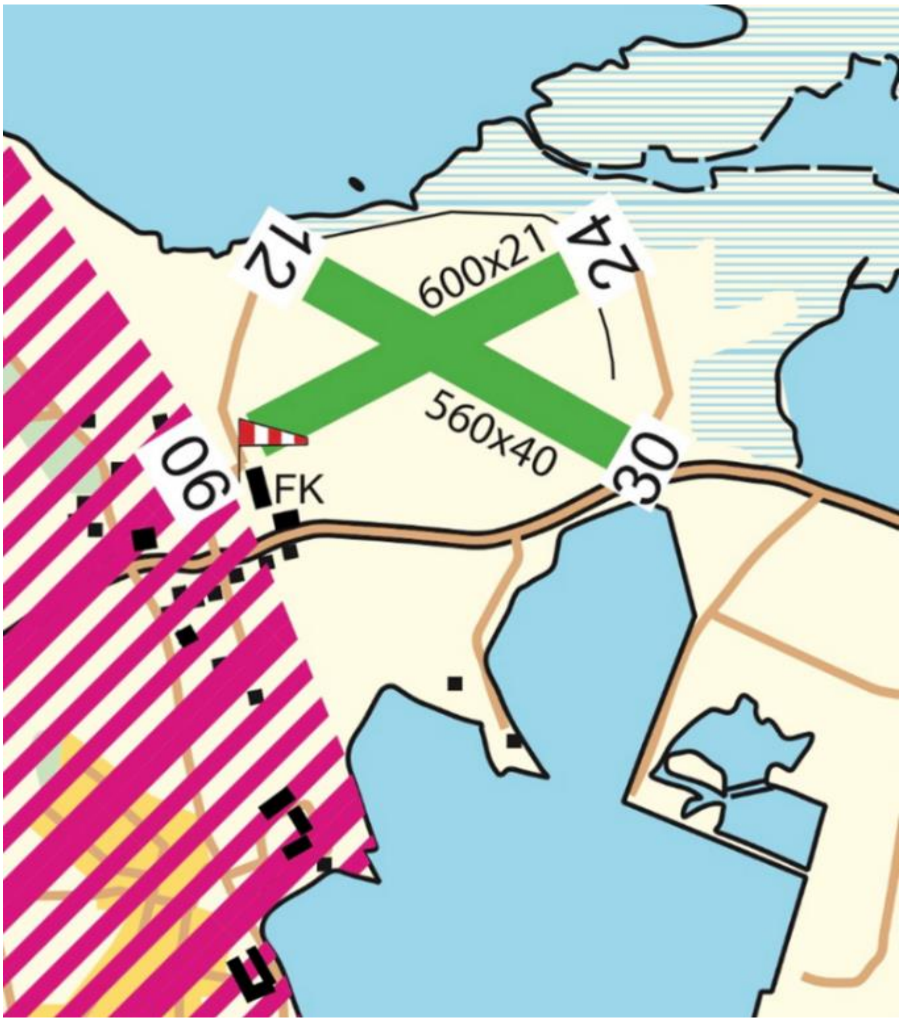

Figure 6. The airfield. Source: KSAB Swedish Airfields.

[13] AIP – Aeronautical Information Publication.

[14] KSAB is a company owned by KSAK, the Royal Swedish Aero Club, which sells aviation-related products.

1.11 Flight recorders

There were no flight recorders on the aeroplane in question, nor was there any requirement for such equipment to be installed on the aeroplane type in question.

1.11.1 Video recording with sound

The passenger, who sat in the right-hand seat, filmed a video sequence with sound during the occurrence. The film begins a moment after the take-off has begun and shows the sequence of events up until the crash. The video sequence is filmed straight ahead. The film shows the right side of the instrument panel and the horizon through the windscreen. The films have been analysed by SHK. The two images below (see Figure 7) are still images taken from the film sequence.

The two images show that the course at the time of the engine failure was the same as at lift-off (cf. with the white roof that is seen in front of the aeroplane) and that the attitude of the nose was normal for the flight phase.

Figure 7. Left image: just after lift-off. Right image: the engine failure.

The two images in Figure 8 show that, following the engine failure and in conjunction with the attempt to restart the engine, the aeroplane had a significantly higher nose attitude than at the time of the engine failure. It is evident in the right image that, a few seconds later, the aeroplane enters a slight left turn (20–30 degrees of bank), with a new, somewhat lower nose attitude.

Figure 8. Left image: attempt to restart. Right image: banking and the nose is lowered.

Figure 9 shows the aeroplane’s attitude when the left wing makes contact with the ground.

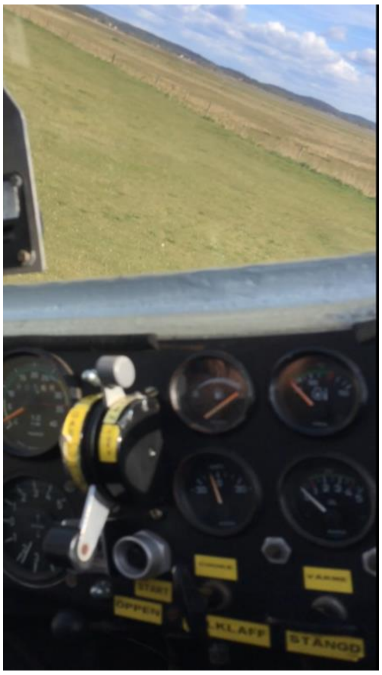

Figure 9. Left wing makes contact with the ground.

1.12 Accident site and aircraft wreckage

1.12.1 Accident site

The aeroplane came to a stop just after and to the left of the end of runway 12 (see Figures 10 and 11).

Figure 10. The arrows indicate the aeroplane's direction and the aeroplane's final position is marked with a red circle. The arrows and the red circle have been drawn by SHK. Image: Google Earth.

Figure 11. The aircraft's position after the occurrence. Image: Varbergs flygklubb.

1.12.2 Aircraft wreckage

The left wing was partly broken off and the broken-off part lay a short distance from the fuselage. The front section of the fuselage suffered major damage on its underside and on its left side forward of the leading edge of the wing. The underside of the rear fuselage also showed signs of damage and the tailwheel was knocked off. One of the propeller's blades was broken a little in from the tip.

1.12.3 Technical examination of the aircraft

SHK conducted an initial technical examination of the powered sail-plane on 8 May 2018 on the flying club's premises, where the plane had been transported following the occurrence. According to information from someone who was at the site shortly after the accident, the fuel cock was in the open position when they arrived at the aeroplane. This is also documented in an image. The fuel cock was subsequently closed.

The engine, the propeller, the carburettor and the ignition cables were inspected visually. It was possible to turn the propeller without abnormal resistance. The function of the mixture control and throttle were checked, as was that of the carburettor heat. Fuel hoses, pipes, pipe couplings and fuel filter cup were checked visually.

It was not possible to detect any fuel leak and, the fuel gauge indicated that the tank was almost full. A sample of fuel was taken from the tank for analysis (see section 1.16.1).

The tank was emptied of fuel and the remaining fuel was measured. The amount of fuel measured was almost 40 litres.

In summary, no faults that were deemed to have potentially caused an engine failure were detected at the time of the initial technical examinations.

Nevertheless, the aeroplane was then transported to SHK's examination facility for further technical examinations. These examination involved the mechanical fuel pump being disassembled (see Figures 12–14). When the fuel pump was taken apart, it was possible to establish that one of the metal plates that drive the pump diaphragm had come loose.

Figure 12. In the foreground in the image is the diaphragm with the outer half of the fuel pump housing. In the background is the other half of the fuel pump housing with one of the plates that drives the diaphragm.

Figure 13. The image shows the interior plate, which is part of how the diaphragm is driven. In the middle of the plate is the part that is supposed to hold the plates and the diaphragm together, the shank and the formed head (the rivet head). The right image shows the swelled shank, marked with a yellow arrow.

Figure 14. Part of the fuel pump with the loose drive plate and the diaphragm.

The rivet that should hold the drive plate in place had a swelled shank where the diaphragm sat (see Figures 13 and 16). However, the exterior diameter of the formed head was barely noticeably larger than the diameter of the hole in the drive plate. The part of the formed rivet that stuck up over the drive plate was measured as just under 0.4 mm (see Figures 14, 15 and 16).

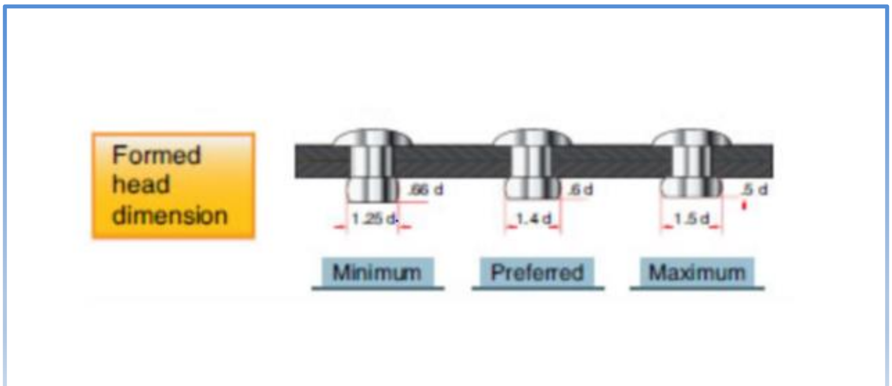

Figure 15. Schematic showing formed rivet heads.

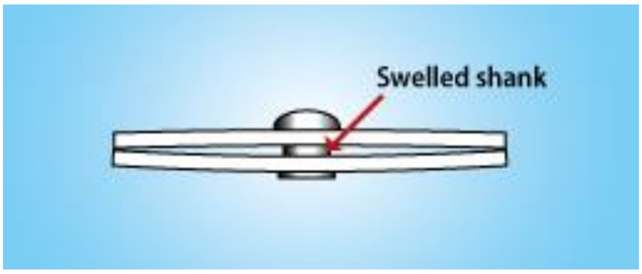

Figure 16. Schematic of riveting where the shank of the rivet has swelled in the middle. See Figure 13, right image, where the shank has swelled.

No faults that were deemed to have potentially caused the engine failure were identified during the examinations of other systems concerned such as the fuel tank, fuel pipes, ignition system, engine, carburettor and fuel filter.

1.13 Medical and pathological information

There is nothing to indicate that the mental and physical condition of the pilot was impaired before or during the flight.

1.14 Fire

There was no fire.

1.15 Survival aspects

1.15.1 Rescue operation

A call was received by SOS Alarm at 11:16 hrs from an individual who had seen an aeroplane crash at Varberg A. The caller stated that it involved a small plane, that there were two people on board and that one of them was seriously injured. She went to the aeroplane and remained there in order to help the injured person until the ambulance arrived.

The fire and rescue service, the police and two ambulances were sent to the site. SOS Alarm also contacted the Joint Rescue Coordination Centre (JRCC)[15], but there was never any need to initiate an air rescue operation. At 11:24 hrs, the fire and rescue service arrived at the site and an ambulance arrived a few minutes later.

The fire and rescue service cut off a couple of steel tubes behind the front seats of the aircraft in order to reduce the risk of further injuries to the pilot when they were being lifted out of the plane. The passenger was able to get out of the aircraft with the help of another person.

The people from the aeroplane were then transported by ambulance to hospital, where they arrived just after 12:00 hrs.

[15] JRCC – the Swedish Maritime Administration's Joint Rescue Coordination Centre.

There was no fuel leak or fire in conjunction with the accident.

The police on site documented the wreckage and the accident site.

No emergency locator transmitter (ELT[16]) was installed in the powered sailplane.

1.15.2 Position of crew and passengers and the use of seat belts

The pilot sat in the left and the passenger in the right front seat and both were strapped in using four-point safety belts. The pilot suffered serious injuries to his face and sprained both feet. According to information from the passenger, he was also difficult to communicate with following the impact. The passenger suffered minor injuries.

1.16 Tests and research

1.16.1 Examination of the fuel

SHK has commissioned Element Materials Technology to conduct an analysis of the aviation gasoline from the aeroplane's tank. The gasoline was of the UL 91/96 type and the measured values are within the limits required under the applicable specification[17].

The results of the analysis show a good purity and low water content without admixture of other fuel.

The values measured for the distillation residue of the sample are just outside the required limits. However, the fact that these values were somewhat outside of the required limits is not something that could have caused the engine failure.

1.17 Organisational and management information

Not pertinent.

1.18 Additional information

1.18.1 Regulations concerning the construction of powered sailplane

The regulations concerning the construction of powered sailplanes (CS-22[18]) imply very simplified requirements concerning engine reliability in comparison with other powered aircrafts. For example, a single ignition system and single fuel pump. This is justified by the fact that a powered sailplane is basically a sailplane that copes relatively well without an engine.

16 ELT – Emergency Locator Transmitter.
17 ASTM D910 – Standard Specification for Leaded Aviation Gasolines.
18 CS-22 Sailplanes and Powered Sailplanes – certification specification for sailplanes and powered sailplanes.

Accordingly, the powered sailplane engine does not meet the normal construction regulations for aircraft engines. Consequently, when flying a powered sailplane, the pilot shall instead ensure that the flight is performed in such a way that, in the event of a potential engine failure, there is a suitable area for landing within reach in a manner equivalent to that which applies to sailplanes.

The idea is thus that it shall normally be possible to cope with an engine failure in a powered sailplane by applying procedures in order to avoid a serious accident.

1.18.2 Training and exercises performed

SHK has reviewed the pilot's training and what exercises the pilot has performed on the aeroplane type. The training is based on a list with 90 specific exercise elements. For some of these, an instructor assesses whether they need to be performed. The instructors had signed the elements in the list that were completed.

In addition to the exercises, a further eight flights were performed as general flight training at the end of the training.

The majority of the exercises were performed in the period from May to September 2017 and May to July 2018. In 2017–2018, the pilot had also flown another type of powered sailplane (HK 36 – Super Dimona).

According to the notes, the relevant exercises on engine failure were performed and signed by the instructor. Three of the exercises included specific practice of engine failure at low altitude in conjunction with take-off. However, the pilot has stated that he has not any clear memory of having performed such exercises during his training.

According to the instructor who conducted the proficiency check in spring 2019, engine failure was not practised during that flight. Nor does the instructions for the proficiency check specify any exercises as mandatory. Accordingly, the proficiency check is to be regarded more as general flight training with an instructor.

1.18.3 EU regulations regarding continuing airworthiness

Commission Regulation (EU) No 1321/2014 on continuing airworthiness[19] aims to ensure that aircraft fulfil the applicable airworthiness requirements and are in a state that allows safe flight throughout their entire lifespan. In order to achieve this objective, there are a range of different rules for various organisations and people who operate within organisations that work with continuing airworthiness (see Figure 17).

[19] COMMISSION REGULATION (EU) No 1321/2014 of 26 November 2014 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks.

Maintenance of components[20]

The maintenance of components may, with certain exemptions, only be performed by maintenance organisations appropriately approved in accordance with Section A, Subpart F of Annex I (Part-M) or with Annex II (Part-145)[21]

Certificate of release to service for components

When all requisite maintenance of components[22] has been completed, a certificate of release to service shall be issued for the components. An EASA Form 1 shall normally be issued. There are certain exemptions from this requirement, but none of these exemptions are applicable in this case. An EASA Form 1 shall have been issued in order for a component that is life-limited[23] to be eligible for installation in an ELA1[24]-aircraft.

Maintenance records[25]

The approved maintenance organisation shall provide a copy of each certificate of release to service to the aircraft owner, together with a copy of any specific repair or modification data used for repairs or modifications carried out.

Installation of components[26]

No component[27] may be fitted unless it is in a satisfactory condition, has been appropriately released to service on an EASA Form 1 or equivalent and is marked in accordance with the regulations[28]. Consequently, a technician who receives an engine following an overhaul must check this before the engine is re-installed in the aircraft.

Standard parts[29] shall only be fitted to an aircraft or a component when the maintenance data specifies the particular standard part. Standard parts shall only be fitted when accompanied by evidence of conformity traceable to the applicable standard.

[20] Commission Regulation (EU) No 1321/2014, Annex I (Part-M), M.A.502(a).
[21] Point c of point 21.A.307 of Annex I (Part-21) to Regulation (EU) No 748/2012.
[22] Commission Regulation (EU) No 1321/2014, Annex I (Part-M), M.A.613(a).
[23] According to point c of point 21.A.307 of Annex I (Part-21) to Regulation (EU) No 748/2012.
[24] ELA1-aircraft (European Light Aircraft) – an aeroplane with a Maximum Take-off Mass (MTOM) of 1,200 kg or less that is not classified as complex motor-powered aircraft.
[25] Commission Regulation (EU) No 1321/2014, Annex I (Part-M), M.A.614(b).
[26] Commission Regulation (EU) No 1321/2014, Annex I (Part-M), M.A.501(a).
[27] Component – every engine, propeller, part or appliance.
[28] Subpart Q of Annex I (Part-21), unless otherwise specified in Annex I (Part-21) to Regulation (EU) No 748/2012.
[29] Commission Regulation (EU) No 1321/2014, Annex I (Part-M), M.A.501(c).

Airworthiness review[30]

To satisfy the requirements for the airworthiness review of an aircraft, a full documented review of the aircraft records shall be carried out by the approved continuing airworthiness management organisation. This shall be done in order to ensure that all service life limited[31] components installed on the aircraft are properly identified, registered and have not exceeded their approved service life limit and that all maintenance has been released in accordance with Annex I (Part-M).

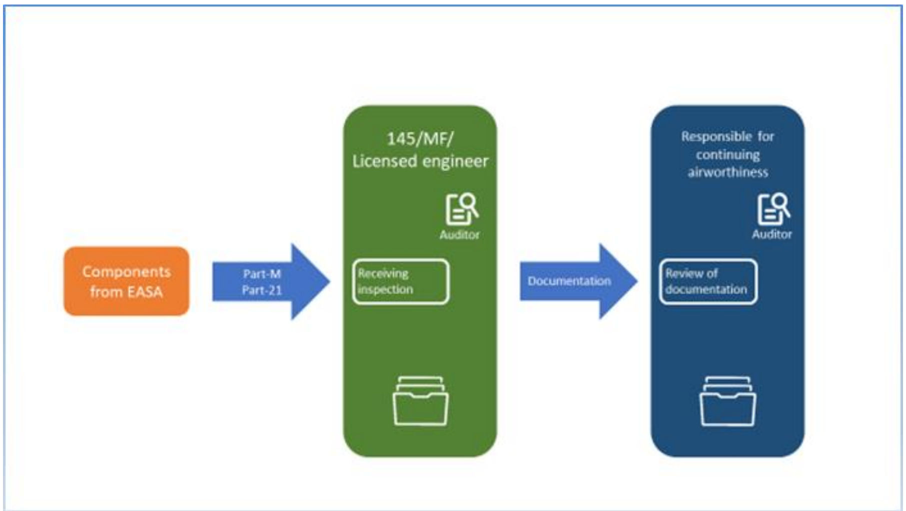

Figure 17. Outline flowchart for the installation of a component in accordance with the regulations on continuing airworthiness. Only approved components may be installed in an aircraft. The maintenance organisation shall check that the components are approved and in a satisfactory condition upon their arrival. The maintenance organisation shall then issue the stipulated documentation concerning the maintenance that has been conducted and this shall be provided to the person responsible for airworthiness, who shall in turn inspect the documentation. Following the re-installation of a component that has been for maintenance, the responsible technician shall issue a certificate of release to service. The person responsible for the airworthiness is also obliged to conduct an airworthiness review at regular intervals.

1.18.4 Actions taken

Swedish Soaring Federation

In view of the accident, the Swedish Soaring Federation has made it clear that it intends to take the following actions:

- Inform all sailplane technicians and airworthiness reviewers that an EASA Form 1 is required for engines, propellers and certain components. This will be done through seminars, recurrent training and visits to flying clubs.
- Inform owners of powered sailplanes about applicable requirements when ordering maintenance and about which maintenance organisations have been approved for different types of maintenance tasks.

[30] Commission Regulation (EU) 2015/1088, M.A.710(a).
[31] Commission Regulation (EU) 2015/1088, M.A.710(a).

- Inform sailplane instructors of how training in the handling of emergency situations is to be conducted in conjunction with flight training on powered sailplanes (TMG).

The federation has also stated that it will be encouraging instructors to practice dealing with emergency situations during proficiency checks and when implementing flight training hours in powered sailplanes. The Swedish Soaring Federation also publishes instructions and counsel to the sailplane clubs in the sailplane manual (SHB). In the upcoming update of the manual, it will be introduced that training in managing emergency situations (e.g. engine failure after take-off at low altitude) should always be carried out during flight training hours with sailplane instructor and that special focus should be on the use of emergency checklist.

German supervisory authority for civil aviation

In view of the accident, the German supervisory authority for civil aviation, Luftfahrt-Bundesamt (LBA), has made it clear that it intends to conduct a review of the maintenance organisation in question in light of the fact that a non-approved Certificate of Conformity was issued following the engine overhaul.

1.19 Special methods of investigation

Not pertinent.

2. ANALYSIS

2.1 Circumstances

The investigation shows that the pilot has undergone the training programme approved by the Swedish Soaring Federation and had passed this.

It is certainly true that the pilot has limited experience of flying powered sailplanes but, according to his instructors, had shown a good flying ability both during the training and during the proficiency check. While it is true that the pilot had not flown during the winter, he had subsequently flown two passes in the aeroplane in question.

The weather at the time of the accident was within the limitations of both the aeroplane and the certificate for the pilot and it is SHK's assessment that it has had only a marginal impact on the sequence of events.

The actual mass and centre of mass were within permissible limits.

The quantity of fuel on board at the time of take-off was sufficient for several hours flying.

According to the pilot, the aeroplane displayed no signs of engine trouble during taxiing, warm-up or the engine tests conducted prior to take-off.

2.2 Sequence of events

The analysis of the video indicates that the take-off proceeded normally up until the engine failure. The engine failure was clear to both the pilot and the passenger.

The video also indicates that the pilot's first action was to try to restart the engine. A sound heard on the video can be traced back to the starter. The video shows that the aeroplane then turns slightly to the left and sinks with its nose attitude largely maintained until the left wing makes contact with the ground.

It is possible to establish that the engine failure took place at an unfavourable time, when an immediate reaction from the pilot would have been required in order to minimise the risks of an accident. The stick would have needed to be moved forward in order to maintain speed and allow recovery prior to touchdown. However, the video indicates that the nose attitude remained high. A nose attitude such as this without engine power results in a rapid reduction in speed. Based on the video evidence and information from witnesses, SHK therefore concludes that the aeroplane lost so much speed following the engine failure that it ended up in a stall, resulting in an increasing vertical speed until the left wing hit the ground.

Accordingly, the first and second point on the emergency checklist, to maintain a speed of 100 km/h and search for a field suitable for landing, were not performed in time. Instead, the focus during the critical phase was on attempting to restart the engine, which may be partly explained by the stress the pilot felt in the situation that arose. The video shows no clear indications that any attempt was made to fly the aeroplane towards a field ahead in the direction of travel.

The documentation from the pilot's training and interviews with the flight instructors indicate that the elements required were performed and signed in the protocol by the instructors. According to the protocol, the exercises that were performed included several exercise elements involving practising engine failure at low altitude. However, the pilot has stated that he has not any clear memories of having performed such exercises. The occurrence itself also shows that the pilot had not sufficiently taken on board the implications of the exercises involving engine failure at low altitude that he had performed. It does not appear to have been made sufficiently clear during the training that these procedures, which have been practised at a higher altitude during training, are intended for use at low altitude. Nor does it appear that the importance of going through the emergency checklist prior to each flight have been given sufficient emphasis during the training.

SHK makes the assessment that the pilot would have had a better chance of dealing with the situation that arose if an exercise in engine failure had been performed during the latest proficiency check and if a run through of the emergency checklist for engine failure had been performed prior to take-off as a form of mental preparation for this type of situation.

The Swedish Soaring Federation has stated that they will update their sailplane handbook for flight training hours with sailplanes instructors and which is carried out with powered sailplanes. In the flight training hour, training in emergency situations should always be included, such as rejected take-off with an abort point, engine failure after take-off at low altitude, engine failure at altitude and aborted landing with a go-around. Special focus should also be placed on the use of emergency checklist. Against this background, SHK considers that there is no reason to issue any safety recommendation in this regard.

However, The Swedish Soaring Federation is recommended to inform pilots in a suitable manner of the importance of going through the emergency checklist ahead of every flight.

2.3 Survival aspects

2.3.1 Rescue operation

The rescue operation was initiated without delay and the actions taken appear to have been suited to the needs that arose in conjunction with the accident. Accordingly, SHK has not found any reason to examine the rescue operation in more detail.

2.4 Reason for the engine failure

During the technical examinations of the fuel pump it was possible to establish that one of the metal plates that drive the pump diaphragm had come loose. The diaphragm stopped being driven when the metal plate came loose. This resulted in the fuel no longer being pumped into the carburettor, which in turn led to the engine shutting down.

The pump plates and the pump diaphragm are held together by what is known as riveting. In riveting, it is important that the length of the shaft is correct, as this has to be deformed plastically in order to create a flattened rivet head that expands sufficiently over the hole. The investigation of the riveting of the drive plates and the diaphragm shows that the flattened rivet head has not been sufficiently expanded. The assembly of the diaphragm and drive plates in the fuel pump has therefore been defective.

No other technical faults on the aeroplane have been identified that are deemed to have potentially caused the engine failure. Nor did the analysis of the aviation gasoline from the aeroplane’s tank indicate any circumstance that may have contributed to the engine failure.

2.5 The engine overhaul

2.5.1 The maintenance organisation’s overhaul

The EU regulations concerning continuing airworthiness aim to ensure that aircraft fulfil the applicable airworthiness requirements and are in a state that allows safe flight throughout their entire lifespan. The regulations are based, among other things, on the principles that only approved and checked components may be installed in aircraft and that maintenance of aeroplanes and components may only be performed by approved maintenance organisations. Maintenance shall also be carried out in accordance with the type certificate holder’s instructions.

According to the repair manual from the type certificate holder for the engine, replacement of all rubber and plastic components is mandatory during an overhaul of an engine of the type in question. This requirement also includes the mechanical fuel pump.

The maintenance organisation has stated that since it replaced all plastic parts, the maintenance of the engine has been performed in accordance with the type certificate holder's instructions. However, the investigation shows that the fuel pump from the manufacturer APG that was installed in the engine at the time of the occurrence and spare parts for this were not listed in the specifications in the type certificate holder's maintenance data. Consequently, in order to comply with the requirements set out by the type certificate holder in the repair manual, the only option would have been to replace the mechanical fuel pump with a fuel pump from the new manufacturer, BCD. However, it can be established that this was not done.

Instead, only certain parts of the fuel pump were replaced. Nevertheless, this was not stated in the documentation concerning the engine overhaul that was produced by the maintenance organisation and provided to the flying club. However, representatives of the maintenance workshop have later shown to the investigation documentation to the effect that a repair kit was installed in the mechanical fuel pump. This repair kit was, however, not included in the type certificate holder's maintenance data and did not have an approved certificate of release to service either. This means that the repair kit was not approved for installation in the engine in question.

The fact that the maintenance organisation installed this repair kit instead of replacing the mechanical fuel pump resulted in the engine being delivered to the flying club following the overhaul with a defective diaphragm and a non-approved fuel pump. The fact that the assembly of the diaphragm was defective has evidently also not been detected during the receiving inspection or when installing the repair kit. Nor did the maintenance organisation issue an EASA Form 1 for the overhaul, despite this being required following this type of overhaul. A Certificate of Conformity was issued instead. This may be explained by the fact that the maintenance organisation was well aware that it was not authorised to issue an EASA Form 1.

2.5.2 Why were the defects not detected by the flying club's technicians or by SFF CAMO?

The fact that the engine overhaul had not been carried out in accordance with the applicable regulations was not detected by the flying club in conjunction with reinstallation of the engine in the aeroplane. The Certificate of Conformity was accepted by the technician responsible for installation and a certificate of release to service after maintenance was issued following installation of the engine. According to the maintenance organisation, the flying club had been informed that the organisation was not able to issue an EASA Form 1. At the same time, however, the organisation described the Certificate of Conformity as a document that is similar to an EASA Form 1.

It is SHK's opinion that the fact that the invalid Certificate of Conformity was accepted has most likely been due to a lack of knowledge on the part of the technician and the flying club that it is only an EASA Form 1 certificate of release to service that can be accepted for a life-limited component that is being installed in an ELA1-aircraft. Nonetheless, even if the technician had known this, it is not certain that they would have reacted to the certificate as it is confusingly similar to the EASA Form 1 certificate of release to service.

The flying club had also not checked the maintenance organisation sufficiently enough prior to making use of its services. If this had been done, it would have been possible to discover that the organisation did not have authorisation to carry out an overhaul of the engine model in question.

The fact that there was no EASA Form 1 in the engine's documentation was also not detected during the airworthiness review conducted by the Swedish Soaring Federation's Continuing Airworthiness Management Organisation (SFF CAMO) on 15 May 2018. It has emerged during the investigation that there is a difference of opinion within SFF CAMO as to which certificates of release to service are required for a life-limited component that is to be installed in an ELA1-aircraft. All in all, this suggests that there are certain inadequacies in terms of the knowledge of airworthiness reviewers and the procedures for airworthiness review.

2.5.3 Overall assessment

In summary, SHK determines that the safety barriers, which aim to ensure that only approved, safe and reliable components are installed in aircraft, have not functioned in this case.

What occurred also indicates that there are inadequate knowledge and routines of both the flying club and the technician who reinstalled the engine and SFF CAMO. These inadequacies have resulted in none of them noticing that the maintenance organisation lacked the requisite authorisation, had not carried out the maintenance in accordance with applicable regulations and the type certificate holder's maintenance data, and that the correct documentation concerning the engine overhaul was missing.

As described, it has also been suggested that there is a difference of opinion among those involved regarding whether an EASA Form 1 is required for the type of engine overhaul in question. This may be explained in part by the fact that some parts of the regulations are tricky and not easy to interpret.

All in all, the Swedish Soaring Federation is, in light of this, recommended to, in cooperation with the Swedish Transport Agency, produce a training plan for a training programme that aims to increase knowledge about the rules that apply to life-limited components and about the checks that need to be conducted. The training programme should be intended for both airworthiness reviewers within SFF CAMO and the technicians concerned. The Swedish Transport Agency has expressed its willingness to assist the Swedish Soaring Federation with this.

3. CONCLUSIONS

3.1 Findings

a) The pilot was qualified to perform the flight.
b) The powered sailplane had a valid Certificate of Airworthiness and valid ARC.
c) The aeroplane's mass and centre of mass were within the permissible limits.
d) The drive plate for the diaphragm in the mechanical fuel pump came loose, which caused the engine failure.
e) The mechanical fuel pump and the parts that were replaced were not consistent with and were not specified in the type certificate holder's maintenance data.
f) The maintenance organisation was not authorised to carry out a overhaul of the engine in question.
g) The Certificate of Conformity for the engine was not valid.
h) The pilot had completed the full training programme but had no memory of any exercises involving dealing with engine failure at low altitude.
i) Engine failure was not practised during the latest proficiency check.
j) The nose attitude remained high after the engine failure.
k) The aeroplane ended up in a stall with an increasing vertical speed.
l) The engine's documentation was accepted by the technician and the flying club at the time of installation.
m) The engine's documentation was accepted at the time of the airworthiness review.
n) Knowledge of which certificate of release to service is acceptable for a life-limited component was not sufficient within the the continuing airworthiness organisations.

3.2 Causes/Contributing Factors

The cause of the engine failure was that a drive plate for the pump diaphragm inside the fuel pump came loose as a result of defective assembly.

The engine failure resulted in a serious accident because the pilot had limited experience, training and mental preparedness to deal with the situation in accordance with the emergency checklist.

A contributing factor to the accident was that the aforementioned fuel pump, which was not an approved component, was not replaced by the maintenance organisation in conjunction with the engine overhaul and that this was not detected by either the flying club, the technician who reinstalled the engine or the Swedish Soaring Federation's Continuing Airworthiness Management Organisation (SFF CAMO).

4. SAFETY RECOMMENDATIONS

The Swedish Soaring Federation is recommended to:

- In cooperation with the Swedish Transport Agency, produce a training plan in order to increase knowledge of the regulations pertaining to life-limited components, for sailplanes technicians, airworthiness reviewers and the person responsible for the continuing airworthiness of an aircraft, see chapter 2.5.3. *(RL 2020:04 R1)*
- In cooperation with the Swedish Transport Agency, improve procedures for airworthiness reviews, see chapters 1.6.8 and 2.5.2. *(RL 2020:04 R2)*
- Inform pilots of the importance of repeating the emergency checklist before each flight, see chapters 1.6.10, 1.1.2 and 2.2. *(RL 2020:04 R3)*

The Swedish Accident Investigation Authority respectfully requests to receive, **by 28 July 2020** at the latest, information regarding measures taken in response to the safety recommendations included in this report.

On behalf of the Swedish Accident Investigation Authority,

Helene Arango Magnusson Tony Arvidsson

Appendix

1. Approving Component Authority/Country
Zuständige Genehmigungsstelle / Staat
Sauer-Flugmotorenbau / Germany

2 **AUTHORISED RELEASE CERTIFICATE**
Freigabebescheinigung
CERTIFICATE OF CONFORMITY
Übereinstimmungsbescheinigung

3. Certificate Number
Bescheinigungsnummer: 08/18

4. Organisation Name and Address:
Name und Anschrift des Unternehmens
SAUER FLUGMOTORENBAU GMBH
Sauer Flugmotorenbau GmbH, Nieder-Olmer-Str. 16, 55270 Ober-Olm,

5. Customer / Kunde
050118 Verbergs Flyklubb

6. Item Pos.	7. Description Beschreibung	8. Part No. Teile-Nr.	9. Qty. Menge	10. Serial No. Werk-Nr.	11. Status/Work Status/Arbeiten
1	Aircraft engine L2000EA2	na	1	1391	overhauled
2	Ignition Magnet Slick 4330	4330	1	14081821	overhauled

12. Remarks: The maintenance of the engine was carried out with reference to approved maintenance documents, Limbach Repair Manual 905 170 020 000. Chapter 2, instructions for overhaul, and SI-s and ID-s, were considered, TTSN na, TSO 0h. Engine receiving report from 21.11.2017, Engine assembly report from 23.01.2018. Engine test run report from 07.03.2018. Final check report from 12.03.2018. The maintenance of the Slick ignition magnet was carried out with reference to approved maintenance documents, Magneto Maintenance Overhaul Manual L1363, 05.2011, and by SI-s and ID-s. TSN na., TSO 0h. Customer order from 19.01.2018

13a. Certifies that the items identified above were manufactured in conformity to:
Bescheinigt, dass die oben angegebenen Artikel hergestellt wurden in Übereinstimmung mit:
☐ approved design data and are in a condition for safe operation
genehmigten Konstruktionsdaten und sich in einem betriebssicheren Zustand befinden
☐ non-approved design data specified in block 12
nicht genehmigten Konstruktionsdaten gemäß Angabe in Feld 12

14a. ☐ Part-145.A.50 Release to Service
Teil-145.A.50 Freigabe
X Other Regulation specified in block 12
Andere in Feld 12 angegebene Vorschrift
Certifies that unless otherwise specified in block 12, the work identified in block 11 and described in block 12, was accomplished in accordance with Part 145 and in respect to that work the items are considered ready for release to service
Bescheinigt hiermit, dass, wenn in Feld 12 nichts anderes festgelegt ist, die in Feld 11 aufgeführte und in Feld 12 beschriebene Arbeit in Übereinstimmung mit Teil-145 durchgeführt wurde und dass der Artikel im Hinblick auf diese Arbeit für die Erteilung einer Freigabe geeignet ist.

13b. Authorised Signature Rechtsgültige Unterschrift	13c. Approval/Authorisation Number Nr. der Genehmigung: DE.21G.0018	14b. Authorised Signature Rechtsgültige Unterschrift	14c. Certificate/Approval Ref. No. Nr. der Genehmigung / Zulassung DE.MF.0504
13d. Name Name	13e. Date (dd mmm yyyy) Datum (TT/MMM/JJJJ)	14d. Name Name	14e. Date (dd mmm yyyy) Datum (TT/MMM/JJJJ) 12.Mar.2018

CERTIFICATE OF CONFORMITY
IT IS CERTIFIED THAT EACH OF THE LISTED GOODS HAVE BEEN INSPECTED; TESTED AND – UNLESS OTHERWISE STATED ABOVE – CONFORM IN ALL RESPECTS WITH THE REQUIREMENTS OF THE CONTRACT OR ORDER:
Übereinstimmungsbescheinigung
Es wird bescheinigt, dass die einzeln aufgeführten Waren geprüft, getestet und – sofern nicht anderweitig angegeben – in jeder Beziehung den Anforderungen des Vertrages oder der Bestellung entsprechen.

Sauer Form 38/1

Figure 18. Certificate of Conformity (CoC)

EASA
European Union Aviation Safety Agency

Easy Access Rules for Continuing Airworthiness
(Regulation (EU) No 1321/2014)

Annex I (Part-M)
APPENDICES TO ANNEX I (Part-M)

1. Approving Competent Authority / Country

2. AUTHORISED RELEASE CERTIFICATE
EASA FORM 1

3. Form Tracking Number

4. Organisation Name and Address:

5. Work Order/Contract/Invoice

6. Item	7. Description	8. Part No.	9. Qty.	10. Serial No.	11. Status/Work

12. Remarks

13a. Certifies that the items identified above were manufactured in conformity to:
□ approved design data and are in a condition for safe operation
□ non-approved design data specified in block 12

14a □ Part-145.A.50 Release to Service □ Other regulation specified in block 12
Certifies that unless otherwise specified in block 12, the work identified in block 11 and described in block 12, was accomplished in accordance with Part-145 and in respect to that work the items are considered ready for release to service.

13b. Authorised Signature	13c. Approval/Authorisation Number	14b. Authorised Signature	14c. Certificate/Approval Ref. No.
13d. Name	13e. Date (dd mmm yyyy)	14d. Name	14e. Date (dd mmm yyyy)

USER/INSTALLER RESPONSIBILITIES
This certificate does not automatically constitute authority to install the item(s).
Where the user/installer performs work in accordance with regulations of an airworthiness authority different than the airworthiness authority specified in block 1, it is essential that the user/installer ensures that his/her airworthiness authority accepts items from the airworthiness authority specified in block 1.
Statements in blocks 13a and 14a do not constitute installation certification. In all cases aircraft maintenance records must contain an installation certification issued in accordance with the national regulations by the user/installer before the aircraft may be flown.

EASA Form 1 -MF/145 Issue 2

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Figure 19. Certificate of release to service (EASA Form 1).