Statens haverikommission
Swedish Accident Investigation Authority

Final report RL 2020:02e

Accident at Norrtälje/Mellingeholm airport, Stockholm county, 29 July 2019 involving the aircraft D-EPFH of the model Cirrus SR22, operated by a private person.

File no. L-101/19

19 February 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 web site: www.havkom.se

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This document is a translation of the original Swedish report. In case of discrepancies between this translation and the Swedish original text, the Swedish text shall prevail in the interpretation of the report.

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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 29 July 2019 that an accident involving an aircraft with the registration D-EPFH had occurred at Norrtälje/Mellingeholm airport, Stockholm county, the same day at 11:43 hrs.

The accident has been investigated by SHK represented by Mr Jonas Bäckstrand Chairperson, Mr Johan Nikolaou, Investigator in Charge, Mr Håkan Josefsson, Operations Investigator and Mr Ola Olsson, Technical Investigator.

Mr Deepak Joshi from the National Transportation Safety Board (NTSB) has participated as accredited representative on behalf of USA.

Mr Alvaro Neves has participated as advisor from European Aviation Safety Agency (EASA).

The investigation was followed by Mr Magnus Axelsson of the Swedish Transport Agency (Transportstyrelsen).

The following organisations have been notified: EASA, EU-Commission, the German Federal Bureau of Aircraft Accident Investigation (BFU), NTSB and Swedish Transport Agency.

Investigation material

Interviews have been conducted with the pilot and a witness. SHK has been at the accident site and investigated the aircraft wreck and measured the airport. SHK has also obtained information from the type certificate holder Cirrus Design Corp.

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Aircraft:	
Registration, type	D-EPFH, Cirrus SR22
Model	SR22
Class, Airworthiness	Normal, Certificate of Airworthiness and Valid Airworthiness Review Certificate (ARC)[1]
Serial number	3497
Owner	Private
Time of occurrence	29 July 2019, 11:43 hrs in daylight Note: All times are given in Swedish daylight saving time (UTC[2] + 2 hours)
Place	Norrtälje/Mellingeholm airport, Stockholm county, (position 5943N 01841E, 12 metres above mean sea level)
Type of flight	Private
Weather	According to SMHI's analysis: wind east-northeast 10–15 knots, visibility more than 10 kilometres, no clouds below 3 000 feet, temperature/dewpoint +23/+15°C, QNH[3] 1013 hPa
Persons on board:	4
crew members including cabin crew	1
passengers	3
Injuries to persons	None
Damage to aircraft	Substantially damaged
Other damage	None
Pilot in command:	
Age, licence	56 years, PPL[4]/IR[5]
Total flying hours	321 hours, of which 252 hours on type
Flying hours previous 90 days	58 hours, of which all hours on type
Number of landings previous 90 days	34

[1] ARC (Airworthiness Review Certificate).
[2] UTC (Coordinated Universal Time).
[3] QNH (Barometric pressure at mean sea level).
[4] PPL (Private Pilot License).
[5] IR (Instrument Rating).

SUMMARY

The flight was a private flight from Lübeck-Blankensee airport in Germany to Norrtälje/Mellingeholm airport.

During the approach to Norrtälje/Mellingeholm airport, the pilot chose runway 25 since he, based on the information in his GPS, assumed that the wind would be light and vary in direction. At touchdown, the nosewheel touched down first. There was no flare, which led to a hard, bounced landing, at which point the pilot tried to abort the landing attempt by giving full throttle, which caused the aircraft to yaw heavily to the left. The aircraft left the runway area and flew into some shrubbery outside the runway strip. It then landed in the terrain outside the runway, at which point the aircraft's landing gear and propeller broke off. The aircraft then skidded and spun around clockwise, and finally came to rest facing north.

According to SMHI's analysis, the wind at the time was east–northeast, 10–15 knots. The choice of runway 25 meant that the approach was carried out with a tailwind. At Norrtälje/Mellingeholm airport, there is a difference in elevation between the threshold ends of the runway, which means there is an upslope at the first part of runway 25. The published runway length was also shorter than the actual.

The design of the airport, combined with the pilot only having experience of airports with air traffic service, meant that reconnaissance of the conditions was not performed to the necessary extent. This likely led to a tailwind landing and to the pilot misjudging the flare and touchdown.

SHK has not been able to determine why the pilot lost control after the aircraft bounced. The fact that the aircraft did not climb, but continued flying at low altitude through the shrubbery, may have been due to the pilot reducing the power to decrease the yaw effect, to the aircraft being subjected to heavy side force, to the angle of attack being so high that the aircraft's drag exceeded the thrust, or due to a combination of these three factors.

The following factors may have contributed to the failed go-around.

1. High engine power
2. P-factor, slipstream and lack of sufficient rudder compensation.

Safety recommendations

None.

1. FACTUAL INFORMATION

1.1 Report on the course of events

1.1.1 Preconditions

The flight started from Lübeck-Blankensee airport in Germany. Its destination was Norrtälje/Mellingeholm, an airport without air traffic services. The flight was conducted using instrument flight rules (IFR) on route and was concluded under visual flight rules (VFR). There were three passengers on board, in addition to the pilot.

The pilot had not previously been to the airport in Norrtälje, and it was his first time flying to an airport without air traffic services. The chart material he had with him indicated that the runway was 18 metres wide and 650 metres long, while in reality, it was 850 metres long. Shortly before the pilot left the radio frequency for Stockholm Control, he cancelled his flight plan, which meant that no follow-up was conducted by air traffic control.

A relative to the pilot was waiting at the airport in Norrtälje when the aircraft landed and she was the sole witness to the event.

1.1.2 History of the flight

The pilot has stated that the approach to Norrtälje was carried out directly towards the airport and for a downwind to runway 25. He chose runway 25 because he, based on the information in his GPS, assumed that the wind would be light and vary in direction. The pilot completed a left-hand circuit to the left base and stabilised on the final approach segment to runway 25. He was maintaining a speed of roughly 80 knots across the runway threshold.

In conjunction with the touchdown, the nosewheel touched down first. There was no flare, which led to a hard landing. This caused the aircraft to bounce, at which point the pilot tried to abort the landing attempt by giving full throttle, which caused the aircraft to yaw to the left. The pilot felt that the aircraft was not climbing, that the speed was too low and that he was at risk of stalling. The aircraft left the runway area and flew into some shrubbery outside the runway strip. It then landed in the terrain, where the aircraft's landing gear and propeller broke off. The aircraft then skidded and veered to the right, and finally came to a stop facing north.

The pilot has stated that his memories of the sequence of events after the aircraft bounced are fuzzy, that it was his first approach to an airport with no air traffic services and that he felt unsure prior to the landing, due to the short and narrow runway.

All on board were able to exit the aircraft unharmed.

The accident occurred in daylight at 5944N 01841E, twelve metres above sea level.

Figure 1. Picture over the final to runway 25 with a yellow marking by SHK at the point of touchdown. Photo: SHK. Published with the consent of The Swedish mapping, cadastral and land registration authority.

1.2 Injuries to persons

	Crew members	Passengers	Total on-board	Others
Fatal	-	-	0	-
Serious	-	-	0	-
Minor	-	-	0	Not applicable
None	1	3	4	Not applicable
Total	1	3	4	-

1.3 Damage to aircraft

Substantially damaged.

1.4 Other damage

None. No fuel leak could be detected.

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 56 years old and had a valid PPL/IR license with flight operational and medical eligibility.

Flying hours				
Latest	24 hours	7 days	90 days	Total
All types	4	4	58	321
Actual type	4	4	58	252

Number of landings actual type previous 90 days: 34.
Type rating concluded on 23 April 2018.
Skilltest for the Instrument Rating (IR) performed on 31 October 2018.

1.6 Aircraft information

The aircraft of model Cirrus SR22 is a four-seat, low-wing, single-engine aeroplane built by the American manufacturer Cirrus Aircraft. It is just under eight metres long with a wingspan of just under twelve metres. The aircraft has a six-cylinder, air-cooled boxer engine with 310 horsepower at 2,700 rpm.

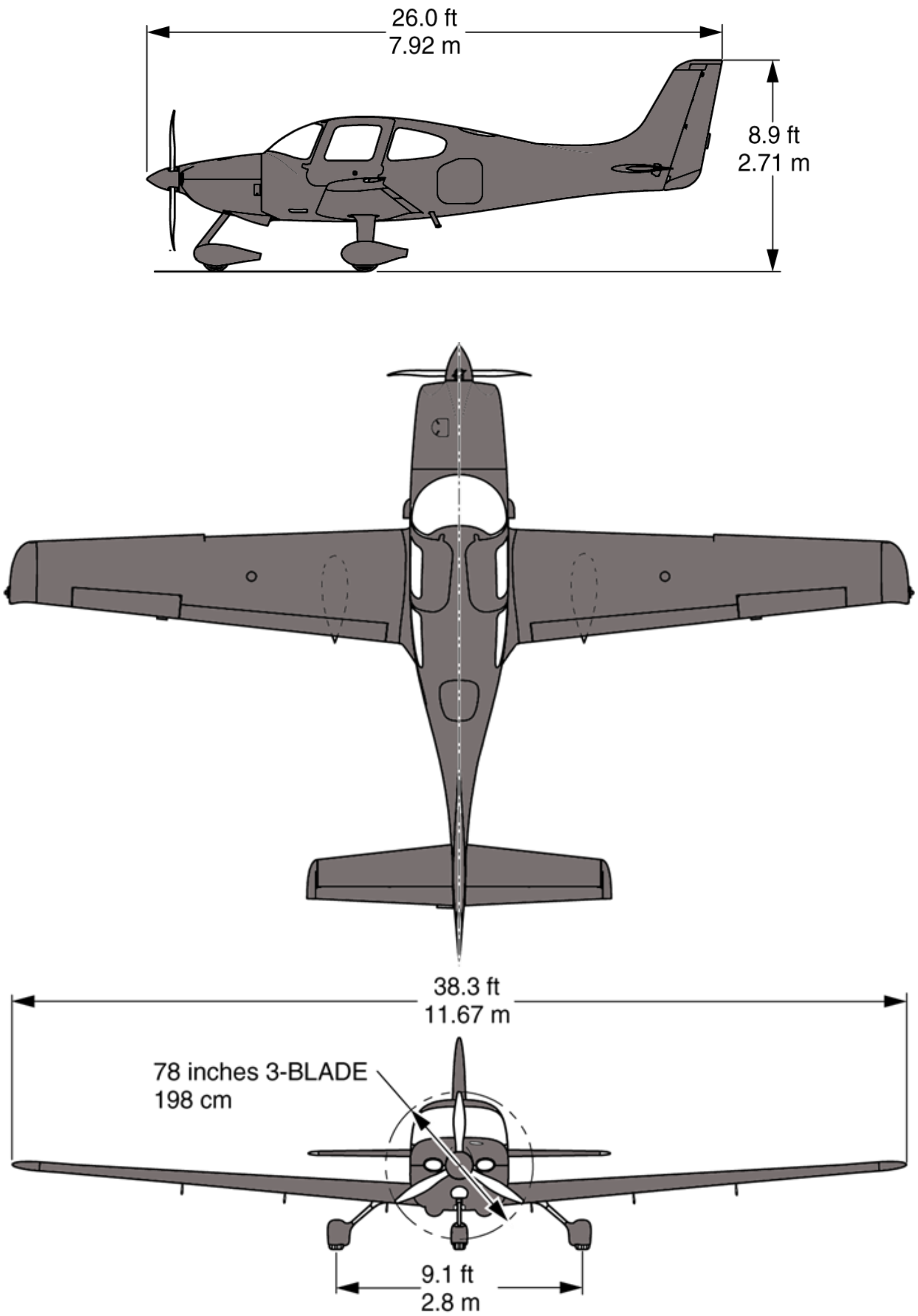


Figure 2. Three-view sketch of the aircraft type. Image: Cirrus Airplane Flight Manual.

1.6.1 Airplane

TC-holder	Cirrus Design Corp
Model	SR22
Serial number	3497
Year of manufacture	2009
Gross mass, kg	Max start/landing mass suspended load 1 542, current 1 440
Centre of gravity	Within limits
Total flying time, hours	1 335
Flying time since latest inspection	25
Type of fuel uplifted before the occurrence	100 LL
Engine	
TC-holder	Teledyne Continental
Type	IO-550-N
Total operating time, hours	1 335
Propeller	
TC-holder	Hartzell
Type	PHC-J3YF
Deferred remarks	None relevant for the event

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

1.6.2 Performance

In accordance with Part-NCO[6] of Regulation (EU) 965/2012, which applies to EASA-certified aircraft, there are no further requirements or limitations in addition to those stated in the flight manual.

Landing performance

The flight manual only provides a landing distance for a maximum landing mass of 1,542 kg. The stated applicable landing mass was 1,410 kg.

The estimated landing distance when passing the threshold at 50 feet in +23°C, with a dry runway and still air was 774 metres. The corresponding estimated ground roll was 388 metres.

The published runway length at the time was 650 metres, whereas the actual runway length was 850 metres.

A tailwind must be compensated for by adding 10 % per 2 knots, i.e. an addition of 50 % in case of a 10-knot tailwind.

[6] Commission Regulation (EU) No 965/2012 of 5 October 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council.

Climb performance

The performance documentation for the aircraft states that, with the indicated landing mass, the aircraft can climb around 1,200 feet per minute at full power in case of a balked landing.

1.6.3 Description of parts or systems related to the occurrence

Rudder

The rudder provides airplane directional (yaw) control. The rudder is of conventional design with skin, spar and ribs manufactured of aluminium.

Rudder motion is transferred from the rudder pedals to the rudder by a single cable system under the cabin floor to a sector next to the elevator sector pulley in the aft fuselage. A push-pull tube from the sector to the rudder bell crank translates cable motion to the rudder. Springs and a ground adjustable spring cartridge connected to the rudder pedal assembly tension the cable and provide entering force.

Rudder trim

Yaw trim is provided by a spring cartridge attached to the rudder pedal torque tube and console structure. The spring cartridge provides a centring force regardless of the direction of rudder deflection. The yaw trim is ground adjustable only.

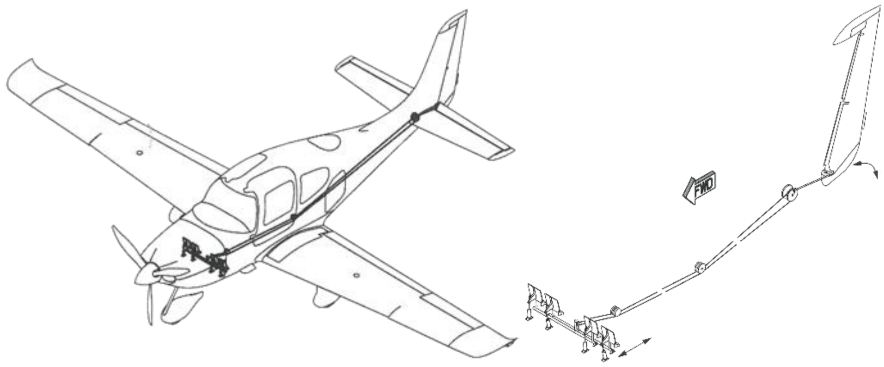


Figure 3. Outline of the rudder control system. Image: Cirrus Airplane Flight Manual.

Ailerons

The ailerons provide airplane roll control. The ailerons are of conventional design with skin, spar and ribs manufactured of aluminium. Each aileron is attached to the wing shear web at two hinge points.

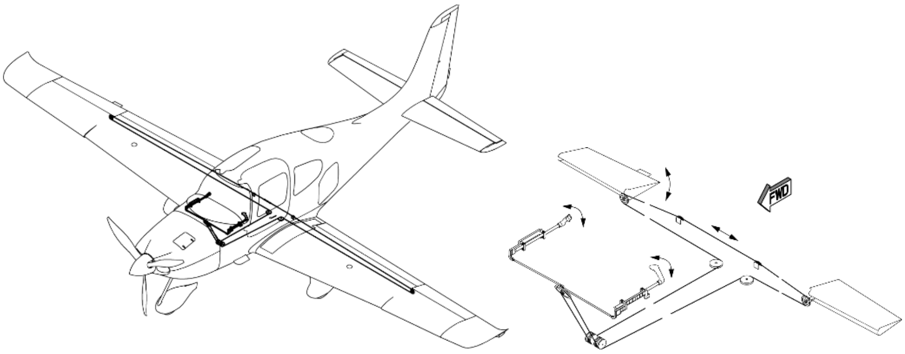


Figure 4. Outline of the ailerons. Image: Cirrus Airplane Flight Manual.

1.7 Meteorological information

According to SMHI's analysis: Wind between east and northeast 10–15 knots, visibility more than 10 kilometres, no clouds below 3 000 feet, temperature +23°C, dewpoint +15°C, QNH 1013 hPa.

It was daylight at the time of accident.

1.8 Aids to navigation

The aircraft had instrumentation for instrument meteorological conditions and was equipped with a GPS-based navigation system displayed on two Garmin 1000[7] screens.

1.9 Communications

Since the airport did not have any air traffic services, and there was no traffic at the airport at the time, the pilot made his intentions known by transmitting blindly[8]. There were no recordings saved of the radio communication.

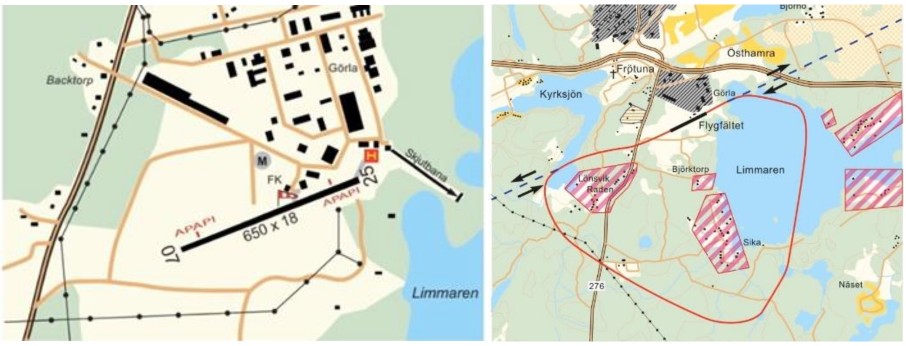
1.10 Aerodrome information

Norrtälje/Mellingeholm airport is a non-licensed airport according to the AIP[9] Sweden. The airport is also listed in KSAB Svenska flygfält. The airport has a pawed airstrip that is 650 metres long and 18 metres wide. A 200-metre-long, newly constructed part at the end of the runway was not mentio-ned in the published information about the airport at the time. The difference in elevation between the ends of the runway is eight metres. The majority of the elevation occurs on the first 400 metres of the runway. The AIP and Svenska flygfält mention the inclination, but not the degree of it. At the time there were no visual threshold markings, which is required according to the Swedish Transport Agency's regulations (TSFS 2010:123) on the design and operations of airports that do not require a license.

[7] Garmin 1000 is an integrated flight instrument system that is normally split between two screens.
[8] Transmitting blindly means that the pilot announces his intentions (e.g. to land) on the radio frequency to inform those who might listen without any requirement of a response.
[9] AIP (Aeronautical Information Publication).

At the south side of the runway, there is a grass strip parallel to the paved runway.

Several noise-sensitive areas which may not be flown over during the circuit are indicated in the chart material from KSAB.



Figur 5. The airport and the circuit with noise-sensitive areas. Images: KSAB Svenska flygfält.

1.11 Flight recorders

No flight data or cockpit voice recorders were required or available.

Memory devices

The aircraft was equipped with a recoverable data module, which registered technical data about the flight. The memory device has been sent to the aircraft manufacturer Cirrus Aircraft in the USA for reading. However, no information could be obtained from the device.

Radar tracks

SHK has obtained radar tracks from the Swedish Armed Forces and the Swedish Air Navigation Service Provider (LFV). Using the data provided by LFV, the following illustration has been produced of the aircraft's route towards Norrtälje.

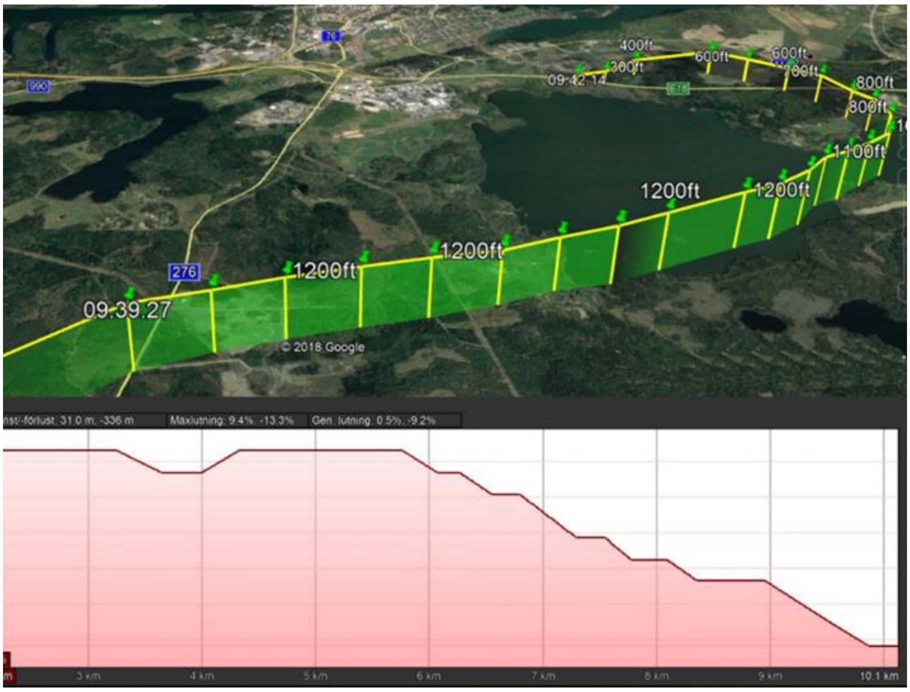


Figure 6. Radar image from LFV with altimeter measurements for the approach. Image: Google Earth.

1.12 Accident site and aircraft wreck

1.12.1 Accident site

Outside the grass strip and 27 metres to the side of the airstrip, there is some shrubbery that is approximately 3.5 metres wide and 3 metres high. Following the event, there were impact marks around 2 metres up in the vegetation. The aircraft bounced on touchdown and then yawed to the left, exiting the runway, after which it flew around 340 metres before colliding with the shrubbery. After the vegetation, there were tracks on the ground from the landing gear and the aircraft up to the point where the aircraft stopped.

Figure 7. The marked shrubbery had impact marks from the aircraft, marking inserted by SHK, which can be seen in the background. Photo: SHK. Published with the consent of The Swedish mapping, cadastral and land registration authority.

Figure 8. The image shows the aircraft's position in relation to the runway and the tracks. Photo: SHK. Published with the consent of The Swedish mapping, cadastral and land registration authority.

The aircraft ended up approximately 45 metres south of the runway in the high grass.

Figure 9. The aircraft at the accident site. Photo: SHK. Published with the consent of The Swedish mapping, cadastral and land registration authority.

1.12.2 The Aircraft wreck

During the event, the aircraft's landing gear and propeller were damaged. Damage also occurred to the fuselage and wings.

Figure 10. Damage to the aircraft.

1.13 Medical aspects

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

1.14 Fire

No fire broke out.

1.15 Survival aspects

1.15.1 Rescue operation

No rescue operation was performed. The pilot and the passengers exited the aircraft on their own and the pilot alerted JRCC[10].

The emergency locator transmitter (ELT) was not activated during the event.

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

There were one pilot and three passengers on board. All on board were wearing seatbelts.

1.16 Tests and research

1.16.1 P-factor and slipstream

The rudder deflection is necessary to keep the aircraft on a straight heading during both takeoff and landing as well as changes in thrust. There are two reasons for this (see figure 11).

One is the slipstream that occurs as the propeller rotates, creating an airstream around the fuselage that exerts force on the fin. A propeller that rotates to the right, from the pilot's viewpoint, creates an airflow that pushes on the left side of the fin, forcing the aircraft to turn to the left. It is thus necessary to compensate by applying the right rudder.

The other reason is the P-factor. This is an aerodynamic phenomenon that causes an asymmetrical relocation of the propeller's centre of thrust as the aircraft's angle of attack increases. The shift in the centre of thrust prompts the aircraft to yaw slightly to the side. This yawing effect, which can also be expressed as torque, increases along with increasing nose elevation, as the angle of attack increases in relation to the airflow on the side of the propeller where the blades are moving downwards.

In a Cirrus SR22, the engine rotates to the right from the pilot's perspective. This means that the right side of the propeller is moving downwards, resulting in the propeller's centre of thrust shifting to the right. The result is a moment turning the aircraft's nose to the left. The pilot can use a right-side rudder deflection to counteract this phenomenon.

[10] JRCC (Joint Rescue Coordination Centre).

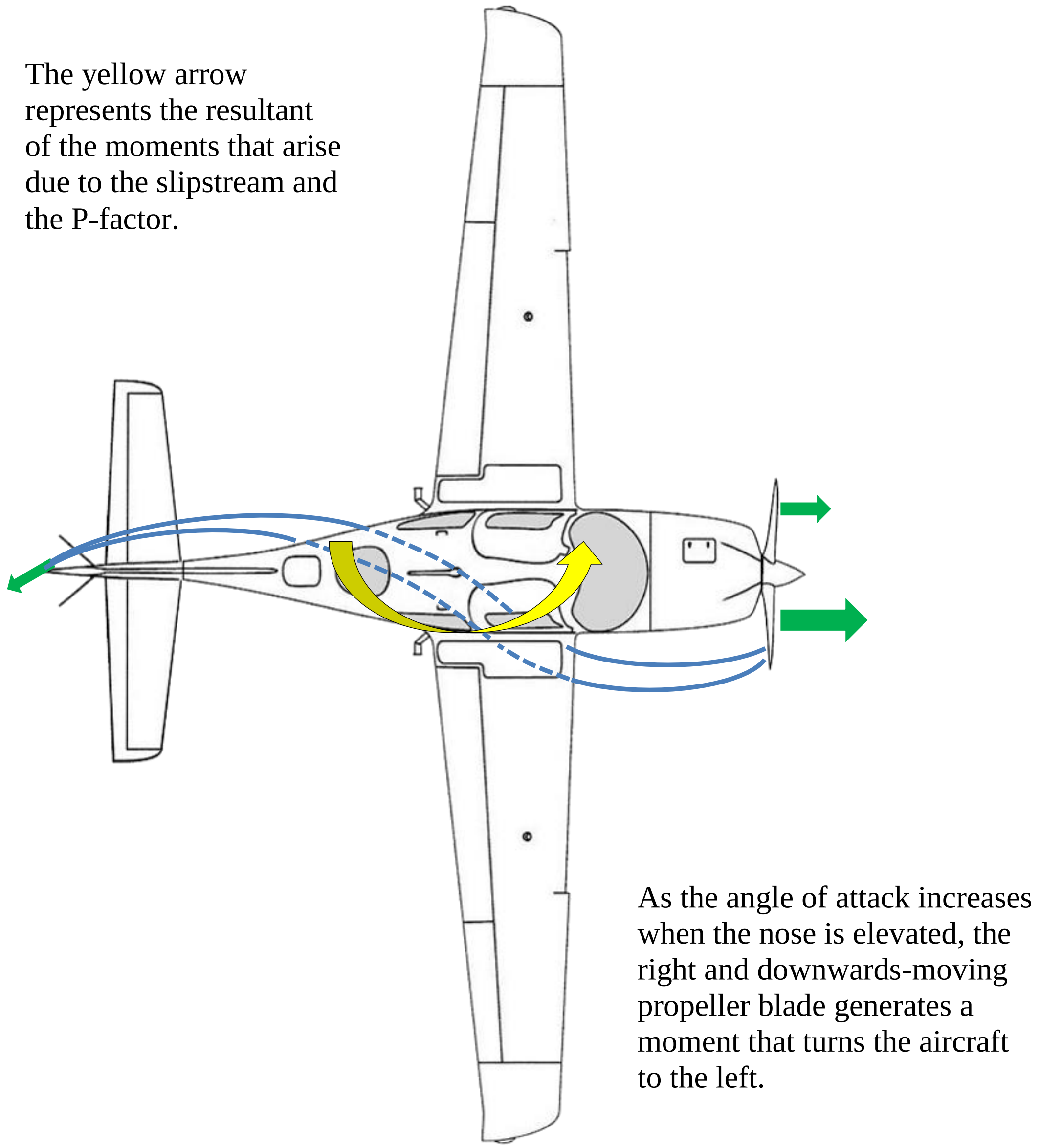


Figure 11. P-factor and slipstream.

1.17 Organisational and management information

Not applicable.

1.18 Additional information

1.18.1 Stabilised approach (SAp)

EASA's definition of a stabilised approach (SAp) is an approach that is flown in a controlled and appropriate manner in terms of configuration, speed and on the extended runway centre line from a pre-determined point or altitude down to a point 50 feet above the threshold.

The Swedish Transport Agency has written a recommendation for stabilised approach for single-pilot aircraft flying under visual flight rules, which is described in the examiners manual[11]. There is an amendment stating: *"Generally speaking, it is safer to balk the landing in case there is any doubt of a safe landing."*

1.18.2 Measures taken

None.

1.19 Special methods of investigations

None.

[11] Examiners manual – manual intended to be a supporting tool for the inspectors certified by the Swedish Transport Agency.

2. ANALYSIS

2.1 Preconditions

The pilot had not previously been to Norrtälje/Mellingeholm airport and had no prior experience of landing at an airport with no air traffic services.

The pilot's choice of runway was made based on an assumption regarding the wind direction and wind speed information from the GPS equipment on board the aircraft. No reconnaissance was carried out to check the status and wind direction at the airport, which led to the approach and landing being carried out with a tailwind. A tailwind entails a higher rate of descent, and thus a slightly lower nose attitude compared to an approach in still air conditions.

At Norrtälje/Mellingeholm airport, there is a difference in elevation of 8 metres between the threshold ends of the runway. The majority of the elevation occurs on the first 400 metres of runway 25. This means that the greatest uphill slope is at the start of the runway.

According to applicable EASA regulations, the flight planning no longer needs to include landing performance calculated on a height of 50 feet above the threshold, which was the requirement under previous regulations. The previous requirement would have meant that the published runway length was not sufficient. As the requirements were changed, the ground roll was adequate provided that touchdown occurred on the threshold. To summarize, it was up to the pilot to determine if there were sufficient margins for a safe landing. The pilot had not previously been to the airport, which meant that there were limited opportunities for the pilot to determine if there were obstacles that would make a landing on the threshold difficult.

The runway at Norrtälje/Mellingeholm airport was longer than what was published at the time in question, which the pilot was unaware of. The runway furthermore had no daytime markings for the threshold. A narrow runway with an uphill slope can give the illusion of the aircraft being at a higher altitude than it actually is.

These factors (tailwind, uphill slope and narrow runway) likely contributed to the pilot misjudging the height, failing to carry out the flare, and to the aircraft landing on the nosewheel first, causing it to bounce.

2.2 The go-around

The pilot has said that the approach was stabilised. Considering the information he has provided, including that the approach speed was around five knots above what the flight manual recommends, the procedure coincides with EASA's recommendation for stabilised approach. A go-around is recommended if the pilot does not manage to stabilise the approach, loses control or is no longer able to carry out a safe landing.

On touchdown, the aircraft bounced, at which point the pilot gave full power without adequately compensating for the yawing moment that the increased thrust entailed, causing the aircraft to yaw left and end up outside the runway area.

Since there is no data from the memory device, and the aircraft had no flight data recorder, and since the pilot has not been able to give a certain account of the entire sequence of events following the bounce, there is no detailed information about how he manoeuvred the flight controls and acceleration.

The engine power of the aircraft should be 310 horsepower at full thrust, which, considering the stated landing mass of 1,410 kg, would have given a sufficient climb angle and speed to fly over the surrounding obstacles. According to the performance data in the flight manual, the aircraft should be able to climb at 1,200 feet per minute in the event of an aborted approach. The distance from where the aircraft bounced to the point where it collided with the shrubbery was around 340 metres. According to SHK's calculations, the aircraft could have been at an altitude of 50 metres when passing the shrubbery.

The fact that the aircraft did not climb, but continued flying at low altitude through the shrubbery, may have been due to the pilot reducing the power to decrease the yaw effect, to the aircraft being subjected to heavy side force, to the angle of attack being so high that the aircraft's drag exceeded the thrust, or due to a combination of these three factors.

3. CONCLUSIONS

3.1 Findings

a) The pilot was qualified to perform the flight.
b) The aircraft had a Certificate of Airworthiness and valid ARC.
c) An approach without reconnaissance was carried out.
d) The runway had an upslope in the landing direction.
e) The approach and the landing attempt were carried out with a tailwind.
f) There was no flare, which caused the aircraft to bounce.
g) The pilot initiated a go-around.
h) There was insufficient correction for slipstream and P-factor.
i) The aircraft ended up to the left of the runway, finally yawing 140 degrees to the right before stopping in high grass.
j) The aircraft's memory device (RDM) contained no data on the flight.

3.2 Causes

The design of the airport, combined with the pilot only having experience of airports with air traffic service, meant that reconnaissance of the conditions was not performed to the necessary extent. This likely led to a tailwind landing and to the pilot misjudging the flare and touchdown.

SHK has not been able to determine why the pilot lost control after the aircraft bounced.

The following factors may have contributed to the failed go-around.

- High engine power.
- P-factor, slipstream and lack of sufficient rudder compensation.

4. SAFETY RECOMMENDATIONS

None.

On behalf of the Swedish Accident Investigation Authority,

Jonas Bäckstrand Johan Nikolaou