



Statens haverikommission
Swedish Accident Investigation Board

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**Accident to helicopter SE-HUN
at Broby säteri, Södermanland county,
on 22 March 2007**

Case L-03/07

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

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Translated by V.J.Miller (B.E. Adelaide) from the original Swedish at the request of the Swedish Accident Investigation Board.

In case of discrepancies between the English and Swedish texts, the Swedish text is to be considered the authoritative version.

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Statens haverikommission
Swedish Accident Investigation Board

2008-08-20

L-03/07

Swedish Civil Aviation Authority

601 73 NORRKÖPING

Report RL 2008:05e

The Swedish Accident Investigation Board (Statens haverikommission, SHK) has investigated an aircraft accident that occurred on 22 March 2007 at Broby säteri, Södermanland county, involving a helicopter with registration SE-HUN.

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

Göran Rosvall

Agne Widholm

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L-03/07

Report finalised 2008-08-20

Aircraft; registration and type	SE-HUN, AS342J, Gazelle
Class, airworthiness	Normal, valid Certificate of Airworthiness
Owner/Operator	Odin Choppers ApS, Denmark
Time of occurrence	2007-03-22, 1638 hrs, in daylight <i>Note: All times are given in Swedish normal time (UTC+ 1 hours)</i>
Place	Approx. 1.5 km north of Broby säteri in Södermanland county (pos. 58°55N 16°28E; 25 m. above sea level)
Type of flight	Private
Weather	According to SMHI analysis: wind, north-east/ 5-10 knots, visibility > 10 km, cloud-base, stratocumulus, at 1500 ft, temp./dp +3/+1 °C, QNH 1017 hPa
Persons on board:	
Crew members	1
Passengers	1
Injuries to persons	Minor
Damage to aircraft	Substantial
Other damage	Damage to ground surface and pollution of seeded land.
Pilot:	
Sex, age, licence	Male, 59 years, ATPL(H)
Total flying time	9000 hours of which 400 hours on the type
Flying hours previous 90 days	157 hours, of which an unknown number of hours on the type.
Number of landings during the previous 90 days	Unknown

The Swedish Accident Investigation Board (SHK) was notified on 22 March 2007 that an accident involving a helicopter with registration SE-HUN had occurred approximately 1.5 km north of Broby säteri in Södermanland county at 1638 hours on that day.

The accident has been investigated by SHK represented by Göran Rosvall, Chairperson, Agne Widholm, Chief Investigator, flight operations and Henrik Elinder, Technical investigator aviation.

SHK has been assisted by Göran Rydén, Operations expert and Liselotte Yregård, Medical expert.

The investigation was monitored by Gun Ström, Swedish Civil Aviation Authority.

Summary

The helicopter concerned had been recently sold by a Swedish owner to an Italian company. On the day preceding the planned departure to Italy, the company's pilot wished to perform a brief flight to check that all systems functioned as intended. During this flight the helicopter crashed in a field after an engine failure. The helicopter became a total wreck and the pilot and passenger were slightly injured. The previous owner documented the preparations for the flight and the phases of the flight performed near the take-off site using a video camera. Radar data recorded from the flight could be used to calculate the time and duration of the flight. The SHK investigation has shown that the engine stopped during the flight as a result of fuel shortage due to inadequate preparation for the flight. It was also found during the investigation, that the pilot did not have the necessary authority to perform the flight.

Recommendations

None.

1 FACTUAL INFORMATION

1.1 History of the flight

1.1.1 *Preconditions for the flight*

The helicopter had been recently sold by a Swedish owner to an Italian company registered in Copenhagen. The sale had been finalized before the accident.

The sale documents stipulated that the helicopter and associated documentation, relevant equipment and specified spare parts were to be taken over from the vendor by a pilot and a technician employed by the Italian company.

During the afternoon of the day of the accident, two Italian helicopter pilots arrived with the intention of taking over the helicopter and flying this to Italy.

One of the pilots had been trained on the type and was to be the commander while the other, without training on the type was to be a passenger.

The relevant equipment was inspected and packed during the afternoon, ready for the flight to Italy the following day.

Before loading the helicopter, the pilot wished to perform a brief flight test to check that the helicopter functioned in all respects.

The previous owner had not flown the helicopter since January. He was aware that there was little fuel in the helicopter tank but did not remember exactly how much. Refuelling was available at the site and the previous owner assumed that the pilot would request refuelling if he considered that there was insufficient fuel in the helicopter tank.

According to the previous owner, no "daily inspection" was performed before the flight, as stipulated in the pilot instructions. This should have been done and documented in the logbook. The cockpit check before start was apparently not performed in accordance with the checklist.

The previous owner experienced the entire procedure as being rushed through under stress, as if the pilot was in a hurry.

As a memory for the future and in his own interest, the previous owner documented the start of the helicopter flight with a video camera. The film confirms to a degree the evidence of the previous owner with respect to the departures from the checklist.

The recording also shows that the fuel quantity indicator shows definitely less than 50 litres, the reading at which the warning lamp for insufficient fuel should illuminate. A maximum of 15 minutes flight is then permitted according to the pilot manual. Whether or not the lamp illuminated is not shown by the recording as it was obscured by other equipment. According to the previous owner, the passenger, on the day after the accident, said that the pilot had asked him if he could see the text on an illuminated red warning lamp. He replied that he could not see because he was without his spectacles.

After the engine start, while the previous owner continued recording, the pilot made a gesture which suggested to the previous owner that he, the pilot, realized that he perhaps should have refuelled after all. The previous owner stopped recording, acknowledged with the usual sign to the pilot to stop the engine and walked toward the refuelling installation, believing that the pilot would stop the engine. To his surprise, the previous owner saw instead that the helicopter lifted and hovered out over the adjacent field.

1.1.2 *The flight*

The helicopter hovered over the field for approximately three minutes after which it flew a circuit around the area taking approximately three to four minutes. The helicopter landed on the field, lifted again, hovered over the field for approximately three minutes after which it began a repetition of the circuit around the farmhouse.

When the helicopter was approximately a kilometre north of the farm and at an estimated altitude of 150 meters, clearly visible to the previous owner and another witness, the sound from the helicopter changed as if, to both witnesses, the engine had stopped.

This caused no immediate alarm as, in his position then, extensive open fields were available to the pilot to make a controlled forced landing. The witnesses drove by car toward the assumed position of the helicopter to rescue the crew and on approaching, saw the occupants walking toward them over the field. The pilot had blood on his face but appeared to be otherwise uninjured. The passenger showed no sign of injury.

The helicopter was then lying on its side, badly damaged, in the middle of the field.

The Aeronautical Rescue Coordination Centre was notified and Fire brigade units, ambulances and police arrived successively at the site.

The accident occurred at position 58°55N 16°28E; 25 m above sea level.

1.2 **Injuries to persons**

	<i>Crew</i>	<i>Passengers</i>	<i>Others</i>	<i>Total</i>
Fatal	–	–	–	–
Serious injuries	–	–	–	–
Minor injuries	1	–	–	1
No injuries	–	1	–	1
Total	1	1	–	2

1.3 **Damage to the aircraft**

Considerable.

1.4 Other damage

On impact with the ground, the helicopter scored a track one decimetre deep and 50 meters long in the ground. Debris such as plexiglass shards and plastic and sheet metal fragments were scattered along its path. A small quantity of oil and hydraulic fluid had leaked from the wreckage at the site.

1.5 Personnel information

1.5.1 Pilot in command

The pilot was a male, aged 59 at the time of the accident. He stated that he had a valid ATPL(H) certificate, a medical classification in class 1 and was authorized to fly the helicopter type.

The Swedish Civil Aviation Authority has been informed by the Italian Civil Aviation Authority that the pilot;

- had a valid ATPL(H) certificate
- had passed a medical examination as Class 1 nine days before the accident
- had no authority to fly the helicopter type,
- had previously no civilian authority to fly the type.

The flight experience of the pilot as stated by the pilot:

<i>Flying time (hours)</i>			
<i>Most recent</i>	<i>24 hours</i>	<i>90 days</i>	<i>Total</i>
All types	Unknown	157	9000
Type concerned	Unknown	Unknown	400

Number of landings of the type concerned during the most recent 90 days: No information.

Conversion to type: Not available.

Most recent proficiency check: No information.

Most recent Periodic Flying Training: No information.

1.6 Aircraft

AIRCRAFT

<i>Manufacturer</i>	Eurocopter (Aerospatiale)
<i>Type</i>	SA 342 J
<i>Serial number</i>	1095
<i>Year of manufacture</i>	1974
<i>Service weight</i>	Max. permitted start/landing weight: 1900 kg, Actual weight : 1350 kg
<i>C.of G. position</i>	Within permissible limits
<i>Total flying time</i>	15439 hours
<i>Number of cycles</i>	24337
<i>Flying time after most recent periodical inspection</i>	0 hours
<i>Fuel supplied before accident</i>	Jet A1

ENGINE

<i>Engine manufacturer</i>	Turbomeca
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<i>Engine model</i>	Astazou
<i>Number of engines</i>	1
<i>Engine</i>	Nr 1
<i>Total service time, hours</i>	2797
<i>Service time since inspection</i>	228
<i>Cycles after inspection</i>	100

<i>ROTOR</i>	
<i>Rotor manufacturer</i>	Eurocopter
<i>Rotor service time after major inspection</i>	
<i>Main rotor</i>	5000 hours

The aircraft had a current certificate of airworthiness.

1.7 Meteorological information

According to SMHI (Swedish Meteorological and Hydrological Institute) analysis: Wind North-East /5-10 knots, visibility >10 km, cloud base, 1500 feet, 8/8 stratocumulus. temp./dewpoint +3/+1 °C, QNH 1017 hPa.

1.8 Aids to Navigation

Not relevant.

1.9 Radio communications

Not relevant.

1.10 Aerodrome information

Not relevant.

1.11 Flight recorders

1.11.1 Flight Data Recorder (FDR, QAR, GPS)

The helicopter was not equipped with flight or sound recorder, there being no requirement for these.

1.11.2 Radar registration

That part of the flight above approximately 100 meters altitude could be reconstructed with the help of radar information plotted by the Swedish Defence Forces. The information gives no certain indication of the flight altitude but shows that the flight was registered from 1529 hours as a local flight over the northern part of Lake Yngaren. After approximately two minutes flight, the radar echo disappeared but returned after approximately four minutes. After a further barely two minutes flight, with the helicopter immediately north of Broby säteri, the echo disappeared and did not return. At that time, the helicopter was flying approximately eastward at a rela-

tively slow speed. The total flight time as recorded can be estimated as just over eleven minutes.

1.11.3 Video recording

An analysis of the video recording made in connection with the flight shows that the indicator of the fuel gauge, at the time of the start, was at between “3 o’clock” and “6 o’clock”, this corresponding to approximately 25 litres of remaining fuel. (See photo below)



Fuel gauge



Picture of fuel gauge from video recording.

Photograph 1 Fuel gauge from helicopter SE-HUN

1.12 Accident site/incident site and aircraft wreckage

1.12.1 Accident site/Incident site

The helicopter landed approximately in the middle of a level field approximately 1000 x 500 meters. The surface was then sodden and with an early crop growth.

Tracks in the ground show that on impact, the helicopter was in its normal attitude with speed forward on an approximately 100 degree heading. The tail skid contacted the ground first, then probably the landing runners after which the helicopter tipped over on to its starboard side, the rotor blades impacting the ground. The helicopter pitched forward and over, coming to rest on its port side with its nose in the direction of the landing.

1.12.2 Aircraft wreckage

The helicopter had been badly damaged. The nose section was crushed and both runners broken. The tail boom was buckled at several places and all rotor blades bent near the rotor hub. The damage to the leading edges of the rotor blades extended inward toward the hub which indicated that the rotor speed was relatively low and that the rotor blades had also impacted against the helicopter structure. See the following photograph.



Photograph 2 Site of the accident with helicopter wreck

1.13 Medical information

There is no evidence that the psychic or physical condition of the pilot was impaired before or during the flight.

1.14 Fire

The accident caused no fire.

1.15 Survival aspects

1.15.1 General

The passenger cabin of the helicopter was seriously damaged by the accident. As the impact was distributed over a certain distance on a relatively soft and energy-absorbing surface, the retardation forces were limited. This, together with other fortunate circumstances and the fact that the helicopter was equipped with safety belts of four-point type may explain why those on board were not seriously injured.

1.15.2 ELT

An emergency location transmitter was installed in the baggage compartment and connected to an external antenna. It was activated by the impact but transmitted no emergency signal as its fixing and the cable to the antenna were broken off by the impact.

1.15.3 Rescue efforts

At approximately 1546 hours, information was received at the SOS central via an 112-call that an accident had occurred with a civil helicopter with two persons on board. After approximately 30 seconds, the emergency operator connected the call to ARCC (Aeronautical Rescue Coordination Centre) to

permit an Aeronautical Rescue coordinator to listen in on the conversation. The informant gave the approximate location of the accident with the information that both on board had left the helicopter unaided and had been transported by car to the nearby Broby säteri. The emergency operator concluded the conversation after approximately five minutes and connected the conversation with the Aeronautical Rescue coordinator to LKC, the county police communications centre.

A total of three ambulances were directed to the site of the accident. The first ambulance was alerted at approximately 1550 hours before the conversation with the prime informant had been concluded. The first ambulance arrived at the site at approximately 1604 hours. The two persons who had been on board the helicopter were given highest priority as accident victims and transported in separate ambulances to the Nyköping hospital.

At approximately 1550 hours the Fire Brigade at Flen was alerted. Those at four other stations were subsequently alerted but when the circumstances became known, only two of the stations despatched fire-fighting units. Two units from Katrineholm were the first to arrive at approximately 1608 hours. The efforts required of them were limited to cordoning off the site in anticipation of the arrival of police.

1.16 Tests and research

1.16.1 Control system

The wreckage of the helicopter was removed from the site and examined at an authorized helicopter workshop. Assistance was provided by a technician with experience of the helicopter type. The control systems of the helicopter were investigated as far as was practically possible. No technical fault or abnormality which could have affected the operation of the helicopter were detected.

1.16.2 Hydraulic system

The helicopter type is provided with an hydraulic servosystem. This can be deactivated with a switch located at the top of the collective controller. More force is then required to manoeuvre the helicopter. This switch is protected by a covering stirrup to prevent its unintentional operation. The servo system incorporates an emergency system which can provide the ordinary system with temporary hydraulic pressure if, for any reason, a pressure drop should develop in the ordinary system. The emergency system function can be checked with a test function activated by operating a special switch located on the instrument panel. The checklist requires such a check of the emergency hydraulic system before each start of the helicopter.

After the accident, both of these switches were found to be in their normal state for flying.

1.16.3 Engine & rotors

The damage to the engine and the rotors indicate that the engine output and the rotor speed were low when the helicopter hit the ground.

1.16.4 Fuel system

The helicopter fuel tank, in the form of a rubber sack, is located in a space behind the cabin. The fuel passes, via a feeder tank containing approximately 5 litres, to the engine fuel pump. There was no visible damage to these tanks which after the accident were completely empty of fuel.

The fuel content sensor of the tank and the fuel gauge were removed from the helicopter and inspected at an instrument workshop. The inspection showed that both instruments functioned in accordance with the relevant specifications.

The fuel system is provided with a warning system in which a warning lamp on the instrument panel illuminates if the fuel contents of the tank is less than 60 litres, corresponding to approximately 20 minutes flight. The warning lamp, which incorporates two incandescent lamps is to be tested before each start as required by the helicopter checklist. The failure of either of the lamps to illuminate is clearly visible.

The two incandescent lamps of the warning lamp were tested at a laboratory to determine if they were illuminated at the time of the accident. It was not possible to determine with certainty the status of the lamps at the time of the accident.

The glass bulbs of the lamps were loose in their sockets and with a ruptured electrical connection which means that they would not have illuminated even if current were applied. It was not possible to determine whether the looseness was caused by the accident or had been caused previously.

The filaments of both lamps were intact and the spiral winding were not tensioned. If the electrical connection was intact at the time of the accident, the appearance of the filaments could indicate that the lamps did not illuminate. Another alternative is that the lamps illuminated then but that they were not subject to sufficiently strong acceleration/deceleration forces to deform the filaments.

The previous owner's video recording film has been studied at the Swedish State Criminal Technical Laboratory, in an attempt to determine, by means of picture analysis, the contents of the helicopter fuel tank at engine start. The result was that the gauge indicated a low content, well under 50 litres. The previous owner has stated that he drained the helicopter fuel system before the final flight in accordance with normal procedures and that the fuel was then free from water and foreign matter.

1.16.5 *Calculation of fuel consumption*

The engine was in operation for approximately eight minutes between start-up and the beginning of the flight. The flight itself, embracing hovering, flying one circuit around the farm, landing, further hovering and the final flying until the accident, occupied approximately eleven minutes.

The engine of the helicopter type consumes approximately 185 litres per hour with normal power output. Eleven minutes flight corresponds to approximately 33 litres fuel consumption. The estimated consumption during operation of the engine before the flight began was approximately ten litres. The total fuel consumption can therefore be calculated as having been 43 litres.

1.17 **Organisational and management information**

Not relevant.

1.18 **Additional information**

1.18.1 *Questions relating to genus equality*

The accident concerned has also been investigated with respect to questions relating to genus equality, i.e. against the background of the possibility that there are circumstances which indicate that the accident or its effects were

caused by or were affected by women and men concerned not having the same possibilities, rights and responsibilities in different respects. No such circumstances have been discovered.

1.18.2 *Environmental aspects*

The effects of the accident on the environment were only marginal.

2 ANALYSIS

With the help of the video recording made by the previous owner and the documented radar plot, the times of the flight can be calculated relatively accurately. The total fuel consumption from engine start-up to the time of the accident has been estimated to be approximately 43 litres.

The reading of the fuel gauge cannot be seen exactly but it appears to have been clearly less than 50 litres. If it is assumed that the calibration of the fuel gauge is on the conservative side, the flight time, fuel consumption and fuel quantity at start correspond well.

Both of the warning lamps for low fuel quantity (less than 60 litres) were probably illuminated at start. If these had been unserviceable then, the pilot should have observed this when checking the lamps before start (push to test). If the pilot has not performed the lamp control, the duplicated function would probably ensure that at least one warning lamp was illuminated at start.

From the damage to the helicopter, and tracks in the ground surface, it can be deduced that after the tail skid contacted the surface, the helicopter, banked at 45 degrees to starboard, and with relatively high forward speed, estimated to be 50-60 knots, struck the ground. Sliding on its starboard side, the helicopter then tipped over on its nose and came to rest lying on its port side.

The tracks scored in the ground by the main rotor blades indicate that the rotor speed was very low, probably under the speed required to maintain lift.

The pilot stated that he became aware of a change in the noise generated by the helicopter but that he interpreted this not as an engine failure but rather as an hydraulic failure and that he then had difficulty in controlling the helicopter.

No technical faults have been found in the helicopter. Everything indicates instead that the engine stopped during the flight and that the pilot was unable to activate an autorotation to be able to perform a controlled forced landing. The stiffness which the pilot felt in the control system was probably caused by a combination of reduced rotor speed and a consequent successive reduction in the servo pressure in the hydraulic control system.

Several independent factors listed below indicate instead that the engine stopped during the flight and that this was the result of lack of fuel.

- Witnesses on the ground state that they heard that the engine stopped during the flight.
- Damage to the helicopter indicates that the impact with the ground was with low rotor speed and low or no engine power output.
- Both the main and feeder tanks were completely empty of fuel after the accident and no fuel was observed on the ground at the site of the accident.
- The fuel available at start corresponded with the time of the flight.

At the time of impact with the ground, the helicopter was probably out of control because of insufficient rotor speed.

According to the Italian Civil Aviation Authority, the pilot was not licensed to fly the helicopter type nor had the type been entered previously in his civilian pilot licence. His own statement regarding his experience of the type may be based on his service in military aviation.

3 CONCLUSIONS

3.1 Findings

- a)* The helicopter had a valid certificate of airworthiness.
- b)* No technical fault was found in the helicopter.
- c)* The engine stopped during the flight because of lack of fuel.
- d)* The rotor speed was low on impact with the ground.
- e)* The pilot was unable to perform a controlled forced landing.
- f)* The pilot was not licenced to perform the flight.

3.2 Causes

The accident was caused by engine failure because of lack of fuel due to inadequate pre-flight preparations.

4 RECOMMENDATIONS

None.