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Report RL 2001:21e

Aircraft accident to D-EDVV at Beterås, approximately 6 kilometers north, north-west of Strömsnäsbruk, G county, Sweden, on the 24th of June 2000

Case L-059/00

The report is also available on our Web site: www.havkom.se

Translated by Dennis Lynn Anderson

From the original Swedish at the request of the Board of Accident Investigation.
In case of discrepancies between the English and the Swedish texts, the Swedish text is to be considered the authoritative version.

2001-07-06 L-059/00

Swedish Civil Aviation Administration

601 79 NORRKÖPING

Report RL 2001: 21e

The Board of Accident Investigation (Statens haverikommission, SHK) has investigated an aircraft accident that occurred on the 24th of June 2000 at Beterås, approximately 6 kilometers north, north-west of Strömsnäsbruk, G county, Sweden, involving an aircraft with registration D-EDVV.

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.

Olle Lundström

Monica J. Wismar Henrik Elinder

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Report finalised 2001-07-06

Aircraft: registration, type	**D-EDVV,** Beech V35B
Class/airworthiness	Normal, valid airworthiness certificate
Owner/Operator	Privately owned
Date and time	24 June 2000, at 13:17 hours in daylight *Note*: All times in the report in Swedish daylight savings time (SDST) = UTC + 2 hours
Place of occurrence	Beterås, approximately 6 km north, north-west of Strömsnäsbruk, G county, Sweden, (position N5635.448 E01340.928, 186 meters above sea level)
Type of flight	Private
Weather	According to the Swedish Meteorological Institution's analysis for Strömsnäsbruk at 13:20 hours: slight southerly winds, visibility probably good with a possible decrease to 5 km in rain showers, cloud cover 3–6/8 with the cloudbase at about 3,000 feet, temp./dewpoint +15/+12 °C, QNH 1009 hPa.
Persons on board: crew	1
passengers	3
Injuries to persons	All onboard were killed
Damage to aircraft	Destroyed
Other damage	Minor tree and ground damage
Pilot in command:	
age, certificate	58 years old, PPL (Private Pilot Licence)
total flying time	2,317 hours up to and including the month of March 2000; the number of hours on the type being unknown. Flying time 102 hours between March of 1998 and March of 2000, accrued on 66 sorties.
flying hours previous 90 days	14 hours, all on the type
number of landings previous 90 days	9

The Board of Accident Investigation (SHK) was notified on the 24th of June 2000 that an aircraft with registration D-EDVV had an accident at Beterås, approximately 6 kilometers north, north-west of Strömsnäsbruk, G county, Sweden at 13:17 hours on that day.

The accident has been investigated by SHK represented by Olle Lundström, Chairman, Monica J. Wismar, Chief investigator flight operations, and Henrik Elinder, Chief technical investigator aviation.

The Board was assisted by Ulf Nylöf as medical expert, by Torgny Nyqvist as technical expert, and by Gunnar Jarsjö as meteorological expert.

The investigation was followed by Gun Ström, Swedish Civil Aviation Administration; by James P. Silliman, U.S. National Transportation Safety Board; and by Stefan Hasenfuss, German Accident Investigation Bureau.

Summary

The pilot was to fly three persons from Lübeck in Germany to Karlsborg in Sweden, on the 24th of June 2000. They took-off from Lübeck at 11:53 hours for a flight initially according to VFR[1] and thereafter according to IFR[2].

When the aircraft entered into Swedish airspace it was cruising at flight level (FL) 110 (11, 000 feet above sea level).

The air traffic controller observed on his radar that the German aircraft at first flew steadily at FL 110 on the indicated course. Without notice, at time 13:15.16 the aircraft started to climb and attained FL 114. Thereafter it descended to FL 085, to subsequently completely disappear from the radar screen. When the air traffic controller observed the aircraft performing the unexplainable altitude changes, he called the pilot several times without receiving any response.

When the aircraft descended under the cloud base it was seen and heard by several witnesses on the ground a few seconds before it crashed. They were of the opinion that the sound from the engine was loud and piercing. Witnesses close to the crash site also observed the aircraft. At first sight it was in a climbing turn and looked like an "x in the sky". After that it continued nose-first into the forest near Beterås.

The investigation has shown that during the past five years the pilot had had medical problems, which occasioned investigation and treatment by a heart specialist. Deficiencies occurred in the pilot's planning of the flight, and at takeoff the mass was above to maximum allowed takeoff mass and the center of gravity was behind the aft center of gravity limit. There was risk for as well as severe turbulence as ice accretion during the flight. No technical fault has been found on the aircraft.

Updated weather radar information is an important aid for judging and prognosticating flight weather and of great significance for the safety of flight. SHK has in the investigation found that this information is available to air traffic control only at one, or perhaps a couple, of the larger airports in Sweden.

The accident was probably caused by the pilot being stricken by acute heart problems, in connection with the aircraft entering an area with severe turbulence and icing, which made him incapable of controlling the aircraft.

The aircraft's particular flight characteristics in critical flight positions, and the fact that the centre of gravity was behind the aft balance limit, may have contributed to the accident.

Recommendations

The Swedish Civil Aviation Administration is recommended to ascertain that ATC at larger airports and ATCC will receive access to updated weather radar information *(RL 2001:21 R1)*.

[1] VFR - Visual Flight Rules
[2] IFR - Instrument Flight Rules

1 FACTUAL INFORMATION

1.1 History of the flight

On the 23rd of June 2000 the pilot took it upon himself to help an acquaintance, who was a pilot but was otherwise engaged, to fly three persons from Lübeck in Germany to Karlsborg in Sweden, where they were to go sailing. The following day at 10:31 hrs he took-off with his aircraft from Hildesheim airport (EDVM) and flew to Lübeck airport (EDHL) where the passengers were to be picked-up. The flight was performed according to VFR and the landing in Lübeck took place at 11:24 hours.

Subsequent to the boarding of the passengers he once again took-off at 11:53 hours for a flight initially according to VFR and thereafter according to IFR onwards towards Karlsborg (ESIA). When the aircraft entered into Swedish airspace and was cruising at flight level (FL) 110 (11, 000 feet above sea level) the pilot asked the air traffic controller if he knew what the height of the cloud tops in the area was. The air traffic controller was informed by another aircraft in the vicinity that the cloud tops were at approximately FL 170, which was relayed to the pilot of D-EDVV. The pilot thanked him for the information and came back somewhat later with a request for weather information at Karlsborg. The air traffic controller could not inform him of this due to the lack of weather reporting from Karlsborg airport. However, the pilot did receive the actual weather for Jönköping airport which is situated a little more than 85 kilometers south of Karlsborg. The actual weather at Jönköping was: wind 190° 10 knots, visibility more than 10 km, broken clouds at 3,000 feet, temperature +16 °C, dewpoint +6 °C and barometric pressure 1009 hPa. The pilot thanked him for the information.

The air traffic controller observed on his radar that the German aircraft at first flew steadily at FL 110 on the indicated course. Without notice, at time 13:15.16 the aircraft started to climb and attained FL 114. Thereafter it descended to FL 085, to subsequently completely disappear from the radar screen. When the air traffic controller observed the aircraft performing the unexplainable altitude changes he called the pilot several times without receiving any response.

When the aircraft descended under the cloud base it was seen and heard by several witnesses on the ground some seconds before it crashed. They were of the opinion that the sound from the engine was loud and piercing. One witness, who was in Hamra about 2.5 kilometers north of Beterås, heard a “terrible roaring over the house” in connection with the passage of an aircraft. About 400 meters north of the accident site there were a few people inside a house when they heard a noise, that sounded like a car revving-up its motor at high RPM and they understood that it came from an airplane. The source of the noise passed by quickly, then the motor RPM increased further and they got the impression that the aircraft climbed. In another house, approximately 100 meters from the impact site, some people heard the sound from the aircraft and perceived it as loud and as if it sounded like a very loud siren. One of them looked out the window and observed the aircraft over a row of trees. At first sight it was in a climbing turn and looked like an “x in the sky”. After that it continued nose-first into the forest near Beterås. Thereafter a muffled thud was heard.

Some of the people in the house were trained in nursing and proceeded promptly to the site. When they arrived they could ascertain that none of the persons on board had survived the accident.

The accident took place at 13:17 hours at location N5635.448 E01340.928, 186 meters above sea level.

1.2 Injuries to persons

	Crew	*Passengers*	*Others*	*Total*
Fatal	1	3	–	4
Serious	–	–	–	–
Minor	–	–	–	–
None	–	–	–	–
Total	1	3	–	4

1.3 Damage to aircraft

Destroyed

1.4 Other damage

Minor tree and ground damage.

1.5 Personnel information

1.5.1 Pilot in command

The pilot was 58 years old and had a valid PPL (A) Licence (Private Pilot Licence (Aeroplane)).

Flying hours previous	*24 hours*	*90 days*	*Total*
All types	1	14	2,317 until March 2000
This type	1	14	unknown

Between March 1998 and March 2000 he had flown 102 hours during 66 sorties.

Number of landings this type previous 90 days: 9. When flight training on the type was concluded is unknown.

Submission of flight time logged, every other year according to German regulations, for continued certificate currency took place during March 1999. The flight time requirement to maintain a PPL (A) is eight hours during two years.

The pilot received his PPL (A) certificate for the first time in September 1976. He had an instrument rating from 1982 up to March 1999. At so-called extension of the certificate, in March 1999, he stated to the German civil aviation authorities that he did not intend to maintain the instrument rating. Otherwise he had Controlled Visual Flight Rules (CVFR), night and aerobatic ratings. CVFR is a rating in Germany that is required for a pilot to be authorised to fly within certain areas, such as in the vicinity of heavily trafficked airports. Among other things, this implies that the pilot shall have a certain knowledge of instrument flight to be able to maintain separation within controlled airspace during VMC[3] with reference to other aircraft that fly according to IFR.

[3] VMC - Visual Meteorological Conditions

1.5.2 The pilot's flying routines

The pilot had accomplished several long distance flights with the aircraft in question and was very familiar with its instrumentation and equipment. According to relatives he had the habit of using oxygen during flight at FL 130 and above. When necessary during flight, he was in the habit of using both the weather radar and the stormscope to avoid unwillingly entering bad weather. When the aircraft was heavily loaded he usually flew manually with the autopilot disengaged as this provided better comfort for the passengers in the back seat.

1.6 Aircraft information

1.6.1 General

AIRCRAFT:

Manufacturer:	Beech Aircraft Corporation
Type:	Beech V35B
Serial number:	D-10381
Year of manufacture:	1981
Gross weight:	Max authorised 1,542 kg (1,642 kg, ref 1.18.2), actual approximately 1,600 kg
Centre of gravity:	Estimated 89 mm behind the aft center of gravity limit.
Total flying time:	1,995 hrs.
Number of cycles:	Unknown
Flying time since latest inspection:	Unknown
Fuel loaded before event:	100 LL

ENGINE:

Manufacture:	Continental
Model:	IO-520-BB
Number of engines:	1
Total operating time, hrs:	Unknown
Operating time since overhaul:	Unknown
Cycles after overhaul:	Unknown

PROPELLER**:**

Manufacture:	Hartzell
Operating time since latest Overhaul:	Unknown

The aircraft had a valid Certificate of Airworthiness.

1.6.2 Fuel tanks

In the original configuration, this aircraft type has two wing tanks that hold a total of 280 liters (74 USG) of useable fuel. The aircraft in question was equipped with two extra tanks, that held a total of 416 liters (110 USG) and were mounted on the wingtips.

1.6.3 Instrumentation

The aircraft was equipped for instrument flight and had the following instrumentation for communication and navigation:

Function	*Number*	*Type*
Com	2	KING KY 196
Nav receiver	1	KING KN 53
Rnav comp.	1	KING KNS 81
Audio-panel	1	KING KMA 24
ADF-rec.	1	KING KR 87
DME	1	KING KN 63
Radar altitude	1	KING KRA 405
Weather radar	1	KING KWX 56
GPS	1	KING KLN 90B
Transponder	1	KING KT 71
Transponder	1	KING KT 79
Encoding altimeter	1	KING KEA 130
Autopilot	1	KING KFC 200
ELT	1	ACKE-01
Stormscope	1	RYANWX 10A
Display unit	1	ARGUS 7000

The aircraft lacked de-icing equipment with the exception of electrical de-icing of the propeller.

1.7 Meteorological information

1.7.1 The general weather conditions

Along the flight route Lübeck–Karlsborg on the 24th of June 2000 between 11:00 and 13:30 hours, there was an extensive low-pressure area that covered Scandinavia and northern Germany. The weather was cloudy and unstable with generally light to moderate showers, however without thunder. The cloud layer over Sweden was between 3,000 feet and 12,000 feet (approximately 900–3,650 meters) with cumulonimbus (cbs), the tops of which extended up to FL 200–250 (approximately 6,100–7,600 meters). Over Germany and Denmark there was a cloud layer between 2,000 feet (approximately 600 meters), locally under 1,000 feet (approximately 300

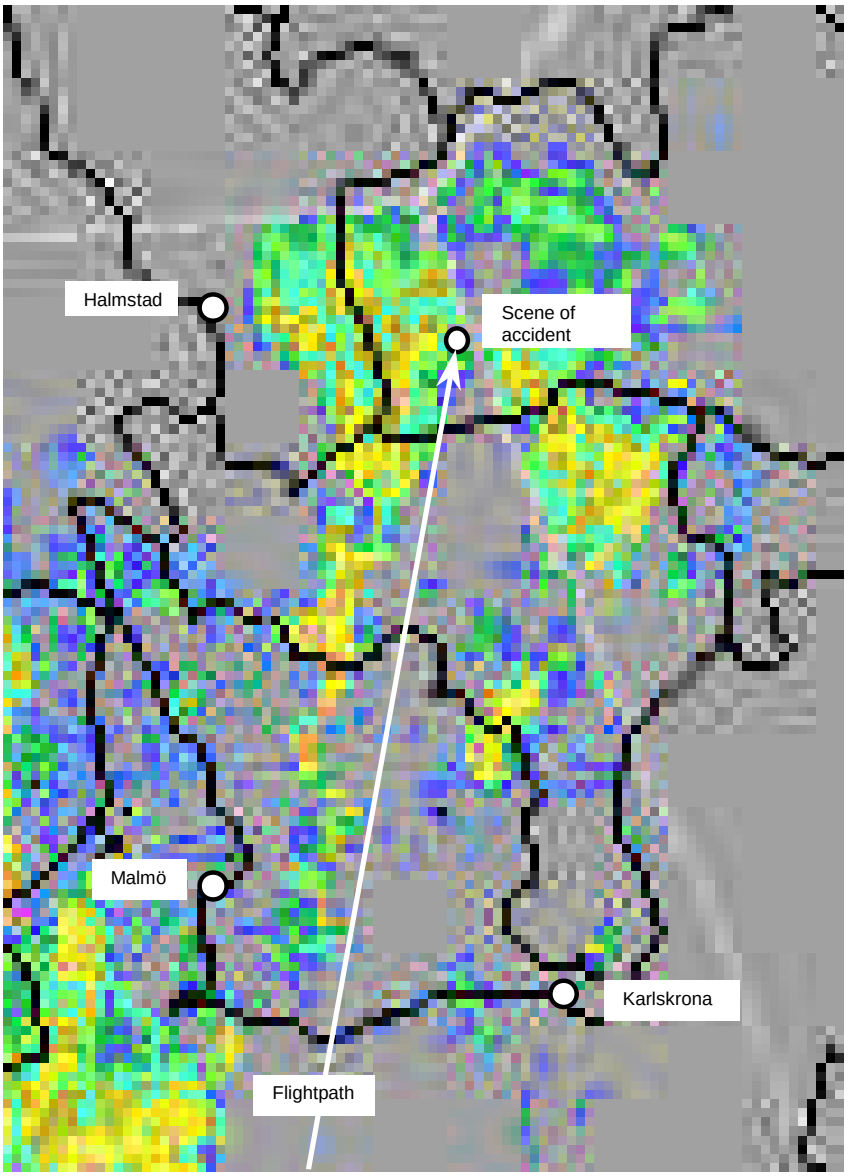
meters), and FL 200 (approximately 6,100 meters) with the tops of the cbs up to FL 250 (approximately (7,600 meters).

Within the cb-clouds over Sweden, the vertical wind speed has been estimated to have been 10 to 15 meters per second. The horizontal winds at FL 100 (approximately 3,050 meters) were 210° at 25 knots (13 m/s). The zero degree isotherm in the area was at about FL 080 (2,450 meters), above which there was a risk of light to moderate icing. There was a possibility of heavy icing within the cb-clouds. A Sigmet[4] had not been issued for the area.

Sigmet for icing shall be issued at severe icing in supercooled rain and at severe icing in clouds, except for convectional clouds such as cumulonimbus, where icing is common.

The radar depiction below over southern Sweden from 13:15 hours shows a 20–30 kilometer wide and 100–200 kilometer long echo from shower-like precipitation in a north-south direction from about Eslöv to Ljungby. The depicted echo showed light to moderate intensities, somewhat stronger in the southern sector. The flight route of the aircraft and the accident site are shown on the radar depiction.

[4] Sigmet – information concerning enroute weather phenomena which may affect the safety of aircraft operation.



1.7.2 *Local weather*

According to the METAR[5] at 09:50 hours on the 24th of June 2000 the visibility at Lübeck airport was 3,800 meters in rain and the cloudbase at 600 feet. One hour later the visibility was 6,000 meters in light drizzle and the base of the clouds was at 900 feet.

According to SMHI:s analysis for Strömsnäsbruk at 13:18 hours: light southerly winds, visibility probably good, possibly down to 5 kilometers in rain showers, clouds 3–6/8 cumulonimbus with the base at about 3,000 feet, temperature +15 °C, dewpoint +12 °C, QNH[6] 1009 hPa.

According to SMHI:s analysis for Karlsborg around 13:20 hours: wind 180° at 10 knots, good visibility at times of no precipitation but decreased in rain showers, clouds 1–4/8 cumulonimbus with bases at 3,000 feet and 5/8 medium altitude clouds, temperature +13 °C, dewpoint +11 °C, QNH 1009 hPa.

[5] METAR - Meteorological report
[6] QNH - Atmospheric pressure

1.8 Aids to navigation

The aircraft was instrument flight equipped. When the pilot contacted the air traffic controller at Malmö Air Traffic Control (ATC) and reported that he was passing the reporting point of MALIV, about 45 kilometers south of Malmö/Sturup airport, he received clearance to fly directly to Karlsborg.

1.9 Communications

A transcript of the recorded radio communication between the pilot and the air traffic controller at Malmö ATC is presented in appendix 1. The sound quality from the aircraft was at first good but deteriorated momentarily during the latter part of the flight.

1.10 Aerodrome information

According to the flight plan the aircraft's destination was Karlsborg airport. To be able to utilize the airport, which is Defense Department property, the pilot is required to obtain special permission (PPR) for this. Such permission had not been requested.

1.11 Flight recorders

There was no requirement to carry a Flight Data Recorder (FDR) or a Cockpit Voice Recorder (CVR) on board the aircraft and neither was fitted.

1.12 Accident site and aircraft wreckage

1.12.1 Accident site

The aircraft impacted with high airspeed on a forest road and created an approximately 1.5 meter deep crater with a diameter of about 6 meters. The magnetic heading at the time of impact was approximately 210 degrees and the angle of impact with the ground was approximately 60 degrees. Prior to reaching the ground the aircraft collided with the tops of a few trees at a height of about 15 meters.

1.12.2 Aircraft wreckage

The aircraft had been crushed and disintegrated upon impact. The engine had been pressed down into the bottom of the impact crater. Other parts of the fuselage and wings were lying in and around the crater. Certain parts had been thrown in the direction of flight up to 50 meters from the accident site. The left wing tank came to rest on the right side of the extension of the impact track while the right tank came to rest on the left side of this extension. Both tanks had been thrown in excess of 10 meters in the direction of flight.

1.13 Medical information

During the past five years the pilot had had medical problems which occasioned investigation and treatment by a heart specialist. In November of 1995 he experienced irregular heart rhythm and was diagnosed with paroxysmal auricular fibrillation and hypertension. Treatment was initiated

and he thereafter received check-ups on a regular basis. The last check-up by the specialist was accomplished in March of 2000, when a working EKG and an echocardiograph were carried out with satisfactory results. At this time the pilot was free of symptoms. His heart doctor discussed the suitability of his continued flying with him, but deferred the decision to an aviation doctor. He did, however, continue treatment with the medicines Isoptin RR, Novodigal, Moduretik and Blopress.

The 20th of March 2000 the pilot underwent a flight medical examination for renewal of his pilot's licence. The tests that were taken at this time showed nothing abnormal and he felt well, thus the aviation doctor approved him for continued flight.

A week or so prior to the accident the pilot had experienced slight discomfort in the chest and left shoulder. He had determined it himself to be orthopaedic and felt that the discomfort subsided.

The medicolegal investigation of the pilot did not indicate the presence of alcohol or drugs.

According to relatives, prior to the flight in question, the pilot was rested and in good mental balance.

1.14 Fire

There was no fire.

1.15 Survival aspects

The impact forces were great and the aircraft was totally demolished. The accident was not survivable.

The emergency locator transmitter of type ACKE-01 was destroyed in the accident.

1.16 Tests and research

1.16.1 The aircraft

After accident site investigation the aircraft wreckage was transported to a hangar for further technical investigation. During the investigation a representative of the aircraft manufacturer participated.

Due to the fact that the aircraft was heavily broken up upon impact, it has not been possible to conduct a thorough investigation of its different control systems. The investigation has however shown that no parts had separated from the aircraft prior to impact with the ground. It has however not been possible to determine with certainty if all the observed material damage occurred during the impact itself.

The outboard surface of the left wing tank was deformed along its entire length, which suggests that the aircraft had around a 90 degree bank to the left upon initial ground contact. Inspection of wing flap actuators and landing gear mechanism showed that they were at their end positions, meaning that both the wing flaps and landing gear were retracted. The fuel tank selector was in position LEFT-MAIN and had uninhibited fuel flow. The

damage to the leading edges of the propeller indicated that the engine produced normal or high power upon impact.

1.16.2 The engine

The engine has been dismantled and investigated by an authorised aviation engine workshop. During the investigation a representative of the aircraft manufacturer participated. No fault or abnormality was observed that could be considered to have influenced the sequence of events.

1.16.3 Instruments

Of the flight instruments that were collected at the accident site, all were more or less crushed, with the exception of two mechanical altimeters. These were set at pressure setting 1014 and 1013 hPa respectively. One of the two transponders was set on code 1342, which was the code the pilot received during the flight.

1.16.4 Maintenance status

The aircraft technical documentation is partially drawn up in the German language. It has have been scrutinized by the German Accident Investigation Bureau. According to the documentation the aircraft was maintained according to existing regulations. All obligatory modifications and airworthiness directives were entered.

1.17 Organisational and management information

Not applicable.

1.18 Additional information

1.18.1 The aircraft type

The aircraft type flew for the first time in the year 1945 and entered production two years later. When manufacturing ceased in 1983 more than 10,000 aircraft had been produced. The aircraft can accommodate four to five persons and is by many users valued for its good performance within the category single-engine light aircraft. In the original design, the cruising speed at 12,000 feet and with 55% power, is 291 km/h (157 knots). With normal fuel margins the possible range is then 1,553 km (839 nm) which equates to a flight time of a little more than five hours.

The aircraft has a characteristic appearance due to that instead of an ordinary vertical fin and stabilizer, it has a so-called ruddervator, normally called "V-tail", for control of the aircraft vertical and yaw axes. This construction is likely to contribute to the aircraft's good performance. However, this also gives the aircraft particular flight characteristics in critical flight positions. The construction requires a rather complicated mechanical construction to be able to perform both elevator and rudder functions with only two aerodynamic surfaces.

The aircraft type has, through the years, been afflicted by several accidents after parts of the tail section have been damaged or separated from the aircraft while airborne, whereby the aircraft has become uncontrollable. In some cases it has been found that the damage has occurred after the pilot has lost control of the aircraft. This has caused the manufacturer to, in the course of time, introduce several aerodynamic as well as strength modi-

fications. The American Federal Aviation Administration (FAA) has also issued several Airworthiness Directives concerning special inspections with regard to this problem.

1.18.2 Weight and balance

According to the aircraft manufacturer the maximum allowable takeoff mass in the original design is 1,542 kg (3,400 lbs) with the balance limits at 82.1 in (2.085 m) and 84.4 in (2.144 m).

According to a hand-written weight protocol dated the 14th of September 1993, that was found in the aircraft documentation, the maximum allowed takeoff mass with the type of extra tanks that were installed was 1,642 kg (3,620 lbs). As per the same weight protocol the aircraft's basic empty mass was 1,175 kg with the balance moment at 2,128 m. SHK have been informed by the manufacturer that they have never changed the maximum takeoff mass. Nor have SHK from any authority been able to get documentation that confirms the higher takeoff mass in the handwritten protocol.

The weight and balance of the aircraft at the time of takeoff from Lübeck has been calculated in appendix 2.

In the calculations the fuel weight has been given as 175 kg, which closely corresponds to the amount of fuel with normal reserves that should have been required for the flight from Lübeck to Karlsborg and then to Malmö, where fueling was planned to take place; a planned flight time of approximately 3½ hours.

It has not been possible to establish the weight of the persons aboard or the baggage. In the calculations of weight and balance the weight of all individuals has been estimated at 80 kg and the baggage at 10 kg per passenger.

According to the calculations the takeoff mass was 138 kg over the maximum allowable (38 kg over the higher allowable maximum mass noted in the handwritten weight protocol) and that the center of gravity was 89 mm behind the aft balance limit.

1.18.3 The radar plot

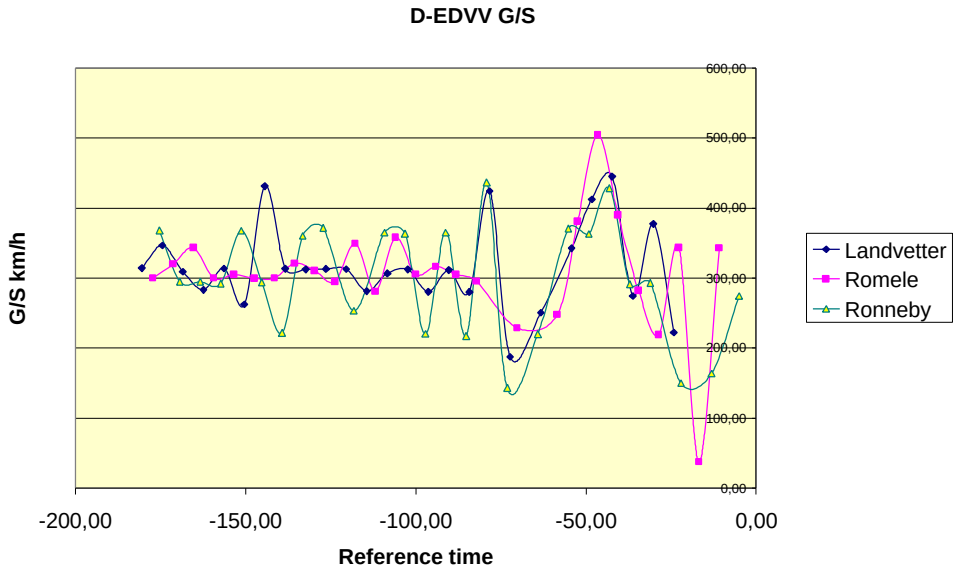
With the help of information from the Swedish Military Intelligence & Security Service (MUST) the route and the altitude of the aircraft have been able to be reconstructed from the time the aircraft entered Swedish territory. Registration has taken place from three different radar stations; Landvetter, Romele and Ronneby. The aircraft's altitude reporting transponder with an accuracy of +/-50 feet (+/-15m) has been used for altitude information. The reported transponder altitudes are not corrected for deviations in atmospheric pressure from standard pressure (QNH 1013 hPa).

In appendix 3 the flight path with the time for each radar echo has been plotted.

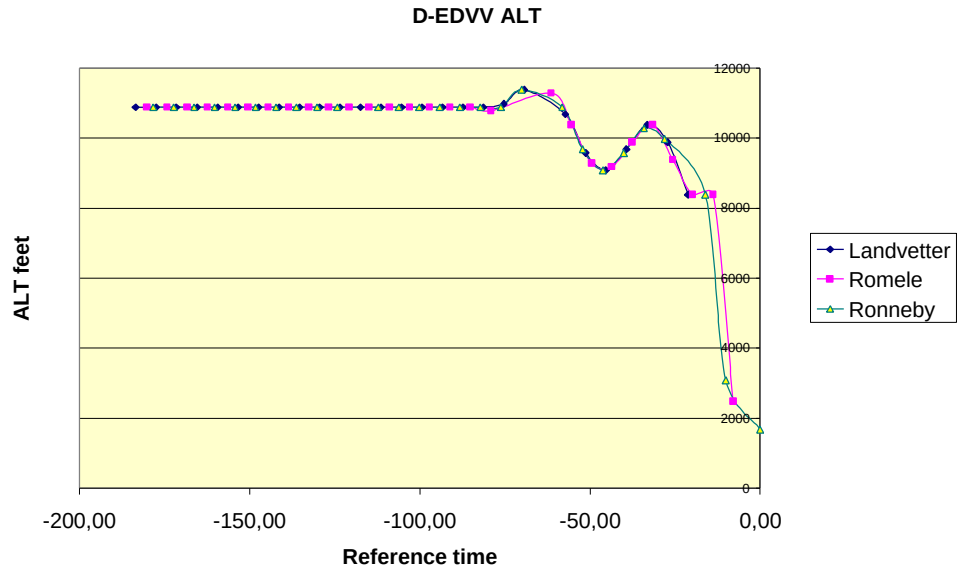
1.18.4 Analysis of the radar plot

To be able to get a deeper apprehension of the flight, the SHK has performed certain calculations of the radar information from MUST. In analyzing the result one must however be aware of the fact that the accuracy of each radar echo point is limited, which clarifies that certain dissimilarities occur between the results obtained by the different stations. The result of the calculations is presented below in diagram form with the relative time to the last radar echo as the horizontal axis and the calculated variable as the vertical axis.

A. Calculated speed over the ground (GS)



B. Altitude above sea level



Note: The transponder reported altitude has been corrected for the actual atmospheric pressure (QNH 1009 hPa).

1.18.5 *Weather radar information*

Weather radar pictures of the type that are depicted in section 1.7.1 and that show amongst other things cumulonimbus activity in the area are normally not available to the air traffic controllers at Malmö ATCC (Air Traffic Control Center). In November 1995, after an aircraft had been radar vectored into an area of cumulonimbus during approach to Malmö/Sturup airport, Malmö ATCC presented a written communication to the Airport and Air Traffic Service Section of the Civil Aviation Administration Inspection Department with the expressed desire that weather radar pictures should be available in their ordinary information system, ISA. Access to such information would make it possible for them to consider and give information to aircraft about possible cumulonimbus activity in the vicinity of airports, approach tracks and airways within the control area and through this increase flight safety. The request was rejected and has still not been approved.

Weather radar pictures are, according to statements, accessible at the ATCC at Stockholm/Arlanda airport through direct link to the weather radar at Arlanda. An earlier trial at Gotland airport has been made where the air-traffic controller had access to radar pictures from the weather radar on Gotland through Internet.

1.18.6 *The pilot's planning of the return flight*

The pilot had planned to fly alone back to Germany on the same afternoon. Before he left Germany he had submitted an IFR-flightplan with planned departure from Karlsborg at 15:15 hours, for a flight of 1 hour and 15 minutes to Malmö/Sturup airport for re-fueling. From there he planned to depart at 17:15 hours on a VFR-flight of 2 hours and 15 minutes back to Hildesheim.

1.18.7 Air Transport of passengers

For commercial aviation in Sweden with passengers aboard and for freight along with other aviation that is pursued commercially, an operational licence is required from The Swedish Civil Aviation Administration. The pilot/pilots shall furthermore hold the minimum of a commercial pilot's licence (CPL-licence).

A pilot holding only a private pilot's licence (PPL-licence) may only carry passengers under the condition that he/she has performed at least 5 take-offs and landings on the actual type and class of aircraft during the last 90 days. Private aviation with passengers aboard does not require authorization from The Swedish Civil Aviation Administration provided that the flights are not undertaken for the purpose of economic gain.

With the exception of those cases where the pilot, without commercial interests, offers passengers a flight The Swedish Civil Aviation Administration lays down three criteria that a private flight with passengers shall be sanction- free:
a) the pilot and passengers shall be acquainted with each other; b) the purpose of the flight shall be the same for the pilot and passengers; c) the pilot and the passengers share the costs of the flight. In respect to the last mentioned criteria however, there is a legal case from the Swedish Supreme Court that states that the flight may be sanction-free even if the total cost is covered by the passengers and the pilot does not otherwise have any direct or indirect profit interest in connection with the flight.

The primary aim with the demand for an operative licence is to guarantee that aviation transportation, that is offered to the public on payment, takes place with the safety that is required. It is therefore a legitimate demand that the one who performs the transportation has been approved by the civil aviation authorities from a flight safety point of view. Continued flight safety is then maintained through the continued inspections of the civil aviation authorities.

2 ANALYSIS

2.1 The flight planning

The pilot's decision to carry out the flight in order to help a pilot friend was made as late as the day prior to the accident. Considering the pilot's long experience of flying and the many international flights he had made over the years with his aircraft one can assume that he considered the flight fairly routine in nature. SHK has, however ascertained that several deficiencies have occurred in the pilot's planning of the flight.

On the day in question the weather along the route between Lübeck and Karlsborg was characterised by an extensive low pressure area with overcast clouds that covered Scandinavia and northern Germany. It should have therefore been clear to the pilot that it hardly could have been possible to accomplish the entire flight according to VFR. Because of the fact that since March of 1999 he no longer had an instrument rating, the flight should have been delayed or cancelled. According to the flight plan the flight over Germany was to be carried out according to VFR and transition to IFR-flight as soon as the aircraft had entered Swedish territory. It lies near at hand to presume that the pilot was aware that the chance of detection of his lack of an instrument rating was minimal in Sweden.

The airport of intended landing in Sweden, Karlsborg, is Defense Department property. To be able to land there special permission is required, something that is apparent from official aviation publications. It was there-

fore a deficiency in the pilot's planning of the flight to not, prior to departure from Lübeck, first obtain the required permission for landing.

Whether the pilot completed an operational flight plan for the flight prior to departure is uncertain. If he had done this he should have noted that the takeoff mass was above to maximum allowed takeoff mass and that the center of gravity was behind the aft center of gravity limit. This means that he either neglected to perform a weight and balance calculation or that he consciously accepted the deviation.

2.2 The flight

At the time of takeoff from Lübeck the aircraft was heavily loaded and it is likely that the pilot, true to his routine with respect to the comfort of the passengers, did not engage the autopilot but flew manually. Despite the fact that the weather was not suitable for flying according to VFR the flight seems to have initially proceeded without problems. It proceeded along the filed route of flight with a ground speed of just above 300km/h and within Swedish airspace at the assigned altitude, 11,000 feet. Nothing contained in the recorded radio communication indicates that the pilot experienced any difficulties.

As is evident from the analysis of the radar plot in section 1.18.3; a little less than two minutes before the aircraft impacted with the ground, something dramatic occurred during the flight. Without warning the aircraft first climbed to 11,500 feet, then descended to 9,200 feet to subsequently climb back to 10,500 feet prior to its thereafter rapidly loosing altitude. Simultaneously, the speed of the aircraft over the ground began to vary between approximately 150 and 450 kilometers per hour.

When the aircraft descended under the clouds several witnesses on the ground heard and observed that it flew at low altitude over the ground with high engine power some seconds before it, out of control, impacted the ground in a steep dive angle.

The sequence of events indicates that for some reason the pilot lost control of the aircraft and was never able to regain it. The investigation has not been able to determine with certainty what took place at the termination of the otherwise seemingly controlled flight. The course of events has obviously been quick and the pilot did not manage to inform the air traffic controller about what had taken place. It is also possible that he was unable to talk on the radio.

The impact with the ground was uncontrolled and probably took place in a steep angle of dive during a left roll, where the left wing tank contacted the ground first and the aircraft then ended up inverted.

The sudden appearance of a technical fault on the aircraft can of course not be completely ruled out but nothing in the technical investigation of the aircraft indicates that such was the case. The damage to the propeller blades and witness statements indicate that the engine was producing normal or high power up to the time of impact. Landing gear and flaps were retracted which indicates that the pilot did not intend to make an emergency landing.

The investigation has however pointed out several factors that could have been causes or contributory causes to the sequence of events.

The aircraft type

The aircraft type has over the years, as mentioned previously, been subjected to several accidents that were caused by the aircraft becoming uncontrollable in the air due to occurring damage of the aircraft structure during flight. The survey that was done of the technical documentation of

the aircraft showed that it was maintained according to existing regulations and that all obligatory modifications intended to prevent the above mentioned accident causes were accomplished. The technical investigation showed that the aircraft was whole at the time of impact, i.e. that nothing had separated from the aircraft in the air. It cannot however be ruled out that some structural breakage, that may have affected the sequence of events, occurred during the uncontrolled maneuvers prior to the collision with the ground. However, nothing indicates that a structural failure could have been the provoking factor.

Turbulence
During the flight at FL 110 the pilot asked the air traffic controller at what altitude the tops of the clouds were, which indicates that the aircraft was in the clouds at that time. Despite the fact that the aircraft was equipped with advanced instrumentation to assist the pilot in avoiding severe thunderstorms and rain showers, it is evident from the weather radar picture in section 1.7.1 that the final portion of the flight was going to take place in or in the vicinity of cb-clouds. Why he did not deviate around these is uncertain. The aircraft can therefore have entered into a local weather system where severe turbulence with vertical wind variations of up to +/–15 meters per second could have existed. Flying in IMC[7] during such conditions can be very demanding, even for an experienced pilot, and has in several cases resulted in the pilot's loss of control of his aircraft. The fact that the aircraft in question was heavily loaded and had a center of gravity aft of the aft center of gravity limit can have rendered the pilot's maneuvering more difficult. If furthermore, one or more of the passengers were ill due to the turbulence, the pilot's work load can have been further increased.

Risk of icing
The flight took place at FL 110 and the zero degree isotherm was at about FL 080, which means that the risk existed for light to moderate ice accretion. The pilot's inquiry about the height of the top of the clouds may have been due to the fact that ice had began to build up on the aircraft and that he contemplated the possibility of climbing to avoid further ice build-up. With the thought in mind that the aircraft was heavily loaded and tail heavy, even light icing of the aircraft, by way of its weight and the aerodynamic disruption that this can cause, could have considerably impaired the flight characteristics of the aircraft which involved a serious stress factor for him. If the aircraft flew into or into the vicinity of a cb-cloud, where the risk of severe icing existed, an extensive accretion of ice could have taken place rapidly, causing the aircraft to become very difficult or impossible to maneuver. The occasional inferior sound quality during the last radio transmissions from the aircraft may well be a sign that the aircraft was at this time in a cb-cloud with accompanying icing.

The pilot's medical status
For the past five years the pilot had experienced heart problems and was treated for this with several different medicines. His continued flying had been questioned by his heart doctor but his ordinary aviation doctor had in consultation with him (the pilot) decided that he could continue to fly. He did not however renew his instrument rating which can possibly be interpreted as if he himself was aware that as a pilot he did not have the same capacity as before.

[7] IMC = Instrument Meteorological Conditions

As mentioned above both turbulence and icing probably arose during the latter part of the flight. Under normal circumstances the pilot should – with his experience of similar situations – have anticipated and dealt with such a situation. That this was not the case on this occasion indicates that the pilot was stricken with some form of medical problem that caused him to be incapable or diminished his capability to handle the situation. As late as one week or so prior to the accident he had experienced discomfort in the chest. It is well known that latent heart problems can worsen rapidly and become acute for instance in the form of so-called auricular fibrillation or heart attack in connection with extreme workload or stress. Contributory to this could have been that the flight had then taken place at an altitude of 11,000 feet for more than one hour and that the pilot possibly did not use oxygen.

Interacting factors
As mentioned earlier it has not been possible during the investigation to establish a clear cause of the accident. Instead everything indicates that the accident was caused by several interacting factors, probably implying that one or several operational problems initiated an acute heart problem with the pilot. The heart problem caused him to be incapable or diminished his capacity to maneuver the aircraft, which rapidly worsened the situation and resulted in the flight becoming totally uncontrolled. Whether the maneuvers that the aircraft was observed to perform at low altitude shortly before impact were the pilot's attempt to regain control of the aircraft when it descended below the clouds and he had obtained ground reference or were the attempt of the passenger in the forward chair to fly the aircraft is uncertain. Irrespective of which is the case, the flight remained uncontrolled up to the accident.

2.3 The transportation of passengers

The flight was intended to transport three passengers from Lübeck in Germany to Karlsborg in Sweden. The pilot was, as far as SHK has been able to determine, not acquainted with the passengers and did not himself have any errand in Karlsborg. His intention was to fly back to Germany as soon as he had delivered the passengers. Irregardless if they paid for the trip or not, according to SHK´s opinion the flight was of such character that in Sweden it would have required a special permit from The Swedish Civil Aviation Administration. Whether such a permit could have been obtained or not is beyond the power of SHK to judge.

The object of the Swedish constitutional regulations that require an operational licence and other simular special permits is to hinder non-professional pilots and organizations from being able to offer cheap and practical air transport to passengers and customers who do not have knowledge of the difference in flight safety that can exist between private and professional aviation. The passengers 'unawareness of this difference is a known problem that SHK last treated in its final report RL 2000:40 and that has occasioned The Swedish Civil Aviation Administration to initiate a number of activities to cope with it.

The flight in question can probably be seen as another tragic example of how in the just mentioned respect uninformed passengers are affected because they for economical or other reasons chose to travel with a private aircraft instead of utilizing ordinary collective means of transportation.

2.4 Weather radar

Updated weather radar information is an important aid for judging and prognosticating flight weather and of great significance for the safety of flight. It makes it possible for air traffic controllers and pilots to discover and follow thunderstorms and rain clouds during IMC and by that means avoid that aircraft enter them. Most modern passenger aircraft are nowadays also equipped with weather radar.

SHK has in the investigation found that this information is available to air traffic control only at one, or perhaps a couple, of the larger airports in Sweden. Considering how important it is from a flight safety viewpoint that air traffic controllers, during the planning of air traffic and the radar vectoring of aircraft in the vicinity of airports, have access to such information, it should be available at all larger airports.

At the flight in question the aircraft was equipped with both a stormscope and weather radar and it is uncertain if access to weather radar information by the air traffic controller would have changed the sequence of events in this case. Possibly the air traffic controller could have issued a warning about probable cb-activity west of the aircraft's route of flight in connection with the pilot inquiring about the tops of the clouds and the weather situation at Karlsborg.

3 CONCLUSIONS

3.1 Findings

a) The pilot was not qualified to perform the flight.
b) The aircraft had a valid Certificate of Airworthiness.
c) The pilot had heart problems and was treated for this with medicines.
d) Deficiencies existed in the pilot's planning of the flight.
e) At the time of departure from Lübeck the aircraft's takeoff mass was above the maximum allowable and the center of gravity behind the aft center of gravity limit.
f) Risk of severe turbulence and icing existed on the route of flight.
g) The flight was uncontrolled a short time prior to the aircraft impacting the ground.
h) No technical fault has been found on the aircraft.
i) The mission of the flight is defined according to the Swedish rules of aviation as unlawful aviation.
j) Updated weather radar information is accessible to air traffic control only at one, or perhaps a couple, of the country's larger airports.

3.2 Causes

The accident was probably caused by the pilot being stricken by acute heart problems, in connection with the aircraft entering an area with severe turbulence and icing, which made him incapable of controlling the aircraft.

The aircraft's particular flight characteristics in critical flight positions, and the fact that the center of gravity was behind the aft center of gravity limit, may have contributed to the accident.

4 RECOMMENDATIONS

The Swedish Civil Aviation Administration is recommended to ascertain that ATC at larger airports and ATCC will receive access to updated weather radar information *(RL 2001:21 R1).*