Statens haverikommission
Swedish Accident Investigation Authority

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Final report RL 2012:18e

Serious incident involving the aircraft SE-KXJ on 24 November 2011 at Hemavan Tärnaby Airport, Västerbotten County, Sweden

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

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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Statens haverikommission
Swedish Accident Investigation Authority

The Swedish Transport Agency

Final report RL 2012:18e

The Swedish Accident Investigation Authority (Statens haverikommission, SHK) has investigated a serious incident that occurred on 24 November 2011 at Hemavan Tärnaby Airport, Västerbotten County, involving an aircraft with the registration SE-KXJ.

In accordance with Regulation (EU) No 996/2010 on the investigation and prevention of accidents and incidents in civil aviation, the SHK investigation team hereby submits a final report on the results of the investigation.

On behalf of the Swedish Accident Investigation Authority,

Mikael Karanikas　　　　Nicolas Seger

Contents

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 again, 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. Accidents and incidents are, therefore, neither investigated nor described in the report from any such perspectives. 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. The investigation is carried out in accordance with Annex 13 of the Chicago Convention.

The investigation

SHK was notified on 24 November 2011 that a serious incident had occurred involving an aircraft of type SAAB 340B with the registration SE-KXJ at 15.51 hrs that day at Hemavan Tärnaby Airport, Västerbotten county.

The incident has been investigated by SHK represented by Mr Göran Rosvall, Chairperson until 25 January 2012, Mr Mikael Karanikas thereafter, Mr Nicolas Seger, Investigator in Charge, Ms Ulrika Svensson, Operations Investigator until 16 March 2012, Mr Kristoffer Danèl, Technical Investigator (aviation) and Mr Patrik Dahlberg, Investigator specializing in Fire and Rescue Services.

SHK was assisted by Mr Bo-Göran Windoff as representative of the type certificate holder and Mr Christer Magnusson as a sound expert.

The investigation was followed by Mr Jan Eriksson of the Swedish Transport Agency.

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Aircraft; registration and type	SE-KXJ, SAAB 340B
Class/Airworthiness	Normal Certificate of Airworthiness and valid Airworthiness Review Certificate (ARC[1])
Owner/Operator	Erik Thun AB/NextJet AB
Time of occurrence	2011-11-24, 15.51 hours, in darkness Note: All times are given in Swedish standard time (UTC[2] + 1 hr)
Place	Hemavan Tärnaby Airport, Västerbotten county, (pos. 65°48′22″N 015°04′58″E; 457 m above sea level)
Type of flight	Commercial air transport
Weather	According to SMHI[3]'s analysis: west-north-westerly wind 10-15 knots, gusting 25-30 knots, visibility at times 500 metres in snow showers, with the cloud base at 1000-2000 feet, temp/dewpoint 0/-1 °C, QNH[4] 1001 hPa
Persons on board:	11
crew members	3
passengers	8
Injuries to persons	None
Damage to aircraft	Slightly damaged
Other damage	None
Commander:	
Age, licence	43 years, ATPL(A) [5]
Total flying hours	3,600 Hours, of which 2,700 hours on type
Flying hours last 90 days	99 hours, all on type
Number of landings last 90 days	114
Co-pilot:	
Age, licence	27 years, CPL(A)[6]
Total flying hours	1,713 Hours, of which 1,167 hours on type
Flying hours last 90 days	131 hours, all on type
Number of landings last 90 days	140
Cabin crew members	1 person

[1] ARC - Airworthiness Review Certificate.

[2] Universal Time Co-ordinated (UTC) is a reference for exact time the world over.

[3] SMHI - Swedish Meteorological and Hydrological Institute.

[4] QNH – indicates barometric pressure adjusted to sea level.

[5] ATPL(A) – Airline Transport Pilot Licence (Aeroplane).

[6] CPL(A) – Commercial Pilot Licence (Aeroplane).

Summary

An aircraft of type SAAB 340B was on a scheduled flight from Hemavan Tärnaby to Vilhelmina. The take off was performed in darkness and winter conditions. In connection with the take off a snowshower came in over the field which meant that visibility deteriorated and the wind speed increased.

During take off the aircraft gradually approached the left edge of the runway. After about 800 meters the aircraft ran out of the left edge of the runway with the left main wheel and the nose wheel, continued parallel to the runway for about 350 meters and then came back up onto the runway again. Shortly thereafter, the aircraft veered once more to the left, left the runway completely and stopped a few metres from the runway edge parallel to the direction of take off.

All persons on board were uninjured and left the aircraft through the main entrance and its staircase.

The incident was probably caused by a perceptual illusion for the pilots on account of large flakes of blowing snow, which led to the aircraft's drift not being noticed in time. The illuminated landing lights have served to reinforce the illusion.

Recommendations

None.

1 FACTUAL INFORMATION

1.1 History of the flight

1.1.1 Circumstances and the take off sequence

The incident occurred in darkness and winter conditions in connection with a flight from Hemavan Tärnaby Airport to Vilhelmina Airport. The aircraft was parked in a cold hangar when the crew and passengers boarded. The aircraft was then towed out to the apron for the engine start. After this, taxiing to runway 15 commenced with the engine anti-icing system on.

The pilots utilized the maximum available distance for take off. The take off was executed as an A take off, which meant that power was applied with brakes activated. However, the aircraft began to slide forwards at an early stage of the power application. The commander released the brakes and started to steer with the nose wheel steering. The engines reached the calculated thrust, and the take off sequence continued.

In connection with the take off, a heavy snow shower came in over the field from the northwest, which meant that visibility deteriorated and the wind increased in strength. After about 800 metres, the aircraft ran off the left edge of the runway with the left main wheel and the nose wheel, continued parallel to the runway for about 350 metres and then came back onto the runway again. Shortly thereafter, the aircraft veered once more to the left, left the runway completely and stopped a few metres from the runway edge parallel to the direction of take off.

All persons on board were uninjured and left the aircraft via the main entrance and its staircase.

1.1.2 Interviews with the crew

In interviews with the commander, co-pilot and purser, it became evident that the take off was preceded by standard preparations. No de-icing was performed because the crew observed that the light snow that was falling melted immediately when it came in contact with the wings. Visibility was assessed to be 1,000-1,500 metres, and the runway edge lights, which were illuminated, were clearly visible. The take off was executed with illuminated taxi and landing lights without windscreen wipers on. The commander manoeuvred the aircraft by means of the nose wheel steering up to a speed of 70 knots. The co-pilot then assumed control of the aircraft.

The pilots discovered that the aircraft was drifting to the left, and the commander called out “right, right”, which was understood by the co-pilot, who tried to correct with right rudder deflection. Shortly thereafter, at a speed of just over 90 knots, the landing gear came in contact with the left snow bank. The commander aborted the take off by performing full thrust reversal, braking and steering. The purser noticed this and on his own initiative called “heads down” to the passengers. The aircraft veered, departed the runway and stopped completely. The engines had stopped and it became completely silent. The commander ordered the passengers to remain seated, notified the tower that the aircraft had run off the runway and then asked for the checklists.

The co-pilot explained that the right rudder pedal felt completely stuck during the sequence. The pilots therefore performed a new inspection of the rudder movement, which was without remark.

The passengers left the aircraft and were transported to the airport terminal by bus, while the crew walked back on the runway. It was found there that the wheel tracks were about a metre to the left of the runway centre, level with the threshold of runway 15. The day marking of the centre line was not visible. The commander explained that he was aware that the drifting snow could make maintaining the heading difficult, while the co-pilot explained that he did not experience any lateral movement on account of the snow.

The passengers were given a debriefing by the crew after the incident. The crew conducted their own debriefing in the evening, which was later followed up by a debriefing with NextJet's Chief Pilot for the aircraft type in question.

1.1.3 *Interviews with other personnel*

The AFIS[7] Officer and the snow clearance manager, who is also responsible for rescue operations at Hemavan Tärnaby Airport, have stated that the runway was treated continuously with the sweeper/snow blower until the aircraft taxied out for take off. This meant that there were only a few millimetres of dry snow on the runway, which had been cleared to its full width. Friction testing had been carried out at 15.11 hrs and demonstrated medium to good braking action. In connection with the aircraft lining up for take off, the snow increased in intensity into an abundance of large, light flakes. When SE-KXJ passed the threshold of runway 15 during the take off sequence, one of the ramp personnel felt a gust of wind over the apron. The AFIS Officer in the tower lost sight of the aircraft about 300 metres after the threshold, took out a pair of binoculars and was able to see the rear position light for a few more seconds.

Ramp personnel subsequently heard that the aircraft performed thrust reversal and that it then became silent. The rescue operations coordinator and the rescue team went out to check the situation. The rescue operations coordinator notified the tower that “the machine is sitting here just fine”, which was taken by the AFIS Officer to mean that the aircraft had aborted take off. No message from the commander that they had run off the runway had been noted by the AFIS Officer. A little later, the tower received information from the rescue operations coordinator that the aircraft had run off the runway. After a visual inspection and contact with the crew, the assessment was made that the airport's own rescue team was adequate for the situation that had arisen.

The incident occurred at position 65°48′22″N 015°04′58″E, 457 m above sea level.

1.2 Injuries to persons

	Crewmembers	Passengers	Others	Total
Fatal	–	–	–	–
Serious	–	–	–	–
Minor	–	–	–	–
None	3	8	–	11
Total	3	8	–	11

1.3 Damage to the aircraft

Damaged blade tips on the left propeller and damage to landing lights and cables on the nose gear.

[7] AFIS – Aerodrome flight information service.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 Commander

The commander was 43 years old at the time and had a valid ATPL(A). At the time of the incident, the commander was PNF[8].

Flying hours			
Previous	24 hours	90 days	Total
All types	~	~	3,600
This type	2	99	2,700

Number of landings on this type previous 90 days: 114.
Type rating concluded on 13 November 2006.
Latest PC[9] was performed on 4 September 2010 on this type.

1.5.2 Co-pilot

The co-pilot was 27 years old at the time and had a valid CPL(A).
At the time of the incident, the co-pilot was PF[10].

Flying hours			
Previous	24 hours	90 days	Total
All types	~	~	1,713
This type	3	131	1,167

Number of landings on this type previous 90 days: 140.
Type rating concluded on 4 February 2009.
Latest PC was performed on 15 December 2010 on this type.

1.5.3 Cabin crew members

One person.

1.5.4 The crew members´ duty schedule

The crew members´ hours of duty were within permitted limits.

1.6 Aircraft information

1.6.1 Airworthiness and maintenance

Aircraft	
TC-holder	SAAB Aircraft AB
Type	340B
Serial number	189
Year of manufacture	1990
Gross mass	Max authorized take off/landing mass 13155/12930 kg, actual take off mass 10,935 kg
Centre of gravity	427.6 in., within permitted limits
Total flying time	45493 hours

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[8] PNF – Pilot Not Flying – The pilot who assists PF.
[9] PC – Proficiency check – Periodic flight training.
[10] PF – Pilot Flying – The pilot who manoeuvres the aircraft.

Number of cycles	41,833	
Flying time since latest inspection	48 hours	
Fuel loaded before event	2,011 litres	
Engine		
TC-holder	General Electric	
Model	CT7-9B	
Number of engines	2	
	Engine No 1	*No 2*
Serial number	GE-E-85204	GE-E-85167
Time since latest inspection, hrs	4352	1128
Time since overhaul	261	14
Propeller		
TC-holder	*Dowty*	
Propeller 1		
Model	R389/4-123-F/25	
Serial number	DRG/5587/88	
Total time	25,242 hours	
Time since overhaul	5,517 hours	
Propeller 2		
Model	R390/4-123-F/27	
Serial number	DRG/2293/90	
Total time	38,239 hours	
Time since overhaul	2,189 hours	
Remarks		
MEL	None	
HIL	"L/H logo lamp unserviceable" "Single point pressure refueling unserviceable"	

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

1.6.2 Description of parts or systems related to the incident

The nose wheel steering

The aircraft is steered on the ground by means of a steerable nose wheel up to speeds of about 70 knots. The wheel can be steered when the nose wheel is in the down and in the locked position. A hydraulic servo ensures that the displacement of the steering wheel at the pilot seat is transferred to the nose wheel. The control wheel is located on the left side panel and must be depressed to activate the steering. The deflection of the nose wheel is equivalent to half the displacement of the wheel. The steerable area of the nose wheel is ± 60°. Figure 1 shows the control wheel for the nose wheel steering and its location at the pilot seat. The nose wheel steering is independent of rudder deflection. The deflection is not recorded by the FDR[11].

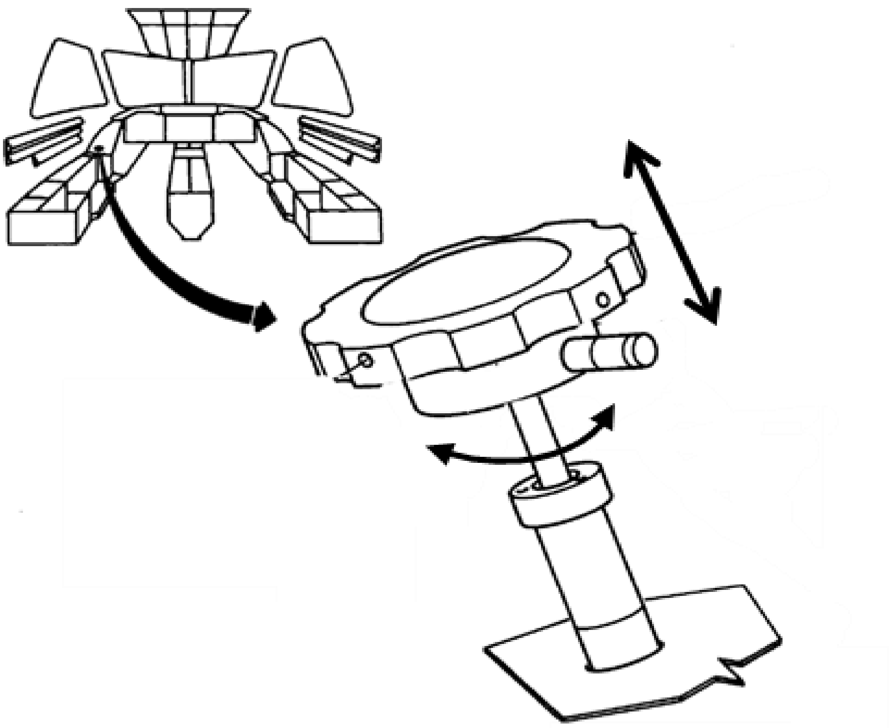

Fig. 1. The control wheel for the nose wheel steering and its location at the pilot seat.

The rudder pedals and the brakes

The rudder is used for steering the aircraft in the yawing plane. While taxiing on the ground, the rudder begins to gain effect at a speed of about 40 knots. From about 70 knots, only rudder is used to steer the aircraft on the ground. Rudder and brakes are controlled with pedals at the pilot seats. There are double sets of pedal units; one for each pilot. Any change in the pedal blade's angle affects the brakes, while moving the pedal affects the rudder. The rudder function is mechanically interconnected between the pedal sets.

When one of the brake pedals at a pilot seat is depressed (the pedal blade angle changes), the respective side of the brakes is activated. Only the main wheels are equipped with brakes. The braking system is equipped with an “anti-skid” function that prevents the wheels from locking during braking with the pedals.

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[11] FDR – Flight Data Recorder.

Description of propeller pitch change with Autocoarsen and thrust reversal.
The propeller blades can be turned so as to obtain an angle corresponding to the least drag. The Autocoarsen system ensures that this is performed quickly and automatically, for example, upon engine power loss. The system can be disconnected with a switch. Autocoarsen operates on one engine at a time and has two modes, one for low power and one for high power. Which mode the system will work in is partly based on the position of the power levers and the current engine power.

With thrust reversal, which occurs when the power levers for each engine are pulled to their rearmost position, the propeller blade angles change so as to provide a backwards thrust. This is normally performed in connection with landing in order to reduce speed. The method is also used in the case of aborted take off. To be able to set the power levers in their rearmost position, a latch on the side of the power lever must be lifted.

1.6.3 Availability and serviceableness of TCAS/GPWS/TAWS

Not applicable.

1.7 Meteorological information

1.7.1. Analysis according to SMHI

West-north-westerly wind 10-15 knots, gusting 25-30 knots, visibility at times 500 metres in snow showers, with the cloud base at 1000-2000 feet, temp/dewpoint 0/-1 °C, QNH 1001 hPa.

1.7.2 Weather recordings according to AWOS[12]

SHK has also examined stored weather information from the airport's AWOS that recorded a two-minute average wind direction and average wind speed of 290 degrees and 14 knots for runway 15 and of 310 degrees and 7 knots for runway 33. The ten-minute maximum value for the wind was 24 knots for runway 15 and 11 knots for runway 33. The system does not record instantaneous wind. The average value over one minute for the meteorological visibility was 800 metres. See Figure 4.

Eight minutes after the incident, all the values for the wind had dropped to below 10 knots and the visibility had increased to above 10 kilometres.

1.7.3 Mountain weather

Hemavan Tärnaby Airport is located in a valley surrounded by mountain peaks that are between 800 and 1300 metres above the airport elevation. These circumstances mean that turbulence is common. Moreover, it is well known that the weather in mountainous terrain has rapid variations with respect to wind direction, wind force, cloudiness and precipitation.

1.7.4 The pilots' planning data

The pilots' planning data included a chart with information on significant weather (SWC[13]). The chart showed that there was a risk of moderate to severe turbulence and snow showers. A SIGMET[14] had been issued with the forecast of weak-

[12] AWOS - Automated Weather Observation System.
[13] SWC – Significant Weather Chart.
[14] SIGMET – Significant Weather Information.

ening severe turbulence within a south-westerly to north-easterly band east of the airport.
The pilots also had access to automatically recorded current weather that prevailed one hour before the event as follows: wind 280 degrees 9 knots, visibility 600 metres without data on visibility variations, runway visual range between 1300 metres and 2000 metres with an upward tendency, snow, vertical visibility 500 feet, temperature 0 °C, dewpoint minus 1 °C, QNH 1000 hPa. Forecasts of the type TAF[15] are not issued for the airport.

1.8 Aids to navigation

All aids to navigation, both terrestrial and on board the aircraft, functioned without remark. During the take off ground roll, only external visual references and the aircraft's heading indicator are used to maintain heading.

1.9 Radio communications

SHK has examined the radio communication during the incident between the air traffic control tower and the aircraft.

About six minutes before take off, the AFIS Officer communicated the following weather information to the crew: wind 310 degrees 7 knots, visibility 2,800 metres in snow, vertical visibility 1,400 feet, temperature 0 °C, dewpoint minus 0 °C, QNH 1,001 hPa, that snow clearance was still in progress and that the braking values would be at 0.36, 0.37 and 0.38 once the runway had been swept. Just before take off, the wind was given again with the following values: 290 degrees 10 knots for runway 15 and 320 degrees 5 knots for runway 33.

The message from the commander to the tower that the aircraft had run off the runway has not been recorded on the tapes.

1.10 Aerodrome information

The airport is listed as an approved aerodrome in accordance with the Swedish AIP[16]. Hemavan Tärnaby Airport is an instrument aerodrome with flight information service (AFIS). The runway, which is covered with asphalt, is 1,444 metres long and 30 metres wide. Larger traffic airports generally have a width of 45 metres. Each runway end has a stopway of 150 metres that can be used at take off or in the case of aborted take off, which means that the longest possible available take off distance is 1,744 metres. On each side of the runway, there are strips, see Figure 2.

The runway is equipped with day markings consisting of a centre line marking and runway edge markings. These were not visible on account of snow. The runway also has low and high intensity runway edge lights on both sides every 60 metres.

The airport has access to equipment for snow clearance and friction measurement. On the day in question, a combined air blowing and snow sweeping machine and a friction measurer of type Skiddometer BV-11 were used, among other equipment. The Skiddometer had been calibrated two months before the incident.

[15] TAF – Aerodrome Forecast.

[16] AIP – Aeronautical information publication – Manual containing information for aviation

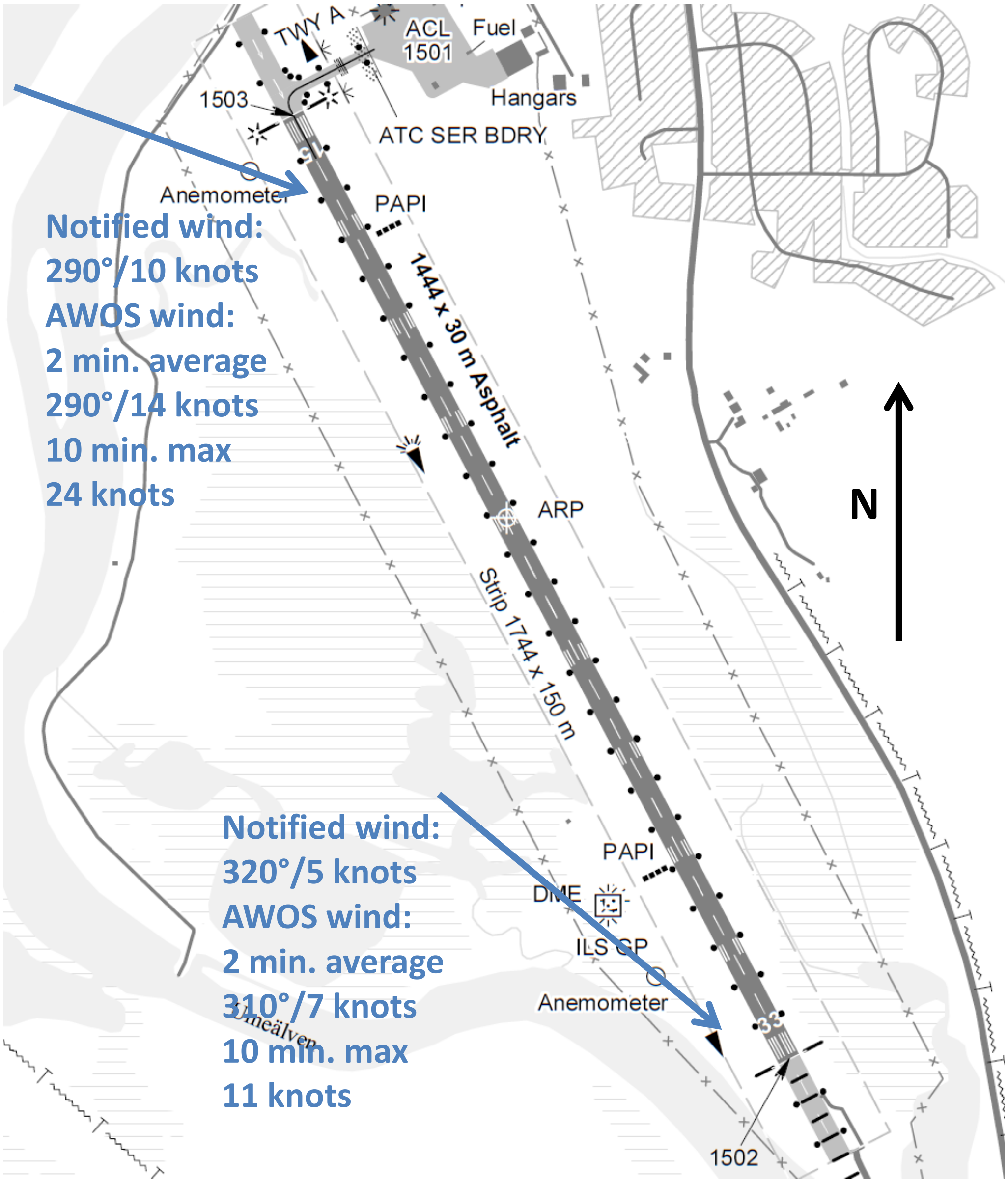

Fig. 2. Hemavan Tärnaby Airport with wind information.

1.11 Flight recorders

1.11.1 Flight Data Recorder (FDR)

The aircraft was equipped with a flight data recorder (FDR) of type PN 980-4100DXUN Sundstrand. The flight data recorder has been secured and the reading of data has taken place. The FDR was transported by SHK to the United Kingdom accident investigation authority (AAIB) where transfer of data to a PC was carried out. After the retrieval of data from the FDR, the information has been processed and interpreted by SHK. See also Chapter 1.16.2.

1.11.2 Cockpit Voice Recorder (CVR[17])

The aircraft was equipped with a cockpit voice recorder of type PN 2100-1020-00 L3 Communications. The CVR has been secured and analysed. The equipment was transported by SHK, together with the FDR, to the United Kingdom accident investigation authority (AAIB). The sound information was transferred to digital

[17] CVR – Cockpit Voice Recorder.

audio files under SHK supervision. The examination of the CVR is presented in Chapter 1.16.3.

1.12 Site of occurrence and the aircraft

1.12.1 Site of occurrence

The reading of the aircraft's recording equipment showed a straight track from the beginning of the take off sequence to the initial contact with the snow bank.

With the assistance of airport staff, SHK has documented the wheel tracks after the incident. The tracks show that the aircraft left the left edge of the runway after half the runway length and ran almost parallel with the same for 350 metres. After this, the aircraft came onto the runway to then once more leave the left edge of the runway, this time with a greater heading deviation. The aircraft stopped about 200 metres from the end of the runway, 15 metres to the left of the runway edge. See Figure 3 below.

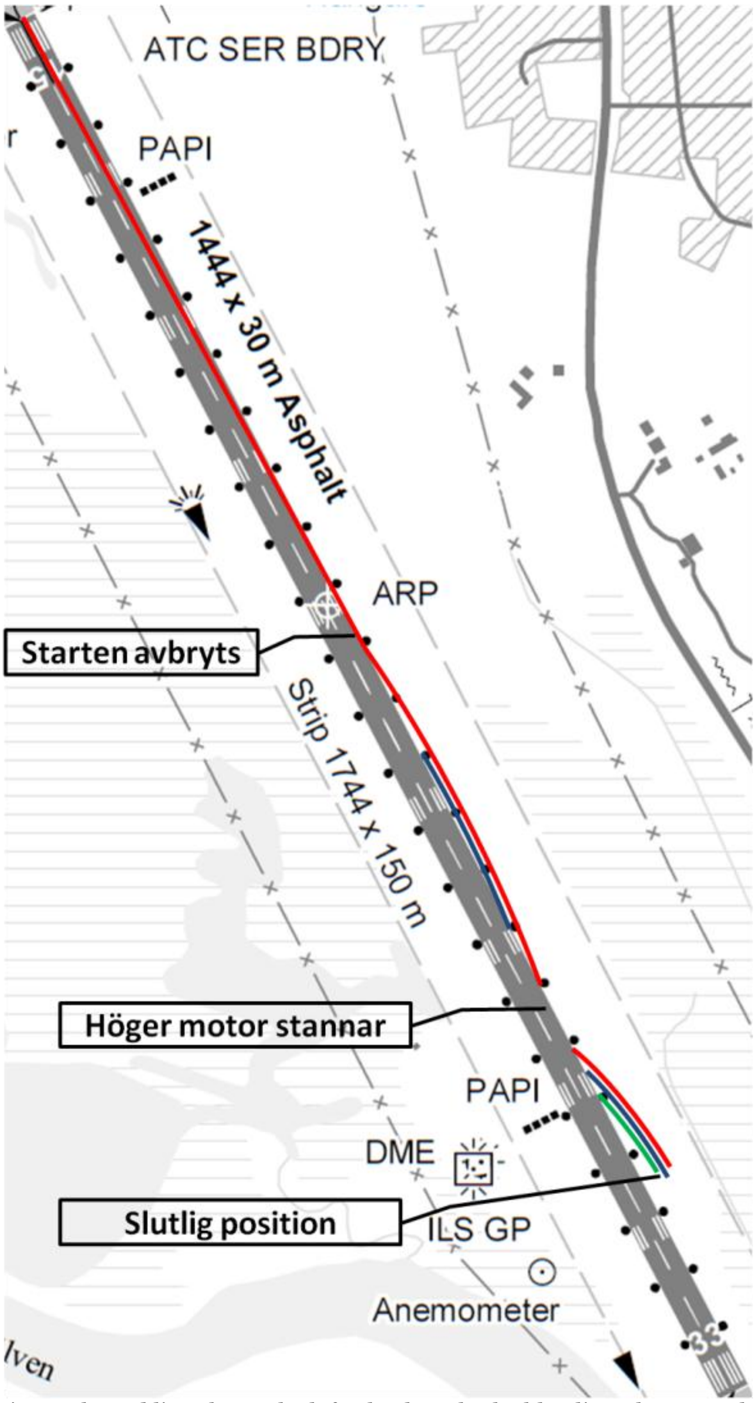

Fig. 3. The red line shows the left wheel track; the blue line, the nose wheel track and the green line, the right wheel track.
Swedish text:
Starten avbryts = Take off is aborted
Höger motor stannar = Right engine stops
Slutlig position = Final position

1.12.2 The aircraft

The aircraft stopped on the left side of the runway, parallel to the runway direction, on the strip area, see Figure 4 below.

Fig. 4. The aircraft after the aborted take off. The ploughed snow bank outside the runway edge is visible in the foreground. Picture: SHK.

1.12.3 *Friction tests*

SHK has examined the brake friction tests that were carried out at the airport before the incident. The tests were carried out about 40 minutes before the incident and gave friction values between 0.34 and 0.37 with an average value of 0.36. After this, snow clearance was in progress until the time of the take off in question, without any repeated friction testing being performed.

1.12.4 *Performance*

Before every take off, the pilots must calculate the take off performance for the aircraft. The quantity of payload and fuel affects the mass of the aircraft. The aerodrome's elevation above sea level, in combination with air pressure, runway length and weather, affects the take off distance on the ground and the aircraft's climbing capability after take off.

For the take off calculations, the pilots used the company's RPM[18] for Hemavan. The pilots chose to take off with 15 degrees of flap as recommended by the manual in the case of a snow-covered runway.

SHK has reviewed the pilots' calculations and found that these were in accordance with the limitations that were applicable.

At take off, three different take off methods can be used, A, B or C. The different methods determine how much take off power is set by the power levers before the brakes are released.

With take off method A, 80-85% of the selected take off power is set before the brakes are released. The corresponding value for method B is 60%. With method C, the brakes are released before power application begins.

[18] Route Performance Manual – Manual with performance data, particularly calculated and published for the operator and the aircraft model for different airports.

The RPM for runway 15 stated that take off method A should be used with 15 degrees of flap for braking action under 0.40, see Figure 5.

Page 4.ESUT 15	24 FEB 11		NextJet		GWC SAAB 340B/GE CT7-9B
HEMAVAN ESUT/HMV RWY 15			SAAB 340B/GE CT7-9B		FLAPS 15 LF
	TORA: 1594 m	RWY WIDTH: 30 m	QNH: 1013 hPa	Anti Ice: Off	TKOF Method A
	TODA: 1594 m	THR ELEV: 1502 ft	APU: Off	Bleeds: Off	
	ASDA: 1744 m	AD ELEV: 1503 ft	APR: Armed		
	LDA: 1444 m	SLOPE: -0.02 %			

Fig. 5. NextJet's RPM for Hemavan runway 15

The operational documentation of the company and of the type certificate holder states that take off method B (Method B) is to be used for take off when the braking action is between 0.30 and 0.40. In the present case, the average braking action was at 0.37, which meant that Method B should be used.

SHK has received information from the issuer of the performance tables that the specified take off method was – through a printing error – stated as method A instead of B.

1.12.5 Wind limitations

According to the operator's RPM, the aircraft had the following limitations regarding maximum allowable values for wind during take off:
Maximum allowable tailwind component: 10 knots
Maximum allowable crosswind component for braking values between 0.35 and 0.39 and a runway width of 30 metres: 17 to 26 knots. These values were to be calculated by interpolation, which meant that a braking value of 0.36 – 0.38 yielded a crosswind limitation in the interval 19 to 24 knots.

Assuming the highest recorded wind values according to AWOS, the highest possible crosswind component is 16 knots, which is within the allowable interval. However, the highest possible value of the tailwind component is 19 knots.

With regard to the wind information that was available to the pilots, all values were within allowable limits.

1.13 Medical information

Nothing indicates that the mental and physical condition of the crew members were impaired before or during the flight.

1.14 Fire

There was no fire.

1.15 Survival aspects

1.15.1 The rescue operation

According to the Civil Protection Act (2003:778), the term “rescue services” denotes the rescue operations for which central government or municipalities shall be responsible in the event of accidents in order to prevent and limit injury to persons and damage to property and the environment.

SHK has reviewed the rescue operation during the incident and concluded that it functioned appropriately and without delay or problems in general.

The Emergency Locator Transmitter (ELT [19]) of type ELT97A2560000001 was not activated during the incident.

1.15.2 *Location of the cabin crew and passengers, and injuries*

Not applicable.

1.15.3 *Evacuation*

Not applicable.

1.16 Tests and research

1.16.1 *Examination of the FDR*

The information from the FDR has been visualized by means of animation software and presented in the form of curves. SHK has specifically studied the aircraft's rudder deflection and engine values and has not been able to identify any malfunctions. The analysis shows that the right engine stopped just before the aircraft left the runway completely whilst the left engine was in the thrust reversal position.

1.16.2 *Examination of the CVR*

The information from the CVR has been synchronized with the information from the FDR and compared with the sound recordings from Air Traffic Services.

1.17 Organisational and management information

NextJet was founded in 2002 and has operated domestic regional traffic in Sweden since 2005. The company has several different types of aircraft and also has various models of the Saab 340.

1.18 Additional information

1.18.1 *Environmental aspects*

Not applicable.

1.18.2 *Perceptual illusions*

It is well known that it is possible to perceive a relative movement that is different to the case in reality, such as when sitting on a train and thinking it is beginning to roll, when in fact it is the neighbouring train that is moving. Similarly, a false impression of lateral movement can be given when travelling in a car at night in the winter and the snow is sweeping across the road in the headlights.

“Human Factors in Flight”, Frank H. Hawkins (Ashgate, 2005), states, among other things, the following: “In winter, blowing snow may be sweeping across an airfield and this gives a false impression of relative movement [...] Quite inappropriate control action can be initiated based on this illusion. [...] This also has relevance during take-off, where it can interfere with normal directional control”.

NextJet's operative manual (OM-B) contained information about illusions associated with blowing snow in conditions of crosswind and illuminated landing lights

[19] ELT - Emergency Locator Transmitter.

in Chapter 2.11.12 that deals with landing. The information was not found in the chapter dealing with take off.

1.18.3 Measures taken

After the incident, the company has sent out information to its pilots regarding the incident with enhanced directions for winter operations. This information has been supplemented with a copy of AIBN report SL2011/10 from the Norwegian accident investigation authority that discusses operations in winter conditions.

NextJet will, in the next revision of the operative manual, supplement this with information about illusions in connection with take off. The company has also had the printing error in the RPM corrected.

1.19 Special or effective methods of investigation

Not applicable.

2 ANALYSIS

2.1 Circumstances

SHK is of the opinion that the crew's preparations for the flight were in line with the operational data that was available. The circumstances for the take off were initially good with relatively weak winds. The fact that boarding was performed inside the cold hangar is understandable in view of the snow.

The crew chose not to de-ice the aircraft, which can be explained by the fact that the snow that was falling melted directly in contact with the wing's upper surface and also that the taxiing distance to the take off runway was very short.

Since the snow clearance of the runway was in progress right until the time of the take off, it is likely that the friction values were unchanged since the previous measurement. SHK is of the opinion that this may explain the fact that the commander did not request a repeated braking measurement.

2.2 The take off sequence

The fact that the take off was executed with take off method A instead of B has not, in SHK's opinion, affected the sequence of events since the initial heading deviation was marginal. The heavy snow shower and wind from right to left and large snowflakes have probably created a perceptual illusion for the pilots. This has resulted in the aircraft drifting off from the runway centre line and gradually approaching the left runway edge. The illusion was presumably reinforced by the aircraft's illuminated landing lights.

The track from the beginning of the take off sequence to the initial contact with the snow bank on the left edge of the runway presents a straight line with small heading deviations. Since the aircraft is manoeuvred in the yawing plane by the commander up to a speed of 70 knots and thereafter by the co-pilot, SHK is of the opinion that it is likely that both pilots have been subject to the same illusion associated with the snow.

The commander's call of “right, right” indicates that he noticed that the aircraft was approaching the left runway edge. The co-pilot attempted to correct the heading with the right rudder pedal but perceived the rudder to feel completely stuck. This can be explained by the fact that the aircraft's left wheel at that stage had already come in contact with the snow bank on the left edge of the runway, which caused a yawing effect to the left that could not be corrected despite full right rudder deflection.

In addition, it cannot be ruled out that the gust that came obliquely from behind decreased the rudder efficiency due to decreased relative wind. Whilst unlikely, it cannot be ruled out completely that the gust was at most the equivalent of a tail-wind component that exceeded the aircraft's limitations.

2.3 The excursion

In connection with the aircraft leaving the left edge of the runway with the left wheel, the commander assumed the controls and aborted the take off by performing thrust reversal, braking and steering. The aircraft continued parallel to the runway for about 350 metres. In connection with this, the nose wheel ploughed into the snow bank, which probably caused the engine loss on the right engine through slush spraying into the air intake.

In turn, the power loss on the right engine probably caused the sharp left veer that led to the aircraft completely departing the runway because the left engine was in the thrust reversal position and was braking at the same time as the braking power of the right engine ceased.

2.4 Overall assessment of the incident

A take off in winter conditions in mountainous terrain is a demanding manoeuvre. The conditions that prevailed at the time, with darkness, snow showers and gusting, contaminated runway, landing lights against snowflakes and water-covered windscreen, meant that the aircraft was being operated close to the operational limitations that have been established. The margins relating to maintaining the heading on the runway decrease with the reduced width of the runway. Non-visible day markings mean that the runway edge lights become the only external reference to maintain heading.

SHK ascertains that the take off, in terms of performance, was fully executable based on the information that was available to the pilots. The sudden gust and snow shower probably reduced the performance margins and caused an illusion that resulted in the drift towards the runway edge. The strip's width and bearing strength resulted in the damage to the aircraft being limited.

3 CONCLUSIONS

3.1 Findings

a) The crew was qualified to perform the flight.
b) The aircraft was airworthy.
c) The preparations were in line with available data.
d) In connection with the take off, there was a sudden gust and snow shower.
e) The aircraft came in contact with the snow bank on the left edge of the runway.
f) The take off was aborted, upon which the right engine stopped.
g) The aircraft departed the runway completely and stopped, upon which the left engine also stopped.
h) The passengers left the aircraft via the normal staircase.

3.2 Causes

The incident was probably caused by a perceptual illusion for the pilots on account of large flakes of blowing snow, which led to the aircraft's drift not being noticed in time. The illuminated landing lights have served to reinforce the illusion.

4 RECOMMENDATIONS

None.