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Report RL 2001:23e

*Aircraft incident to SE-LKB
in the Hudiksvall airspace, X county,
Sweden, on February 23, 2001*

Case L-007/01

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

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Translated by Bob Arnesen

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.

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2001-08-24

L-007/01

Swedish Civil Aviation Administration

601 79 NORRKÖPING

Report RL 2001: 23e

The Board of Accident Investigation (Statens haverikommission, SHK) has investigated an aircraft incident that occurred on February 23, 2001 in the Hudiksvall airspace, X county, Sweden, involving an aircraft with registration SE-LKB.

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.

A translation to English of the report will be enclosed later.

Olle Lundström

Monica J Wismar

Henrik Elinder

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Report finalised 2001-08-24

<i>Aircraft: registration, type</i>	SE-LKB , Embraer EMB-120ER
<i>Class/airworthiness</i>	Normal, valid certificate of airworthiness
<i>Owner/Operator</i>	SEB Finans AB, 167 81 Stockholm/IBA International Business Air AB, Bodekullsvägen 1, 374 35 Karlshamn, Sweden
<i>Date and time</i>	February 23, 2001 at 0122 hours in darkness <i>Note:</i> All times in the report in Swedish time = UTC + 1 hour
<i>Place of occurrence</i>	In the Hudiksvall airspace, X county, Sweden (approx. pos 6145N 01707E, approx. 4,600 m above sea level)
<i>Type of flight</i>	Non scheduled flight (charter)
<i>Weather</i>	According to SMHI's (Swedish Meteorological and Hydrological Institute) analysis: wind 330° at 10 knots, visibility 50 km, cloud nil, temp./dew point -18°/-21°C, QNH 1009 hPa.
<i>Persons on board: crew</i>	2/1
<i>passengers</i>	27
<i>Injuries to persons</i>	None
<i>Damage to aircraft</i>	No damage
<i>Other damage</i>	None
<i>Commander:</i>	
<i>age, certificate</i>	35 years, Airline Transport Pilot Licence
<i>total flying time</i>	4,199 hours, of which 804 hours on type
<i>flying hours previous 90 days</i>	79 , all on type
<i>number of landings previous 90 days</i>	76
<i>Co-pilot:</i>	
<i>age, certificate</i>	27 years, Commercial Pilot Licence with instrument rating
<i>total flying time</i>	1,403 hours, of which 1,030 hours on type
<i>flying hours previous 90 days</i>	123 , all on type
<i>number of landings previous 90 days</i>	137
<i>Cabin Attendant:</i>	Employed with the company since 2000.

The Board of Accident Investigation (SHK) was notified on March 01, 2001 that an aircraft with registration SE-LKB had an incident at 0122 hrs on February 23, 2001 in the Hudiksvall airspace, X County, Sweden.

The incident 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 investigation was followed by Kåre Jernling from the Swedish Civil Aviation Administration (SCAA).

Summary

The aircraft departed the Sundsvall/Härnösand airport on a domestic charter flight with 27 passengers onboard bound for the city of Jönköping.

About 17 minutes into the flight during the climb the pilots became aware of a burning smell onboard. The odour became progressively stronger and light haze was observed in the cockpit. The commander contacted the Sundsvall ATC and declared an emergency, asking for radar vectors back to the Sundsvall airport.

The return to the Sundsvall was carried out with a depressurised cabin. The haze dissipated rapidly leaving a sticky burning smell.

The landing was uneventful. The commander felt that the situation was under control and taxied the aircraft to the terminal building where the passengers disembarked.

An investigation of the problem revealed that one of the bolts on the connection terminal board in front of the instrument panel for the heating element in the right front windshield was loose. The electrical cable and terminal board in this area had been exposed to burn damage. The pilots did not don their oxygen masks as detailed in the emergency checklist.

The incident was caused by an intermittent connection and arcing around a loose bolt on the connection terminal board, resulting in local overheating and burning smell.

Recommendations

It is recommended that the SCAA:

- take the necessary action to ensure that aircraft with pressurised cabin used for commercial purposes are equipped with oxygen masks and smoke goggles that are both functional, easy-to-use and quick donning, and that pilots receive both initial and regular re-current training in their proper use, including the necessary hands-on training (*RL 2001:23e R1*).
- take the necessary action to ensure that that companies, their employees and other concerned parties are made more aware of the instances when it is their duty and responsibility to file reports to the SCAA (*RL 2001:23e R2*).

1 FACTUAL INFORMATION

1.1 History of the flight

The crew was to fly from Sundsvall/Härnösand airport with 27 passengers onboard late in the evening of February 22, 2001, bound for Jönköping. The departure was delayed about an hour and a half due to problems starting the right engine. After de-icing the aircraft it departed Sundsvall at 0105 hrs with the co-pilot acting as the flying pilot.

About 17 minutes into the flight during the climb-out passing through Flight Level 150 (approx. 4,600 m), the pilots became aware of a burning smell which became increasingly stronger and was accompanied by light haze. The commander switched both air conditioning packs to off, which at the time were being supplied with air from the auxiliary power unit (APU). He contacted Sundsvalls air traffic control (ATC), declared an emergency and requested radar vectors back to the Sundsvall airport. ATC responded by giving them radar vectors and clearance to descend towards Sundsvall.

The return was performed with a depressurised cabin and with the pilots flying the aircraft manually. The smoke/haze dissipated rapidly leaving a sticky burning smell. The commander announced to the passengers that they had a technical fault with the aircraft and that they would be returning to Sundsvall. The pilots were informed by ATC that the Hudiksvall airport was closer but they determined that the runway there was too short and decided to continue towards Sundsvall.

During the emergency the commander used his oxygen mask periodically while the co-pilot, who had not experienced the same discomfort as the commander, did not use his mask.

The commander took control of the aircraft for landing which was uneventful. As he considered the situation to be under control he taxied the aircraft to the terminal building where the passengers disembarked. Once inside the terminal the passengers were informed about what had happened and were then transported to a hotel. It was first a few days later before the cabin attendant, who had followed the passengers to the hotel, received more information concerning the event.

In the morning after the incident the passengers were flown to Jönköping onboard two other aircraft.

The incident occurred at approximate position 6145N 01707E; approx. 4,600 m above sea level.

1.2 Injuries to persons

	<i>Crew</i>	<i>Passengers</i>	<i>Others</i>	<i>Total</i>
Fatal	–	–	–	–
Serious	–	–	–	–
Minor	–	–	–	–
None	3	27	–	30
Total	3	27	–	30

1.3 Damage to aircraft

Slightly damaged.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 Commander

The commander was 35 years old at the time and had a valid Airline Transport Pilot Licence.

Flying hours

<i>previous</i>	<i>24 hours</i>	<i>90 days</i>	<i>Total</i>
All types	2.5	79	4,199
This type	2.5	79	804

Number of landings this type previous 90 days: 76.

Latest PC (proficiency check) carried out in 2001-01-05 on EMB 120.

1.5.2 Co-pilot

The co-pilot was 27 years old at the time and had a valid Commercial Pilot Licence with an instrument rating.

Flying hours

<i>previous</i>	<i>24 hours</i>	<i>90 days</i>	<i>Total</i>
All types	2.5	123	1403
This type	2.5	123	1030

Number of landings this type previous 90 days: 137.

Latest OPC (operational proficiency check) carried out in 2000-10-17 on EMB 120.

1.5.3 Cabin crew

The one cabin attendant onboard had been employed with the company during the year 2000 and had completed emergency training on October 27, 2000.

1.5.4 The pilots' duty roster

During the week before the incident the pilots had the following duty roster:

	<i>Commander</i>	<i>Co-pilot</i>	<i>Number of Flights</i>
2001-02-16	10.00–12.00	off-duty	1
2001-02-17	off-duty	off-duty	–
2001-02-18	off-duty	off-duty	–
2001-02-19	08.00–16.00	off-duty	–
2001-02-20	08.00–16.00	off-duty	–
2001-02-21	08.00–16.00	off-duty	–
2001-02-22	12.00–17.00	12.00–17.00	2

1.6 Aircraft information

AIRCRAFT:

<i>Manufacturer:</i>	Embraer
<i>Type:</i>	120 ER
<i>Serial number:</i>	120 016
<i>Year of manufacture:</i>	1986
<i>Gross weight:</i>	Max authorised landing weight 25,794 lbs. (11,700 kg), actual landing weight 25,700 lbs. (11,657 kg)
<i>Centre of gravity:</i>	Index 39, within allowable limits
<i>Total flying time:</i>	21,187 hrs
<i>Flying time since latest inspection:</i>	285 hrs A-check
<i>Fuel loaded before event:</i>	Jet A1, 900 litres

ENGINE:

<i>Manufacture:</i>	Pratt and Whitney Canada	
<i>Model:</i>	PWw118	
<i>Number of engines:</i>	2	
<i>Engine</i>	<i>Nr 1</i>	<i>Nr 2</i>
<i>Total operating time, hrs</i>	13,044	11,040
<i>Cycles after overhaul</i>	11,270	9,684

The aircraft had a valid certificate of airworthiness.

1.7 Meteorological information

According to SMHI's analysis: wind 330° at 10 knots, visibility 50 km, cloud nil, temp./dew point -18°/-21° C, QNH 1009 hPa.

A combination of a low-pressure system over the Baltic States and a high-pressure system over northern Scandinavia gave cold winds and clear weather throughout the area.

1.8 Aids to navigation

Runway 34 at the Sundsvall/Härnösand airport (ESNN) was equipped with ILS¹ and DME². The aircraft was equipped for instrument flight.

1.9 Communications

Normal communication was observed between the crew and ATC, both en-route and with the tower controller.

1.10 Aerodrome information

The airport met all the requirements as outlined in the Swedish Air Information Publication (AIP).

¹ ILS – Instrument Landing System

² DME – Distance Measuring Equipment

1.11 Flight recorders

1.11.1 Flight Data Recorder (FDR)

The aircraft was equipped with a 17M800-251 FDR. The recorded information has not been analysed.

1.11.2 Cockpit Voice Recorder (CVR)

The aircraft was equipped with a 93-A100-83 CVR. The recorded information has not been analysed.

1.12 Incident site

The incident occurred in the airspace above Hudiksvall, about 4,600 m above sea level.

1.13 Medical information

Nothing indicates that the mental or physical condition of the crew had been impaired before or during the flight.

1.14 Fire

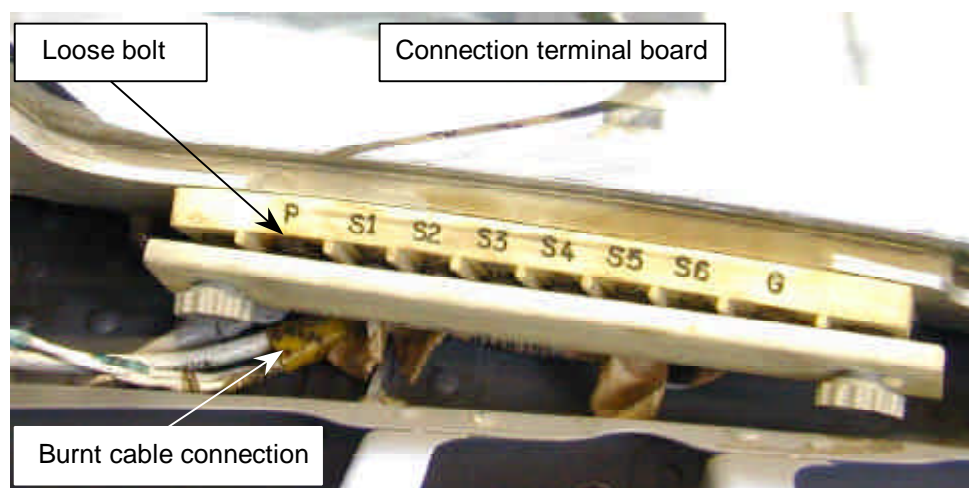
There was no fire however electrical arcing did occur (see section 1.16).

1.15 Survival aspects

During the flight the commander donned his oxygen mask when he felt a sticking sensation in his throat. The co-pilot felt no irritation from the smoke and refrained from donning his mask. Both pilots experienced difficulty in communicating both with each other and on the radio with the masks on. The commander took off his mask during these occasions.

1.16 Tests and research

Company personnel carried out an inspection of the aircraft after the incident, which revealed a loose bolt on the terminal board for the right windshield heating system. The purpose of the bolt is to fasten one of two cable shoes that are connected to the electrical cables (W110-2834-8) that supply electrical power to the windshield heating element. Carbonization and heat damage to the cable insulation and the connection terminal board indicated that overheating had taken place.



1.17 Organisational and management information

1.17.1 General

IBA International Business Air AB has its head office in Karlshamn, Sweden, however operates from the Stockholm/Bromma airport. The company has an AOC³ in compliance with JAR-OPS⁴ 1. The company operates both scheduled and unscheduled traffic utilizing the Embraer EMB-120 and Fairchild Swearingen SA-227-AC.

1.17.2 Emergency Checklist

The aircraft is equipped with a Quick Reference Handbook (QRH) containing the procedures to be followed in an emergency situation. It outlines the necessary actions to be taken in the “Cabin Fire and Smoke” and “Smoke Evacuation” checklists. It also outlines the steps to be taken in the event the pilot suspects the fire/smoke is coming from a known source, for example the air conditioning system or the electrical system.

The first checklist items to be followed when fire or smoke is suspected on-board is for the pilots to don their oxygen masks and select 100% undiluted oxygen, shut off the air-condition system and to establish communication with the other crew members.

In this case the crew only followed the procedure outlined for “Smoke Evacuation”.

1.17.3 The Company’s reporting system

The company’s Flight Operations Manual (FOM) states that a report shall always be written when an incident has taken place. It shall then be submitted to the flight operations department who will forward the original to the SCAA. The company shall always keep a copy of the report on file.

An incident report reached the SCAA on February 27, 2001 and was later forwarded to SHK on March 01, 2001.

³ AOC – Air Operator Certificate

⁴ JAR-OPS - Joint Aviation Requirements-Operations

1.18 Additional information

1.18.1 SHK's investigation

The event was initially treated as a minor incident. A report was not submitted to the SCAA Aviation Safety Department until February 27th and SHK was informed after an additional two days had past. As a result a representative from SHK did not monitor actions taken by company personnel to inspect the aircraft after the incident. SHK has however complete confidence in the on-site trouble-shooting made by the company and also the report later submitted regarding this work and the observation that were done.

1.18.2 Serious incidents

The ICAO Conventions "Annex 13, Attachment D" outlines what shall be considered a serious incident. Among other things events such as smoke and fire in the cabin or circumstances that necessitate the use of emergency oxygen equipment by the crew are listed.

According to Chapter 5, paragraph 8, of the Swedish Civil Aviation Act (1957:297), it is the responsibility of the commander to report all incidents and accidents that occur while operating an aircraft. If the commander is unable to perform this duty it then becomes the responsibility of the aircraft operator or owner.

Section 20 of the Ordinance on the Investigation of Accidents (1990:717) states that all reporting shall be made immediately to the SCAA.

1.18.3 ARCC's reporting system

When the pilots had declared an emergency with ATC this information was relayed to the Air Rescue Co-ordination Center (ARCC). In ARCC's procedural handbook the presence of a burning smell or smoke on-board were not classified as a serious incident. The incident was therefore not treated in accordance with established procedure. Since the incident changes have been made to these procedures.

1.18.4 Oxygen masks

Modern aircraft with a pressurized cabin are equipped with an oxygen system and oxygen masks to be used by the pilots in the event of a pressure loss in the cabin or if the cabin air should for some reason be contaminated. There are a wide variety of oxygen systems and masks available on the market. In some systems the mask and smoke goggles are two separate items while other systems incorporate a full unit, or so-called full-face mask. Oxygen masks are normally equipped with a microphone to allow communication with the mask donned.

Experience has shown that it can be difficult for a pilot to quickly put on the mask and goggles and get them to function properly, especially if the pilot is wearing glasses and using a headset. The ease with which a mask can be donned varies according to its design. It is a well-known fact that pilots can experience difficulty in communicating both with each other and over the radio with ATC with the masks on.

1.18.5 Crew Resource Management

During the flight the commander informed the passengers that they had a technical problem that required them to return to Sundsvall, where after the cabin attendant was informed of the time remaining to landing. However she was not informed of the fact that the pilots had declared an emergency. She

followed her normal routines prior to landing and afterwards helped to arrange hotel accommodation and to follow the passengers to the hotel. It was first a few days later when she received a detailed account of the incident from the commander. She felt that she could have been better prepared if the pilots had given her more information during the flight.

2 ANALYSIS

2.1 The flight

When a burning smell and/or smoke from an undisclosed source is experienced on-board during flight, it should always be treated as a serious incident. The commander's decision to discontinue the flight and declare an emergency was therefore correct. The subsequent actions taken by the pilots during the return to Sundsvall were performed according to the applicable sections of the emergency checklist and contributed to the smoke dissipating rather quickly. The pilots did however not perform the initial actions of donning their oxygen masks and informing the cabin attendant about the situation.

2.2 The burning smell on-board

As indicated in section 1.16 one of the bolts situated on the terminal board for the right windshield heat system was loose. The electrical cable and the terminal board in this area had suffered burn damage. This indicates that the loose connection had caused arcing, generating a heat build up and overheat the area, which in turn manifested itself in the form of a burning smell and smoke. As the electrical current in the heating element did not exceed normal values even with the system selected to maximum heating, the system circuit breaker did not trip. The arcing most probably ceased spontaneously.

The investigation has not been able to ascertain when the bolt became loose. It is possible that the bolt had been loose for quite a period of time, giving no noticeable indications of intermittent dis-connection or arcing.

2.3 Use of oxygen masks

Smoke or fire, along with other contaminants of the cabin air, can be poisonous and rapidly effect the crew's ability to function normally. It was therefore important for both pilots to immediately don their oxygen masks as a precautionary measure, as dictated in the emergency checklist. As oxygen masks are often used in connection with a serious problem on-board it is of the utmost importance that the pilots don their oxygen masks without delay and ensure that they function properly.

Through information obtained in similar incidents and by talking to experienced pilots SHK has been able to ascertain that it can be difficult to quickly and easily don both an oxygen mask and smoke goggles and get it functioning. The ability to communicate through the mask has been identified by those pilots and the actual pilots as being particularly difficult. This raises the need for the SCAA inspectors to be especially aware of the value of impressing on operators the need to install easy-to-use quick-donning type oxygen equipment on their pressurized aircraft. It is also equally important that companies initially train their personnel on the proper use of the equipment and then establish regular re-currency training on a regular basis so they can remain proficient in its use.

2.4 Crew Resource Management

Crew Resource Management (CRM) has with time been identified as a subject very important to the initial and even re-current training of aircrew. The need for good co-operation between crewmembers when a serious problem arises on-board is of particular importance. It is paramount that all crewmembers be informed of the real situation on-board so that the necessary steps can be taken.

In this case the cabin attendant had received only limited information as to the reason for the return to Sundsvall. She was also unaware that the flight had declared an emergency to ATC. As a result, she felt she had not been able to participate properly in the events that took place and amongst other things was left unable to prepare for any further emergency procedures, should they have arisen, or to answer any questions the passengers may have had.

2.5 Written reports after events

An accident or serious incident shall, as outlined in section 1.18.2, always be reported immediately to the SCAA. This responsibility is of course depending on the individuals concerned being able to correctly identify what an aircraft accident or incident is.

For the most part the person responsible for reporting has no difficulty in identifying what can be classified as being an aircraft accident. It is however SHK's experience that the responsible parties involved can very often make the mistake of incorrectly classifying a serious incident as being minor, such as in the case of the negative side effects of contaminated cabin air or aircraft excursions from the runway surface. Attachment D of Annex 13 of the ICAO Convention contains a list of events that can be classified as being serious incidents.

This unawareness by personnel for the need to promptly file a report has resulted in a number of cases where it has arrived far late to the SCAA and SHK. This has in turn resulted in situations where companies have taken action to rectify a problem without SHK being present to observe and participate, as was seen in this incident. This premature corrective action as seen in both this case and in several previous ones, has thus far not been an obstruction to the outcome of the investigation. It is nevertheless in all circumstances incorrect procedure and not in accordance with current regulations. In some cases however it has resulted in important information being lost or erased.

It is therefore SHK's conclusion that it is of the utmost importance that companies, pilots and other involved personnel be made much more aware of the situations where it becomes their responsibility to file the necessary reports.

3 CONCLUSIONS

3.1 Findings

- a) The pilots were qualified to perform the flight.
- b) The aircraft had a valid Certificate of Airworthiness.
- c) A bolt on the terminal board for the heating element for the right windshield was loose.
- d) A loose contact and arcing caused overheating in the area.

e) Oxygen masks were not used as prescribed in the emergency checklist.

3.2 Causes

The incident was caused by a loose contact and arcing across a loose bolt on a connection terminal board. This in turn caused overheating in the area and the smell of smoke on-board.

4 RECOMMENDATIONS

It is recommended that the SCAA:

- take the necessary action to ensure that aircraft with pressurised cabin used for commercial purposes are equipped with oxygen masks and smoke goggles that are both functional, easy-to-use and quick donning, and that pilots receive both initial and regular re-current training in their proper use, including the necessary hands-on training (*RL 2001:23e R1*)
- take the necessary action to ensure companies, their employees and other concerned parties are made more aware of the instances when it is their duty and responsibility to file reports to the SCAA (*RL 2001:23e R2.*)