Statens haverikommission
Swedish Accident Investigation Board

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Report RL 2009:19e

Incident involving aircraft HA-LPB over Kalmar county, Sweden on 2 March 2009

Case L-03/09

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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Statens haverikommission (SHK) Swedish Accident Investigation Board

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Swedish Accident Investigation Board

2009-12-15 L-03/09

The Swedish Transport Agency
SE-601 73 Norrköping, Sweden

Report RL 2009:19e

The Swedish Accident Investigation Board has investigated an incident that occurred on 2 March 2009 over Kalmar county, Sweden, to an aircraft registered HA-LPB.

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

The Swedish Accident Investigation Board will be grateful to receive, by 14 June 2010 at the latest, particulars of how the recommendations included in this report are being followed up.

Göran Rosvall Roland Karlsson

Stefan Christensen

Report RL 2009:19e

L-03/09
Report finalised 2009-12-15

Aircraft; registration and type	HA-LPB, Airbus A320-233
Class, airworthiness	Normal, valid Certificate of Airworthiness
Registered owner/Operator	Wizz Air Hungary Kft
Time of occurrence	2 March 2009, at approximately 21:30 hours, in darkness. Remark, all times are given in Swedish standard time (UTC + 1 hour)
Place	In airspace above Kalmar county
Type of flight	Commercial air transport
Weather at the departure airport	According to SMHI's analysis: Wind South to South-east, 5-10 knots, visibility 1-2.5 km, snowfall, vertical visibility 500-1000 feet, temperature/dew point 0/0°C, QNH 1006 hPa
Persons on board:	
crew members	6
passengers	79
Injuries to persons	None
Damage to the aircraft	None
Other damage	None
The commander	
Sex, age, licence	Male, 38 years ATPL
Total flying time	5,980 hours, of which 1,790 hours on type
Flying hours previous 90 days	168:15 hours, on type
Number of landings previous 90 days	92, on all types
Co-pilot:	
Sex, age, licence	Male, 31 years.CPL.
Total flying time	1,319 hours, of which 1,117 hours on type
Flying hours previous 90 days	172 hours, on type
Number of landings previous 90 days	94, on all types
Cabin crew members	1 male, 3 female

The Swedish Accident Investigation Board (SHK) was notified on 19 March 2009 that an aircraft with registration HA-LPB had an incident at 21:30 hours on 2 March 2009 over Kalmar County in Sweden.

The accident was investigated by SHK represented by Göran Rosvall, Chairperson, Stefan Christensen, Investigator in Charge and Roland Karlsson, Operational Investigator.

SHK was assisted by Björn Brink as a technical expert.

The investigation was followed by Niclas Svensson, Swedish Transport Agency.

Summary

The incident took place during a flight between Västerås, Sweden and Poznan, Poland. During cruise, over the southern part of the province of Småland, a strange smell arose on the flight deck. The flight crew thought that the unfamiliar odour could perhaps cause incapacity and decided as a preventative measure to use their oxygen masks from time to time for the duration of the remaining flight to their destination. Two of the cabin crew and one passenger were at the same time afflicted by slight breathing difficulty and felt irritation in their eyes. In order to alleviate the breathing difficulty, these people were supplied with oxygen from the portable oxygen bottles carried on the aircraft. An investigation showed that de-icing fluid had entered into and contaminated the aircraft air conditioning system during de-icing on the ground while the

aircraft was at Stockholm/Västerås airport. During the flight the fluid had evaporated and mixed with air supplied to the passenger cabin. The reason for the contamination of the air conditioning system was that the de-icing treatment had commenced before the aircraft had been prepared for de-icing and that the treatment had been applied without knowledge of the special requirements of this type of aircraft. SHK has found deficiencies in the education and training of the personnel who performed the de-icing service at the airport, along with deficiencies in the aircraft operator's training and checks on the supplier of this service at the airport.

Recommendation

It is recommended that the Transport Agency, in connection with operational checks of airports, confirms that there is an agreement between the purchaser and supplier of de-icing services in the case of operators who conduct their operations in accordance with EU-OPS 1. *(RL 2009:R1)*

1 FACTUAL INFORMATION

1.1 History of the incident

The flight was a scheduled flight from Västerås, Sweden, to Poznan in Poland. The aircraft, an Airbus A320-233 registered HA-LPB and with flight number Wizz Air W6524, was operated by Wizz Air Hungary Kft. Before the incident the aircraft had arrived at Stockholm/Västerås airport with passengers from Poznan. During its time on the ground at Stockholm/Västerås airport the aircraft was refuelled and de-iced, and in other respects prepared for the flight to Poznan.

There was heavy snowfall at the airport during the time the aircraft was on the ground and it was de-iced with hot water and successively treated with de-icing fluid in order to prevent re-freezing. The treatment began before the ground staff had received clearance from the flight crew that the aircraft was ready for de-icing. Fluid made its way into the APU system and the aircraft's air conditioning system. The flight crew noticed a strange odour on board and called for de-icing to stop. The aircraft doors were opened and the aircraft was ventilated, also with assistance from the air conditioning system, at a high temperature for about 20 minutes. The aircraft was then de-iced again and treated with de-icing fluid before take-off.

The flight to the destination was commenced and proceeded without any problems until over the southern part of Småland. The pilots then detected an unpleasant smell in the cockpit and assessed that there could be a risk of incapacitation before the source was located. They thus decided to take the preventive measure of temporarily using the oxygen masks connected to the permanent oxygen supply system in the aircraft. Two members of the cabin crew and one passenger were at the same time afflicted by slight breathing difficulty and felt irritation in their eyes. In order to alleviate the breathing difficulty, the cabin crew provided breathing assistance with oxygen from the portable oxygen bottles carried on the aircraft.

According to the Commander there was no increased flight safety risk due to the unpleasant odour, and no faults could be detected in the aircraft in general. The Commander did however consider landing at the nearest airfield, but decided that the time gained would be marginal compared with continuing to the destination. The flight then continued without further problems and landed at Poznan airport.

The incident occurred in darkness in the airspace above the southern part of Småland at cruising altitude.

1.2 Injuries to persons

	Crew members	Passengers	Others	Total
Fatal	–	–	–	–
Serious	–	–	–	–
Minor	–	–	–	–
None	6	79	–	85
Total	6	79	–	85

1.3 Damage to the aircraft

None.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 The commander

The commander, male, was 38 years old at the time and had a valid ATPL[1].

Flying hours			
previous	24 hours	90 days	Total
All types	8	168:15	5,980
This type	8	168:15	1,790

Number of landings this type previous 90 days: 92.
Flight training on type carried out on 01.10.04.
Latest PC (Proficiency Check) carried out on 19 July 2008 on A320.

1.5.2 Co-pilot

The co-pilot, male, was 31 years old at the time and had a valid CPL[2].

Flying hours			
previous	24 hours	90 days	Total
All types	8	172	1,319
This type	8	172	1,117

Number of landings this type previous 90 days: 94.
Flight training on type carried out on 05.02.07.
Latest OPC (Operator Proficiency Check) carried out in November 2008 on A320.

1.5.3 Cabin crew members

1 male and 3 females.

1.5.4 The crew members' duty schedule

It was the commander's second day in a duty period. The accumulated duty time in the previous 7 day period was 11:26 hours and the planned duty period on the day in question was 11:30 hours.

The co-pilot was on his third day of duty and had accumulated 20:54 hours of duty time in the previous 7 days. His planned duty period on the day in question was 10:30 hours.

The duty times for the pilots were within the prescribed limits.

[1] ATPL - Air Transport Pilot Licence
[2] CPL - Commercial Pilot Licence

1.6 The aircraft

The aircraft	HA-LPB
Manufacturer	Airbus Industrie
Type	A320-233
Serial number	1635
Year of manufacture	2001
Gross mass	Max. authorised take-off/landing mass 71,900/64,500 kg
Centre of mass	18.883/25.79%
Total flying time	2,046 hours
Number of cycles	13,527
Flying time since latest inspection	3,526 hours

Engines		
Manufacture	IAE	
Engine model	V2527E-A5	
Number of engines	2	
Engine	*No. 1*	*No. 2*
Total operating time, hrs		
	13,517	26,326
Operating time since overhaul	4,283	3,886
Cycles since overhaul	2,618	2,382

The aircraft had a valid Certificate of Airworthiness.

1.7 Meteorological information

Meteorological information according to SMHI[3] at 20:30 at Stockholm/ Västerås airport: Wind South to South-east, 5-10 knots, visibility 1-2.5 km, snowfall, vertical visibility 500-1000 feet, temperature/dew point 0/0°C, QNH 1006 hPa. It was dark at the time of the incident.

1.8 Aids to navigation

Not applicable

1.9 Communications

Not applicable

1.10 Aerodrome information

According to AIP[4]Sweden, the airport was a municipal licensed instrument aerodrome.

[3] SMHI– Swedish Meteorological and Hydrological Institute
[4] AIP – Aeronautical Information Publication

1.11 Flight recorders and voice recorders

Not applicable.

1.12 Incident site

1.12.1 Incident site

In airspace above Kalmar county, Sweden.

1.13 Medical information

During the flight the pilots noticed an unpleasant smell in the cockpit. As a preventative safety measure the pilots breathed oxygen from time to time through their oxygen masks connected to the permanent system in the aircraft for the later part of the flight. Otherwise nothing has been discovered to indicate that the psychological or physical condition of the pilots was degraded before or during the flight.

Two members of the cabin crew and one passenger experienced slight breathing difficulty and felt irritation in their eyes, and were provided with oxygen from the portable oxygen bottles carried on the aircraft for the later part of the flight.

1.14 Fire

Not applicable.

1.15 Survival aspects

Not applicable.

1.15.2 Actions by the rescue services

Not applicable.

1.16 Tests and research

1.16.1 De-icing of the aircraft on the ground

De-icing of aircraft and preventive treatments when risk of precipitation attaching to the aircraft is present, are usually handled by other contractors than the airline itself.

According to Appendix 2 of EU-OPS 1.175, an operator that engages another organisation than its own for any service must ensure that the subcontractor meets and maintains an agreed standard. This normally takes place by means of the airline operator examining the contractor's documentation and equipment to be used for the service, and by carrying out periodic audits[5] on the contractor.

[5] Audit – checking and reviewing to ensure that the contracted work is being carried out in accordance with determined procedures and aims.

1.16.2 Methods for de-icing aircraft on the ground

De-icing of aircraft on the ground, removing snow, ice and frost, is usually performed using hot water, or a heated mixture of water and de-icing fluid, called Type I de-icing. Anti-icing treatment is applied as necessary after de-icing with water or Type I fluid. Anti-icing fluid, which is gel-like, comes in three variants, Types II, – III and – IV, with generally similar characteristics. Anti-ice fluid creates a liquid film that prevents any precipitation from becoming attached to the aircraft. At a certain minimum speed during take-off, the anti-icing fluid together with any precipitation that may have collected on the aircraft after treatment, slips off from the surfaces that have been treated.

Airports normally have Type I for de-icing and one of either Type II, – III or – IV fluids for anti-ice treatment. Type II, – III or – IV fluids can differ from each other in terms of viscosity and adhesion to the aircraft.

The dilution by water of the anti-icing fluid is determined with the aid of special tables. The tables, Guidelines for the application of Type I, Type II, Type III and Type IV, were prepared by AEA[6] in co-operation with the manufacturers of anti-icing fluids. The guidelines have been harmonised in conjunction with, among others, SAE[7], ISO[8], IATA[9], ICAO[10] and various aviation authorities.

The tables include Hold Over Time, HOT, which is a guide to the time period during which protection is provided by the applied treatment with various types of mixture and the intensity of precipitation. The initial values in the tables that are used are external air temperature, type and concentration of the anti-icing fluid. The values in the tables are used as a basis for the commander's assessment before take-off of whether the aircraft is free from accumulations of snow, ice or frost. The assessment by the commander also includes other factors, such as any change in weather conditions after de-icing has been completed, and the inspection of certain characteristic surfaces on the aircraft.

1.16.3 AEA recommendations in respect of the training of personnel for de-icing aircraft

The AEA has issued recommendations, Recommendations for De Icing/Anti-Icing of Aircraft on the Ground, 23rd Edition September 2008, concerning the methods that should be included in the education and training of ground staff intending to perform de-icing services. This includes knowledge of different aircraft types and the use of standardised radio communications phraseology that should be used by de-icing staff, see the extract in Appendix 1. The recommendations also include drawings of the most common aircraft types, showing which areas on the aircraft that must be avoided during the application of fluid, i.e. No Spray Areas.

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[6] AEA - Association of European Airlines
[7] SAE – Society of Automotive Engineers
[8] ISO - International Organization for Standardization
[9] IATA - International Air Transport Association
[10] ICAO – International Civil Aviation Organization

1.16.4 *Personnel and training for the ground-based de-icing of aircraft at Stockholm/Västerås airport*

Västerås Flygplats AB provides ground-based de-icing of the aircraft that operate from the airport. It can be seen in documents from Västerås Flygplats AB that SHK has obtained, that standards and recommendations are applied that were prepared by AEA, ISO 11076, SAE ARP[11] 4737, with supplements for various operator standards and procedures.

Staff who performs de-icing of aircraft at the airport must have undergone special training. Västerås Flygplats AB is responsible for the education, training and checks on the personnel who are to perform on-ground de-icing of aircraft under the responsibility of the company. The scope of the training is shown in the certificate of competence, see Appendix 2, that is issued to staff who have completed the training and passed a written examination. The certificate of competence, which is valid for one year, can be renewed after a new training period and a new test. At the time of the incident 13 personnel had valid certificates of competence issued by Västerås Flygplats AB. The certificates of competence held by the de-icing personnel involved did not carry information concerning their training in aircraft knowledge and phraseology.

The staff, who had undergone training under the auspices of Västerås Flygplats AB, stated in interviews that they had received general training concerning which parts of aircraft should not be treated with de-icing or anti-icing fluid. The training had however not included any part concerning the differences between aircraft types that used the airport and that were offered de-icing by Västerås Flygplats AB. Nor had, according to the same staff, education and training in the recommended phraseology been provided.

1.16.5 *Equipment for the ground-based de-icing of aircraft at Stockholm/Västerås airport*

Västerås Flygplats AB has at its disposal for de-icing services a mobile de-icing unit of DIV 110 type, see Figure 1. The unit is operated by one person, who both drives the vehicle and manoeuvres a pivoted de-icing nozzle from a platform on the end of an arm that can be raised and lowered. The vehicle has three fluid tanks, for water, Type I and Type II fluid. The water and Type I tanks are equipped with immersion heaters. The de-icing fluid and water can be mixed in different proportions before the mixture is sprayed on to the aircraft. The mixing proportion is determined by the external air temperature, aircraft skin temperature, precipitation and the desired holdover time in accordance with the tables provided by the fluid manufacturer. The de-icing mixture is set by the operator of the vehicle in accordance with the order from the commander and the table values for the existing conditions.

The treatment is normally applied by one person, although there may be help provided by an authorised assistant on the ground. When two people perform the de-icing, the one on the ground handles the communication with the aircraft, while the other controls the vehicle and the de-icing equipment. In one-man operation the de-icing operator handles both the communication with the commander, before and after treatment, also manoeuvring the vehicle and the nozzles.

[11] SAE ARP – Society of Automotive Engineers Aerospace Recommended Practice

The de-icing staff are also responsible for checking that all snow, ice and frost are removed from the aircraft. After completing the de-icing and checking, the method, type of de-icing fluid and mixture proportions are reported to and approved by the commander. This communication normally takes place by the handover of a written message to the commander, through the cockpit window. The message may also be delivered by radio communication between the aircraft and de-icing vehicle operator or via the person assisting on the ground.

Figure 1. Type DIV 110 de-icing vehicle.

1.16.6 Ordering de-icing at Stockholm/Västerås airport

Ground de-icing of aircraft in scheduled or charter traffic at Stockholm/ Västerås airport normally takes place in accordance with an agreement between the particular airline and Västerås Flygplats AB.

The need for de-icing the aircraft is decided by the commander, who also orders the type of treatment that is to be applied. In certain cases de-icing may be initiated by flight technicians or other authorised staff, if the flight crew is not available on site. The order must normally be issued as a form that is provided by the airline and stored by Västerås Flygplats AB, Appendix 3. This form also serves as an instruction to the de-icing personnel, and is normally also available on board the aircraft. After de-icing has been completed, information is given to the commander on the time the de-icing started, which method and fluid were used, the status of the aircraft in respect of contamination after de-icing, and any other information relevant to the treatment.

De-icing of aircraft performed by Västerås Flygplats AB is periodically reported on a form that is stored at the airport.

1.16.7 De-icing services for Wizz Air that are carried out by Västerås Flygplats AB

According to a representative of Västerås Flygplats AB, at the time of the incident there was no agreement between Wizz Air and Västerås Flygplats AB concerning the purchase of de-icing services, and that Wizz Air had been repeatedly reminded that such an agreement had not been reached. Västerås Flygplats AB also stated that Wizz Air did not carry out any quality audit of the de-icing services.

After the incident, Västerås Flygplats AB performed an internal audit of the de-icing services at the airport in accordance with a checklist, the Station Inspection Checklist, prepared by the AEA. The checklist mainly focuses on the technical and organisational aspects of the services. The audit did not reveal any deviations.

1.16.8 Wizz Air's instructions to flight crews in respect of de-icing Airbus types A318, A319, A320 and A321 on the ground

The airline's Flight Crew Operating Manual, FCOM, for the Airbus A320 states that it is the responsibility of the commander to decide whether de-icing should take place and that communication must be established with the ground staff before the procedure begins. The procedure for ground-based de-icing of aircraft, which is described in the FCOM and in the pilots' checklists, is with the intention of preparing the aircraft for de-icing using fluid. The final item in the flight crew checklist for de-icing on the ground states: "Aircraft Prepared for Spraying – Inform Ground Crew.", i.e. the ground staff must be informed when the aircraft has been prepared for de-icing.

Some of the tasks that must be performed before de-icing are that the air systems for the APU and the engines must be closed, along with the air conditioning system. In addition, the ditching pushbutton must be placed in the ON position, which results in the closure of certain valves in the cabin. These measures are intended to prevent de-icing fluid from making its way into the air conditioning system and the cabin.

1.16.9 The order for de-icing prior to the incident

The aircraft landed at Stockholm/Västerås airport after a flight from Poznan, and after ground stop was to fly back to Poznan. Heavy snow was falling at the airport and the runway was being cleared of snow during the wait on the ground. At the airport there were two people on ramp duty with authorisation to perform aircraft de-icing.

Due to the heavy snowfall one of these people was engaged in clearing the runway, while the other person was manning the de-icing vehicle. Before de-icing of the Airbus aircraft commenced, the de-icing vehicle operator requested by radio that someone at the airport should come out with the form to be used by the aircraft commander to order de-icing. The relevant form could not be found however at the airport and the de-icing vehicle operator decided to obtain the order for de-icing personally from the commander on board the aircraft.

The de-icing vehicle operator received an order from the commander that a two step de-icing of the wings and tailplane should be performed, i.e. using both Types I and II. The verbal communication between the operator and the aircraft commander took place in English. The de-icing operator stated to SHK that the conversation on board concluded with the question: "Are you ready for de-icing?" The commander stated that this question was answered by the order: "Be ready for de-icing." The de-icing operator stated that he understood the commander's reply to be: "Ready for de-icing."

1.16.10 De-icing of the aircraft

This was the first de-icing of an Airbus A320 that this particular de-icing operator had on his own been responsible for. He had previous experience of de-icing of Boeing 737 and other types, but had not received any particular training on the Airbus A320 in respect of areas that should not be sprayed with de-icing fluid.

The AEA drawings show differences between the Boeing 737 and Airbus A320 in respect of areas that must be avoided during spraying. These drawings were not available in the de-icing vehicle.

The de-icing operator commenced de-icing of the aircraft when the loading hatches and the rear door were closed and the rear steps had been removed. He noted at the same time that the front door was closed but not locked, and that the external stairs were still at the aircraft. It is normally the task of the loading staff to remove the stairs once the loading and passenger boarding had been completed. The intention of the de-icing operator was to first de-ice the right side of the aircraft and then continue with the left, once the front stairs had been moved away from the aircraft. He was also ready to move the stairs himself if there was no-one else available to do it. The operator admitted that there was a certain amount of stress during the work, to get the aircraft ready for departure and make room for incoming aircraft. The stress level was however no greater than usual in the case of traffic situations handled by Västerås Flygplats AB.

De-icing began on the right side of the aircraft when passengers had boarded. Since the external air temperature was around zero degrees, de-icing with hot water took place on small areas, one at a time, which were thereafter sprayed with Type II fluid to prevent re-freezing. When the flight crew detected the smell of de-icing fluid in the cockpit, de-icing had already commenced. The commander then asked for de-icing to stop immediately, since it was suspected that de-icing fluid had forced its way into the APU's[12] air system and beyond, into the aircraft air conditioning system. In order to ventilate the fumes from the de-icing fluid out from the cabin and the aircraft systems, all the aircraft doors were opened. At the same time the air conditioning system was set to provide forced ventilation at a high temperature, and fed with air from the APU system for about 20 minutes. After this there was no abnormal odour in the cabin. The aircraft doors were closed and renewed de-icing and anti-icing treatment was applied.

In correspondence after the incident with a representative of Västerås Flygplats AB, the airline stated that similar events had happened previously when the airline's aircraft were being de-iced at Stockholm/Västerås airport. The airline also asked Västerås Flygplats AB to inform its staff about the importance of using the Wizz Air procedures, which were given in the company's Ground Handling Manual, and of following up the knowledge and understanding of the staff when these procedures were being applied.

The affected staff of Västerås Flygplats AB, with whom SHK talked, reported that they had afterwards received a notification from their employer with a reminder to meticulously follow the rules and procedures in connection with de-icing.

[12] APU – Integrated Air conditioning and Power Unit

1.16.11 The flight

The take off and the first part of the flight to Poznan proceeded normally. While flying at cruising altitude, with the aircraft assessed as being over the southern part of Småland, the flight crew however noticed a disturbing smell from the air conditioning system and decided as a preventive measure to use their oxygen masks. This is normal practice in accordance with the aircraft checklist, to avoid incapacitation, if a strange odour arises in the aircraft. At about the same time, two members of the cabin crew and one passenger were afflicted by slight breathing difficulty and felt irritation in their eyes. The cabin crew offered the passenger oxygen, and the two crew members with breathing difficulties also breathed oxygen during the later part of the flight. The commander did not consider that there was any danger to flight safety, and therefore decided to continue the flight as planned. The commander also decided that the flight time to a suitable alternative airport would be about as long as to get to their destination. The remainder of the flight and landing took place with no problems.

1.16.12 Health risks deriving from the inhalation of glycol-water evaporation fumes

Monopropylene glycol was used to de-ice the aircraft. According to the Swedish Arbetsmiljöverket (Working Environment Agency) this glycol is only mildly toxic and hygienic limit values for the working environment have not been established. Nor are there indications that inhaling the fumes has any harmful effect on humans. If the liquid enters the eyes, however, they can sting.

1.17 Organisational and management information

Wizz Air is a Hungarian airline that was established in September 2003 and started operations on 19 May 2004. The principal owner is an American investment company. Wizz Air, which altogether has 10 bases in Poland, Hungary and Bulgaria, had at the time of the incident about 800 employees and served about 130 different routes. The company was expanding rapidly and transported in 2008 about 5.9 million passengers. In the spring of 2009 Wizz Air had about twenty Airbus A320 aircraft in service and had ordered several new aircraft, also having signed several purchase options for Airbus aircraft.

1.18 Other aspects

1.18.1 Equal opportunities aspects

This event has also been examined from the point of view of equal opportunities, i.e. against the background that there are circumstances to indicate that the actual event or its effects were caused by or influenced by the women and men concerned not having the same possibilities, rights or obligations in various respects. Such circumstances were however not found.

1.18.2 Environmental aspects

No harmful environmental influences resulted from the incident.

2 ANALYSIS

2.1 Smell and fumes on board

The occurrence of an odour and fumes on board the aircraft while in flight indicates that some de-icing fluid remained in the aircraft's air conditioning system after the crew had taken measures on the ground to ventilate the aircraft. One possible reason could be that the ventilation was carried out only with the air conditioning system set for maximum heating and not in addition with maximum cooling of the cabin air. In the external air temperature conditions that were present, it is however uncertain whether, without technical measures being taken on the aircraft, it would have been possible to make the air conditioning operate in its full cooling mode. SHK therefore considers that the flight crew took reasonable action to ventilate the aircraft.

It is the opinion of SHK that no health risks arose due to the incident.

2.2 De-icing of the aircraft

The message to the de-icing operator from the commander to be ready to commence de-icing was understood by the operator to mean that the aircraft was ready for de-icing. Part of the reason for this could be that the communication between the commander and the operator on board the aircraft took place in unfavourable circumstances. The aircraft APU and air conditioning system were operating, at the same time as other work was in progress on board. Among other things the flight crew were engaged in programming the aircraft computer system and making other preparations for the flight. At the same time, in the passenger cabin the catering supplies were being stowed, immediately adjacent to the cockpit. The surrounding noise environment and the other work in progress by the personnel probably contributed to the decision on de-icing being misinterpreted by the operator, and that there was no confirmation of the decision.

The de-icing staff were familiar with the fact that de-icing could be performed either with one person, or with assistance from a colleague on the ground. The fact that the de-icing procedure was in this case performed by one person was, in the opinion of SHK, not a contributory factor to the incident.

Nor does SHK consider that the verbal order for de-icing, instead of using a written message on the air operator's form, affected the development of the incident.

SHK assesses that the stress level of the airport personnel was naturally heightened to some extent by the de-icing, but that this had only a minor effect on the events that took place.

2.3 Education and training of the de-icing personnel

SHK considers that the certificate of competence that was issued to staff who had been approved to perform de-icing services did not contain information concerning the education and training in aircraft knowledge and standard phraseology. Västerås Flygplats AB claimed to provide de-icing services in accordance with the AEA Recommendations, which state that these subjects must be dealt with in the training.

2.3.1 *Aircraft knowledge*

This particular case was the first time the de-icing operator had performed de-icing of an Airbus A320 on his own. He had otherwise experience of treating the Boeing 737, and certain other types of aircraft. According to the AEA drawings showing areas that should be avoided when applying de-icing fluid, there are differences between the Airbus A320 and Boeing 737. SHK considers that Västerås Flygplats AB's education and training of operators was deficient in this respect and contributed to the incident.

2.3.2 *Standard phraseology*

The use of standardised phraseology and the principle of read-back and confirmation of information are cornerstones of flight safety. In this particular incident read-back of the order did not take place, which was a contributory factor to the subsequent events.

According to the view of SHK, Västerås Flygplats AB's education and training in the use of standard phraseology showed deficiencies when such standard phrases should be used for communication between flight and ground personnel.

2.4 Agreement in respect of de-icing services

A representative of Västerås Flygplats AB stated that there was no agreement between the airport and Wizz Air in respect of de-icing services at the time of the incident, and that this had been repeatedly pointed out to Wizz Air. Detailed instructions for de-icing in accordance with the Ground Handling Manual had however been provided by the airline. Absence of an agreement can not be considered as having any direct effect on the incident that occurred.

A drawn up agreement however always has to form the basis for the services negotiated by an air operator, so the incident that has occurred should encourage the airline to review its procedures within this area.

2.5 Wizz Air checks on Västerås Flygplats AB as a supplier of de-icing services

According to the EU-OPS regulations, an air operator may engage subcontractors to perform certain services, if an agreement is signed between them. In such cases the air operator is responsible for determining the standards and procedures for the services, and for checking that these are continuously maintained, which normally done by means of audits. Among other things, EU-OPS says that air operators must be assured that the suppliers meet the requirements in respect of de-icing methods, special aircraft procedures and checks on the procedures for communication.

In the opinion of SHK this places extensive demands on both air operators and subcontractors, and may require relatively large resources, particularly for air operators who are at the same time undergoing rapid expansion. There are similar conditions in other countries such as the USA, and have been highlighted by the American aviation authority, the FAA[13] at seminars in 2008 for suppliers of ground-based aircraft de-icing.

[13] FAA - Federal Aviation Administration

However, this does not diminish the responsibility of Wizz Air for its deficiencies in establishing an agreement beforehand with Västerås Flygplats AB concerning the purchase of ground-based de-icing services. SHK also considers that Wizz Air failed to check Västerås Flygplats AB's knowledge and understanding of the Wizz Air standards and procedures on respect of de-icing services.

3 CONCLUSIONS

3.1 Findings

a) The pilots were qualified to perform the flight.
b) The aircraft had a valid Certificate of Airworthiness.
c) The de-icing staff were authorised to perform de-icing of aircraft under the responsibility of Västerås Flygplats AB.
d) No agreement existed between Västerås Flygplats AB and Wizz Air in respect of the purchase of ground-based de-icing services.
e) Wizz Air had not performed any audit of the de-icing services provided by Västerås Flygplats AB.
f) The training plan of Västerås Flygplats AB for de-icing personnel did not include an item concerning aircraft knowledge.
g) The training plan of Västerås Flygplats AB for de-icing personnel did not include an item concerning standard phraseology for use when de-icing aircraft.
h) The order for de-icing was not carried out in accordance with the normal procedure determined by Wizz Air and Västerås Flygplats AB.
i) The instruction by the commander concerning commencement of de-icing was misconstrued by the de-icing personnel.

3.2 Causes of the incident

The cause of the incident was a deficiency in the use of standard phraseology in the communication between the ground staff and the commander. Contributory were deficiencies in the airline's follow-up and checking - by means of an agreement and audits – of the negotiated service's quality and implementation.

4 RECOMMENDATION

It is recommended that the Transport Agency, in connection with operational checks of airports, confirms that there is an agreement between the purchaser and supplier of de-icing services in the case of operators who conduct their operations in accordance with EU-OPS 1. *(RL 2009:R1)*

Appendix 1.

3.3.23 snow:
Precipitation of ice crystals, most of which are branched, star-shaped or mixed with unbranched crystals. At temperatures higher than -5°C (23°F), the crystals are generally agglomerated into snowflakes.

3.3.24 snow grains:
Precipitation of very small white and opaque particles of ice that are fairly flat or elongated with a diameter of less than 1 mm (0.04 in.). When snow grains hit hard ground, they do not bounce or shatter.

NOTE: For holdover time purposes treat snow grains as snow.

3.3.25 snow pellets:
Precipitation of white, opaque particles of ice. The particles are round or sometimes conical; their diameter range from about 2-5 mm (0.08-0.2 in.). Snow pellets are brittle, easily crushed; they do bounce and may break on hard ground.

3.3.26 slush:
Snow or ice that has been reduced to a soft watery mixture.

3.4. Abbreviations

°C:	degrees Celsius
°F:	degrees Fahrenheit
AFM:	Airplane Flight Manual
APU:	Auxiliary Power Unit
FP:	freezing point
LOUT:	Lowest Operational Use Temperature
OAT:	Outside Air Temperature

3.5. General

The various local rules concerning aircraft cold weather operations are very specific and shall be strictly adhered to.
A pilot shall not take off in an aircraft that has:
frost, snow, slush or ice on any propeller, windshield or power plant installation or on airspeed, altimeter, rate of climb or flight altitude instrument systems;
snow, slush or ice on the wings or stabilisers or control surfaces, in gaps between the airframe and control surfaces, or in gaps between control surfaces and control tabs, or any frost on the upper surfaces of wings or stabilisers or control surfaces. For this reason a contamination check of the aircraft surfaces shall be performed prior to departure.

3.6. Staff training and qualification

De-icing/anti-icing procedures must be carried out exclusively by personnel trained and qualified on this subject.
Companies providing de-icing/anti-icing services should have both a Qualification Programme and a Quality Assurance Programme to monitor and maintain an acceptable level of competence.

3.6.1 Training for crews
Both initial and annual recurrent training for flight crews and ground crews shall be conducted to ensure that all such crews obtain and retain a thorough knowledge of aircraft de-icing/anti-icing policies and procedures, including new procedures and lessons learned.
Training success shall be proven by an examination/assessment which shall cover all training subjects laid down in 3.6.2.
The theoretical examination shall be in accordance with EASA Part 66 / JAR-66 or any equivalent requirements. The pass mark shall be 75% and only persons passing this examination can be qualified.
For personnel performing the actual de-icing/anti-icing treatment on aircraft, practical training with the de-icing/anti-icing equipment shall be included.

3.6.2 Training subjects shall include but are not limited to the following (when applicable):
a) Effects of frost, ice, snow, slush and fluids on aircraft performance.

b) Basic characteristics of aircraft de-icing/anti-icing fluids, including causes and consequences of fluid degradation and residues.
c) General techniques for removing deposits of frost, ice, slush, and snow from aircraft surfaces and for anti-icing.
d) De-icing/anti-icing procedures in general and specific measures to be performed on different aircraft types.
e) Types of checks required.
f) De-icing/anti-icing equipment and facilities operating procedures including actual operation.
g) Safety precautions.
h) Emergency procedures.
i) Fluid application and limitations of holdover time tables.
j) De-icing/anti-icing codes and communication procedures.
k) Special provisions and procedures for contract de-icing/anti-icing (if applicable).
l) Environmental considerations, e.g. where to de-ice, spill reporting, hazardous waste control.
m) New procedures and development, lessons learned from previous winters.
n) Conditions which can lead to the formation of ice on the aircraft.

NOTE: Refer to the AEA document "Training Recommendations and Background Information for De-Icing / Anti-Icing of Aircraft on the Ground" for more detailed information about training subjects.

3.6.3 Records
Records of personnel training and qualifications shall be maintained for proof of qualification.

3.7. Fluid handling

De-icing/anti-icing fluid is a chemical product with environmental impact. During fluid handling, avoid any unnecessary spillage and comply with local environmental and health laws and the manufacturer's safety data sheet.
Different products shall not be mixed without additional qualification testing.

3.7.1 Storage

3.7.1.1 Tanks dedicated to the storage of de-icing/anti-icing fluids shall be used.

3.7.1.2 Storage tanks shall be of a material of construction compatible with the de-icing/anti-icing fluid, as specified by the fluid manufacturer (corrosion resistant steel, plastic, etc). Care should be taken to avoid using dissimilar metals in contact with each other, as galvanic couples may form and degrade thickened fluids.

3.7.1.3 Tanks shall be conspicuously labelled to avoid contamination.

3.7.1.4 Tanks shall be inspected annually for corrosion and/or contamination. If corrosion or contamination is evident, tanks shall be maintained to standard or replaced. To prevent corrosion at the liquid/vapour interface and in the vapour space, a high liquid level in the tanks is recommended.

NOTE: If the quality of the fluids is checked in accordance with paragraph 6.3.4, the inspection interval may be longer than one year.

3.7.1.5 The storage temperature limits shall comply with the manufacturer's guidelines.

3.7.1.6 The stored fluid shall be checked routinely to ensure that no degradation/contamination has occurred.

3.7.2 Pumping
De-icing/anti-icing fluids can show degradation caused by excessive mechanical shearing.
Therefore only compatible pumps and spraying nozzles shall be used. The design of the pumping systems shall be in accordance with the fluid manufacturer's recommendations.

3.7.3 Transfer lines

3.7.3.1 Dedicated transfer lines shall be conspicuously labelled to prevent contamination and shall be compatible with the de-icing/anti-icing fluids to be transferred.

Appendix 2.

8. Kompetensbevis för avisning av flygplan. Västerås flygplats.

STOCKHOLM/VÄSTERÅS

KOMPETENSBEVIS FÖR AVISNING AV FLYGPLAN

Kompetensbevis för **Avisning av flygplan** har utfärdats för nedanstående personer efter godkänd och genomgången utbildning. De är behöriga att hantera och framföra fordon och tekniska hjälpmedel samt hantera avisningsvätskor enligt BCL-F3 5 AEA, AMS 1424, AMS 1428 samt ISO 11075 -78.

Utbildningen har omfattat:
Aerodynamik
Meteorologi
Snö, is och frostbeläggningar. Inverkan på flygplan
Definitioner
Avisningsvätskor och avisningskoder
Holdovertime och tabeller
De-/anti-icingmetoder
Skydds-och säkerhetsföreskrifter
Kvalitets- och leveranskontroll av avisarvätskorna
Ansvarsförhållanden
De-icing release
Arbetsmiljön gentemot omvärlden

Personerna är anställda i **Västerås Flygplats AB** och arbetar på **Västerås Flygplats**.

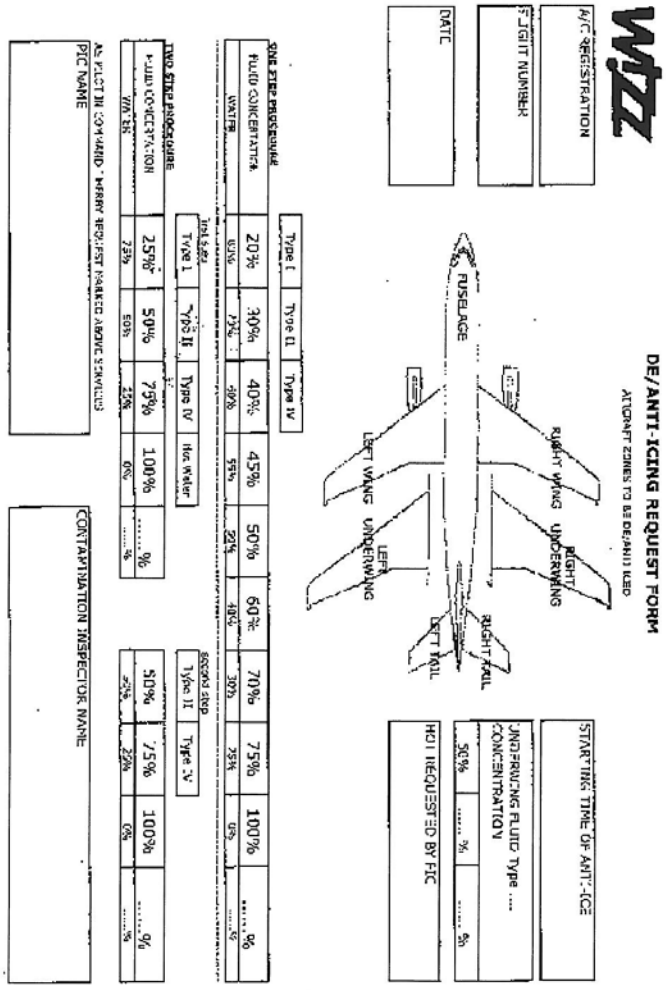
NAMN:

Beviset skall förnyas senast 09-11-05.

Västeras 08-11-05

Appendix 3.

14. Wizz Air Deicing/Anti-icing request form.



DE/ANTI-ICING REQUEST FORM

A/C REGISTRATION

FLIGHT NUMBER

DATE

AIRCRAFT ZONES TO BE DE/ANTI-ICED

FUSELAGE

RIGHT WING

RIGHT UNDERWING

RIGHT TAIL

LEFT WING

LEFT UNDERWING

LEFT TAIL

STARTING TIME OF ANTI-ICE

UNDERWING FLUID Type .... CONCENTRATION

50% ..... % ..... %

HOT WATER REQUESTED BY PIC

ONE STEP PROCEDURE

FLUID CONCENTRATION	Type I	Type II	Type IV
WATER	20%	30%	40%
	80%	70%	60%

TWO STEP PROCEDURE

FLUID CONCENTRATION	Type I	Type II	Type IV	Hot Water
WATER	25%*	50%	75%	100%
	75%	50%	25%	0%

FLUID CONCENTRATION	Type I	Type II	Type IV
WATER	45%	50%	60%
	55%	50%	40%

FLUID CONCENTRATION	Type I	Type II	Type IV
WATER	70%	75%	100%
	30%	25%	0%

FLUID CONCENTRATION	Type I	Type II	Type IV
WATER	50%	75%	100%
	50%	25%	0%

AS PILOT IN COMMAND - HEREBY REQUEST MARKED ABOVE SERVICES

PIC NAME

CONTAMINATION INSPECTOR NAME