



F I N L A N D

## Investigation report

C 13/1999 L

Translation of the original report in Finnish

### Parachuting accident at Hanko airfield on 29.6.1999

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## APPENDICES RELATED TO THE ACCIDENT

Other investigation material is stored at the Accident Investigation Board, Finland.

## SYNOPSIS

On Tuesday, 29.6.1999 at 11.25 a.m. a parachuting accident took place at the Hanko airfield. A 30-year-old Swedish skydiver was seriously injured as a result of a steep turn at low altitude ("hook turn"). The accident was reported by phone to senior investigator Esko Lähteenmäki at Accident Investigation Board (AIB) Finland. He requested senior constable Kirsi Kanth, an expert of the Finnish AIB, to start the investigation. She arrived at the accident site at 19.00.

Accident Investigation Board Finland set an official investigation by decision C 13/1999 L and ordered Kirsi Kanth to be the case investigator at her consent.

The case investigator heard the accident skydiver on 6.7.1999 and the on-site witnesses during the day of the accident (29.6.1999) and on 2.7.1999. The investigation was concluded on 13.4.2000.

## **1 FACTUAL INFORMATION**

### **1.1 The accident skydive**

Skydivers were having a training camp during the Midsummer holidays on 29.6.1999 at the Hanko airfield, hosted by Suomen Laskuvarjokerho ry. (later called SLK). The accident occurred on the sixth lift of the day at 11.25 local time. The jump load consisted of 24 skydivers. Two of them exited at an altitude of 1100 m, one at 3000 m and the remaining 21 at 4000 m on two separate jump runs. The accident skydiver was a member of a 4-way FS -group which was to exit last on the second jump run.

The accident skydiver is a Swedish citizen. She participated in the skydiving camp together with her partner she lived with. They lodged in a tent at the airfield. She had skydived actively before the accident, total 18 jumps during the camp. All of the them were formation skydiving. The accident skydive was her second that day.

The jump run was from north to south, in line with the runway about 400 meters east of it. The exit occurred approximately 1000 m upwind of the landing area. The exit point was at the maximum distance from the landing area taking the wind conditions into account.

The freefall part of the jump was quite normal. The jumpers broke off at an altitude of about 1200 m, and tracked apart towards their own sectors.

The tracking direction of the accident skydiver was away from the dropzone. According to her, after she stopped tracking, she deployed her canopy at about 850-900 meters altitude. The canopy inflated normally. She immediately began to steer towards the landing area, located east of the runway approximately 300 meters from its southern end.

She checked the altitude at her wrist-mounted altimeter. She hadn't even considered of an optional landing place, being sure she could reach the primary one. She reached the airfield area at the level of the southern end of the runway. She told that she made the last altitude check when she was already above the airfield. The altimeter read approximately 100 meters.

The accident skydiver made a steep, nearly 180° turn, above the southern threshold of the runway, on its west side, at an altitude of 10-20 m and collided with the ground about 13 meters from the runway in grass area. She hit the ground feet forward, her body tilted about 45° forward.

The accident was noticed by people both at the loading area and the club area that is located very close to the landing area. The emergency operations were initiated immediately. Several persons arrived at the accident place quickly and they discovered that the skydiver was unconscious and that she had an open bone fracture at the ankle.

One of the first people to arrive was a professional ambulance driver. She was responsible for the first aid before the arrival of the ambulance.

The ambulance with a health care center doctor arrived at the place in about 10 minutes. After the first aid was given, the patient was transferred to Tammisaari regional hospital, and, during the same day, to Töölö Hospital in Helsinki.

The three other skydivers of the same group managed to land on the primary landing area.

## **1.2 Injuries**

The left shinbone and left fibula were broken above the ankle (open fracture). The left heel bone (calcaneus) was fractured and the left instep (metatarsus) was dislocated. The ankle bones of the right leg were fractured. The spinal vertebrae L2-L4 were fractured. All the injuries required surgical procedures.

## **1.3 Damages to the parachuting rig**

The container - harness combination (rig) was slightly damaged. The vertical stitching on the right side of the main container was torn apart from its mid part at a length of 3 cm. The stitching of the right leg strap cover was torn apart from the harness at its upper end. The right side of the rig was stained with chlorophyll.

## **1.4 Other damages**

The integral helmet of the accident skydiver was damaged. It had got some minor fissures in painting already some time earlier during air cargo transfer. Post accidental investigation of the helmet revealed plenty of clefts, mostly around the facial area. The jumpsuit, as well as the weight vest, underwear and shoe strings had to be cut off during the first aid operations.

## **1.5 Personnel**

### **Accident skydiver:**

Female, 30 yrs.

Weight 56 kg.

Swedish citizen

Parachuting training: first jump course in September 1997, Kiruna Fallskärmklubb.

Qualifications: C-license (certified skydiver) March 1997 Kiruna Fallskärmklubb, D-license (over 250 jumps), International Parachutist Certificate / FAI, certified by Swedish Parachute Association 13.04.1999.

Experience: the accident jump was her 412<sup>th</sup>.

## **1.6 Parachuting equipment**

### **Main canopy:**

The main was a commonly approved square parachute for sport parachuting. According to the rig log, it was last inspected on Feb 10, 1999.

- a) Opening system: collapsible pilot chute / BOC
- b) Deceleration system: p.o.d, slider.
- c) Type of the main: Sabre, serial number LS150-00666, manufactured in February 1991 by Performance Design. Canopy area 150 sq.ft.

### **Reserve:**

The reserve was a commonly approved square reserve for sport parachuting. It was last inspected on 10.12.1999 and packed on 19.06.1999. The Stevens reserve static line was attached to the left riser.

- a) Canopy type: Precision Micro Raven, serial number 00117151, manufactured in February 1991.
- b) Opening system: reserve handle, Stevens.

### **Harness:**

Type: Sun Path Javelin, model J-1, serial number 1616, manufactured in March 1991.

## **1.7 Other equipment**

General clothing of the skydiver was adequate. In addition to underwear she had a FS jumpsuit, integral helmet, wrist-mounted visual altimeter Bargo, audible altimeter Pro Dytter, weight vest 8 kg, gloves and sports shoes without ankle support.

## **1.8 Weather**

Dry weather with cloud cover, visibility over 10 km. Surface wind 210 degrees 7 m/s max. 9,5 m/s. Temperature approximately +25 degrees.

Many of the skydivers at the site that day reported heavy downward thermals at the airfield area.

## **1.9 Radio communication**

The radio traffic was normal during skydiving activity.

## **1.10 Drop zone**

The drop zone is located at Hanko airfield, meeting also the requirements for student training.

The direction of the runway is 029°/209°. It has an asphalt covering with a length of 1600 meters and width approximately 20 meters. There it a grassy clearing cut for the planned transversal runway at the eastern side of the runway. It is normally used as a student landing area.

The runway is surrounded by a soft, grassy zone, 30 m wide in west, 80 m wide in east. The grass was about 20 cm high. There are no fixed obstacles within the area.

At the southern end of the airfield, there is a shallow ditch, low bushes, farmland and a golf course. At the western side of the grassy southern end a shallow ditch borders the zone, besides, there are bushes 5 to 10 meters tall, farmland and the golf course. The loading and refueling area is located at the eastern side by the south end of the airfield and there are also warehouses and some pine forest.

The landing area for certified (licensed) skydivers is usually the grassy zone at the mid-section level of the runway, in front of the clubhouse of SLK. It is approximately 100 meters wide and 200 m in length. The borders of the area are formed by the runway, service road and the taxiway. The packing area is located between the landing area and the club house.

The wind sock is located at the southern end of the airfield, at the level of the road that leads to the airfield, east of the runway at 150 m distance from the landing area.

At the landing area there is a separate windsock a few meters tall, and at least that day there were two poles with colorful streamers showing the wind direction.

## **1.11 Aircraft**

The aircraft was a DHC6 Twin Otter (OH-SLK) owned by SLK. It is widely used for sky-diving.

## **1.12 Alarm and rescue operations**

An observer at the packing area immediately called the emergency centre and later guided the emergency teams to the site. He called the centre again after he had got more detailed information on the injuries.

One of the first skydivers to arrive at the site was a professional ambulance driver. She gave the patient first aid, guided others what to do and assisted the ambulance crew doctor. The ambulance arrived in about 10 minutes.

At first the unconscious skydiver was removed of her helmet, her breathing and pulse were checked and the harness was loosened. She was immobilized and kept calm before the arrival of the ambulance.

The operation at the accident site was well organized.

### **1.13 Investigations**

#### **1.13.1 Accident site**

The specific accident site could no more be located at the arrival of the investigator, because it had not been marked on the grassy ground, and there were not any tire tracks left. The accurate landing site was determined with help of the eyewitnesses.

#### **1.13.2 The wrist mounted visual altimeter**

The investigator checked all the gear the accident skydiver had used on the same day. At the inspection it was remarked that the visual altimeter, type Barigo, still read 75 meters. It was secured for further inspection. The skydiver had kept it on her right wrist.

The altimeter was inspected on 2.7.1999 in Helsinki in a low pressure chamber designed and built by master rigger Hannu Leskinen. The indications of the altimeter were checked against two other altimeters. The testing was performed by skydivers Timo Salminen and Kirsi Kanth. The protocol of the measuring is attached to this report. There were no abnormalities found when compared to the control altimeters.



## 2 ANALYSIS

### 2.1 The parachuting equipment

The parachuting equipment of the accident skydiver was adequate and appropriate. She owned all the equipment and was familiar with its performance capability.

The main was zero-porosity, widely used so-called fast canopy. The wing size was adequate considering the exit weight of the skydiver. The wing load was 1,1 which is within the limits recommended by the manufacturer. The main was last inspected in the spring of 1999 when the suspension lines were changed. Otherwise the main was in good condition. The skydiver had done over 300 jumps with this canopy so it can be concluded that she was very familiar with it. According to the eyewitnesses the main had been behaving normally before the steep turn which led to the accident. A normal feature of all fast canopies is that they lose altitude very rapidly in a fast turn. This feature is emphasized on fast, elliptical canopies. This is why low, steep turns, so called hook turns, are considered very dangerous. This is already told to the students attending to the first jump course. Manuals for fast canopies recommend every user to get acquainted with this feature with care and in safe altitude. There are no standards for any minimum safe altitude to start a turn. However, it is not considered safe to initiate a steep turn at an altitude below 50 m under any circumstances.

The visual wrist-mounted altimeter of the accident skydiver is manufactured for skydiving purposes and it is a commonly used mechanical coil spring altimeter. The calibration must be checked and reset (zeroed) before every skydive. Even at its best the altimeter indication is only guiding at low altitude, since the resolution of the display is 2 mm / 50 meters with 50 meters division lines. At the inspection done at the accident site, the indication was 75 meters so the altimeter was taken for further inspection. The skydiver had used the same altimeter on over a half of her jumps, and she never had noticed any false indications. There were no exceptional deviations observed when tested in a pressure chamber (protocol attached), but it is not possible to exclude a false altimeter from being one of the factors that lead to the accident. It is possible that the settings of the altimeter could have changed during the freefall part of the skydive as a result of a hard contact, but there was no evidence of that according to other skydivers of the group. The settings have most probably changed at the impact with the ground, since the device is normally very sensitive to even knocking.

The integral helmet with a visor looked new, despite of damages. The helmet had been damaged during a former air cargo transfer. It had several cracks in painting around the facial area. At the post-accident inspection, several cracks were observed around the facial area and chin part which was almost broken apart. The soft inner lining of the helmet was intact. The helmet, despite of the earlier minor damages, has undoubtedly protected the skydiver's head from additional significant injuries.

## **2.2 Effect of the weather**

In a hot weather the asphalt surface of the runway warms up causing turbulence on the sides.

Other skydivers, who had been skydiving that day told about heavy downward thermals at the landing area next to the runway, a typical feature of Hanko airfield. The partner of the accident skydiver who was landing on the primary landing area at the same time as the accident occurred, told he noticed the turbulence to cause him problems in staying on his feet after the flare. Another skydiver landing close to him at the same time had fallen down. The mean wind checked after the accident was 7 m/s with gusts of 9,5 m/s. This had a cumulating effect on the turbulence.

The sink rate of a parachute can increase remarkably in a heavy downward thermal. It is assumed that the skydiver was familiar with the conditions at the drop zone and the nearby terrain. She made her previous skydive a couple of hours before the accident. She had been skydiving at the drop zone 30 times a year ago and 18 times during the week before the accident. Turbulence is often reported at the landing area for certified skydivers. The landing area is bordered by the runway, which cumulating effect on the turbulence is obvious. The skydiver should have given thought to the effect of the runway on the possible turbulence and should have avoided flying near the runway at low altitude.

Eyewitnesses did not report any higher than normal sink rate during the approach of the accident skydiver. Sink rate is very difficult to notice from the ground, though. The skydiver collided with the ground ten meters from the runway. It can be assumed that in a weather like that there have probably been heavy downward thermals that have increased the sink rate of the skydiver.

## **2.3 Experience and skills of the accident skydiver**

The accident skydiver had started parachuting in September 1997. She had got her C-license certificate in March 1998 and D-license (over 250 jumps) in April 1999. She had done more than 300 skydives during the last 12 months, of which during the last three months more than 200 skydives, that is, half of the total number of jumps. After she got her C-license she had concentrated almost completely on FS-jumps. According to the skydiving logbook, she had done a skydiving tournee to the U.S together with her partner in the spring of 1999. She had participated in a plenty of large FS-formation jumps, even 30-ways and larger. She could be considered as an active and skillful FS-skydiver, but restricted to one discipline only.

The accident skydiver considers herself a cautious skydiver, despite of her active skydiving career. She told that she always initiates the final at minimum 100 meters. She had never before made a hook turn nor landed downwind. It is probable that the main attention and concentration of the accident skydiver who had practiced only one parachuting discipline after getting the C-license, had been focused primarily on the performance part of the jump, that is, freefall movements. Due to this, she paid less atten-

tion to the canopy handling and landing procedures. It is very common for FS-skydivers to think that the whole skydive consists of the freefall part, the actual skydive ending to the canopy inflation. In this case the canopy is easily considered merely a landing aid and landing only a means of getting on another skydive. This is supported by the skydiver's own theory of herself being a cautious canopy handler and her habit of flying "long finals".

On the way to the hospital the accident skydiver told she had checked the altitude on her wrist mounted altitude just prior to the steep turn leading to the accident; the indication was 100 meters. The true altitude, according to the witnesses has been maximum 20 meters. If the altimeter did show 100 m at this altitude, the skydiver should have been able to determine that the indication was false based on her earlier skydiving experience.

Based on the aforementioned facts, it can be concluded that the accident skydiver was not concentrated on the landing, even though she told that she has always made a long final and handles the canopy cautiously. This assumption is supported by the fact that she had never before made a low turn. It is probable that the freefall formations requiring a lot of skill, practicing and concentration have taken all the attention from the continuously successful landings to the extent that she might have built an idea of landing being a routine performance which does not require much concentration. This fact, ignoring the turbulent conditions and a possible false altimeter indication might have lead to a judgment failure, and, as a result, she started a steep turn at a very low altitude.

If she had chosen to land downwind, she would have probably remained uninjured.

### **3 CONCLUSIONS**

#### **3.1 Findings**

1. The parachuting equipment of the skydiver was adequate and she was familiar with it.
2. The skydiver was certified for the skydiving activity she was engaged in.
3. The experience of the skydiver was restricted to one discipline and it had been gained in a rather short period of time.
4. A false altimeter indication already before the impact with the ground cannot be excluded. It is more probable, though, that the false indication was caused by the impact.
5. The skydiver did not pay enough attention to the landing.
6. The skydiver did not consider the possible turbulence caused by the runway while choosing an alternate place to land.
7. The skydiver would probably have remained uninjured, if she had chosen to land downwind on the soft lawn area.
8. The accident site had not been marked on the field.

#### **3.2 Cause of the accident**

The accident was caused by a low, steep left turn at a maximum altitude of 20 m leading to a collision with the ground while the skydiver was still in a pendulum-like motion.

Contributing factors were the downward thermal affecting the canopy and the resulting rapid loss of altitude, and an erroneous estimation of the altitude before initiating the final turn.

A possible false altimeter indication leading to the judgment error cannot be excluded.

## **4 SAFETY RECOMMENDATIONS**

No recommendations.

Helsinki, April 13<sup>th</sup>, 2000

Kirsi Kanth

## **LIST OF APPENDICES**

### **Appendices**

1. The protocol of the altimeter inspection.
2. The sketch of the wind direction, jump run direction and exit point of the last skydivers on the accident jump by the pilot of the aircraft.